



Caltrans[®]

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

NOTICE TO BIDDERS
AND
SPECIAL PROVISIONS

**FOR CONSTRUCTION ON STATE HIGHWAY IN LOS ANGELES COUNTY IN
BURBANK FROM WEST MAGNOLIA BOULEVARD OVERCROSSING TO 0.3 MILE
NORTH OF BUENA VISTA STREET/WINONA AVENUE UNDERCROSSING**

In District 07 On Route 5

Under

Bid book dated August 13, 2012

Standard Specifications dated 2006

Project Plans approved May 21, 2012

Standard Plans dated 2006

Identified by

Contract No. 07-1218W4

07-LA-5-29.4/31.6

Project ID 0700021119

Federal-Aid Project

ACIM-005-3(078)N

Electronic Advertising Contract

Bids open Thursday, October 4, 2012

Dated August 13, 2012

OSD

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SPECIAL NOTICES

- For federal-aid projects, the Department is modifying its DBE program.
- Refer to Section 8-1.07, "Liquidated Damages," of the Amendments to the Standard Specifications for your project-specific liquidated damages based on your total bid.
- The Department is providing an electronic Information Handout for this project. Refer to Section 2-1.03B, "Supplemental Project Information," in the Amendments to the Standard Specifications for the location of this information.
- See Section 2, "Bidding," of these special provisions regarding a mandatory prebid meeting.
- The Department is allowing contractors to submit electronic payroll records to the District Labor Compliance Office. Refer to section titled "Electronic Submission of Payroll Records" under Section 5, "General," of these special provisions.

CONTRACT NO. 07-1218W4

The special provisions contained herein
have been prepared by or under the
direction of the following Registered Persons.

RAILROAD (TRAFFIC SIGNAL)



REGISTERED CIVIL ENGINEER



LANDSCAPE



REGISTERED LANDSCAPE ARCHITECT



RAILROAD



REGISTERED CIVIL ENGINEER



PUMPING STATION



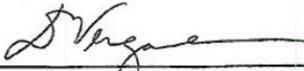
REGISTERED CIVIL ENGINEER



CONTRACT NO. 07-1218W4

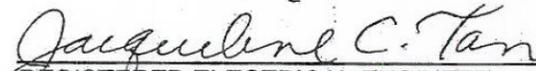
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MAINTAINING TRAFFIC (FREEWAY)


REGISTERED CIVIL ENGINEER

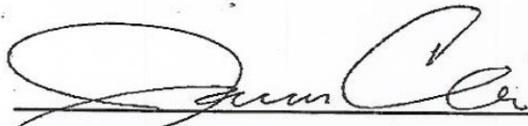


ELECTRICAL (ITS)


REGISTERED ELECTRICAL ENGINEER



STRUCTURE


REGISTERED CIVIL ENGINEER



ELECTRICAL

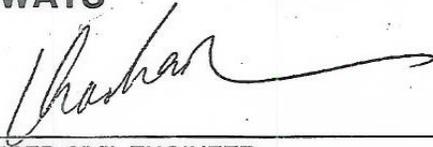

REGISTERED ELECTRICAL ENGINEER



CONTRACT NO. 07-1218W4

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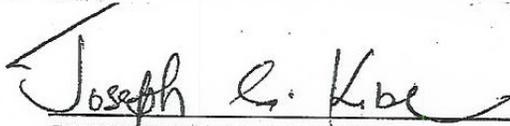
HIGHWAYS



REGISTERED CIVIL ENGINEER



MAINTAINING TRAFFIC (LOCAL)



REGISTERED CIVIL ENGINEER

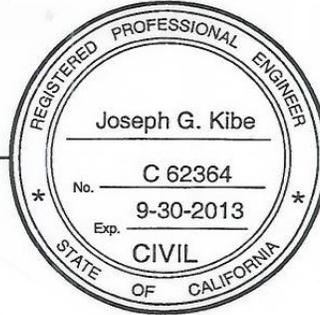


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STANDARD PLANS LIST

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RSP A77C3	Metal Beam Guard Railing – Typical Line Post Embedment and Hinge Point Offset Details
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RSP A77E1	Metal Beam Guard Railing – Typical Layouts for Embankments
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A82C2	Crash Cushion (Type React 9CBB) – Backup Block Details

A82C3	Crash Cushion (Type React 9CBB) – Concrete Barrier Transition Details
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RSP P8	Jointed Plain Concrete Pavement – Individual Slab Replacement
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D72	Drainage Inlets
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B15-9	Sound Wall Masonry Block Miscellaneous Details
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S2	Overhead Signs – Truss, Single Post Type – Post Type II thru IX
S3	Overhead Signs – Truss, Single Post Type – Base Plate and Anchorage Details
S4	Overhead Signs – Truss, Single Post Type – Structural Frame Members Details No. 1
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S93	Framing Details for Framed Single Sheet Aluminum Signs, Rectangular Shape
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ES-4E	Electrical Systems (Signal Faces and Mountings)
RSP ES-5A	Electrical Systems (Detectors)
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ES-6H	Electrical Systems (Lighting Standard, Types 35 and 36-20A, 10 Degree Type)
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ES-7A	Electrical Systems (Signal and Lighting Standards, Push Button Posts and Type 15TS Standard)
RSP ES-7B	Electrical Systems (Signal and Lighting Standard – Type 1 Standards and Equipment Numbering)
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RSP ES-7G	Electrical Systems (Signal And Lighting Standard – Case 5 Arm Loading, Wind Velocity = 100 mph, Arm Lengths 50' to 55')
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ES-15A	Electrical Systems (Sign Illumination Equipment)
ES-15B	Electrical Systems (36" Fluorescent Sign Illumination Equipment)
ES-15C	Electrical Systems (Sign Illumination Equipment)
RSP ES-15D	Electrical Systems (Lighting and Sign Illumination Control)
ES-16A	Electrical Systems (Closed Circuit Television, Pole Details)

CANCELED STANDARD PLANS LIST

The Standard Plan sheets listed below are canceled and not applicable to this contract.

NSP P31	Canceled on June 5, 2009
D97B	Canceled on June 6, 2008
NSP H54	Canceled on July 31, 2009
ES-8	Canceled on January 20, 2012
ES-10	Canceled on July 20, 2012

NOTICE TO BIDDERS

Bids open Thursday, October 4, 2012

Dated August 13, 2012

General work description: Realign Route 5 and railroad tracks and reconfigure on- and off-ramps.

The Department will receive sealed bids for CONSTRUCTION ON STATE HIGHWAY IN LOS ANGELES COUNTY IN BURBANK FROM WEST MAGNOLIA BOULEVARD OVERCROSSING TO 0.3 MILE NORTH OF BUENA VISTA STREET/WINONA AVENUE UNDERCROSSING.

District-County-Route-Post Mile: 07-LA-5-29.4/31.6

Contract No. 07-1218W4

The Contractor must have either a Class A license or a combination of Class C licenses which constitutes a majority of the work.

The DBE Contract goal is 8 percent.

Federal-aid project no.:
ACIM-005-3(078)N

For the Federal training program, the number of trainees or apprentices is 36.

Bids must be on a unit price basis.

Complete the work, including plant establishment work, within 1,150 working days.

The estimated cost of the project is \$200,000,000.

A mandatory prebid meeting is scheduled for this project at 10:00 am, on August 28, 2012, at California Department of Transportation, District 7, 100 Main Street, 1st Floor Room 01.037, Los Angeles Ca 90012.

The Department will receive bids until 2:00 p.m. on the bid open date at 3347 Michelson Drive, Suite 100, Irvine, CA 92612-1692. Bids received after this time will not be accepted.

The Department will open and publicly read the bids at the above location immediately after the specified closing time.

District office addresses are provided in the Standard Specifications.

Present bidders' inquiries to the Department and view the Department's responses at:

http://www.dot.ca.gov/hq/esc/oe/project_status/bid_inq.html

Questions about alleged patent ambiguity of the plans, specifications, or estimate must be asked before bid opening. After bid opening, such questions will not be treated as bid protests.

Submit your bid with bidder's security equal to at least 10 percent of the bid.

Prevailing wages are required on this Contract. The Director of the California Department of Industrial Relations determines the general prevailing wage rates. Obtain the wage rates at the DIR Web site, <http://www.dir.ca.gov>, or from the Department's Labor Compliance Office of the district in which the work is located.

The federal minimum wage rates for this Contract as determined by the United States Secretary of Labor are available at <http://www.dot.ca.gov/hq/esc/oe/federal-wages>.

If the minimum wage rates as determined by the United States Secretary of Labor differs from the general prevailing wage rates determined by the Director of the California Department of Industrial Relations for similar classifications of labor, the Contractor and subcontractors must not pay less than the higher wage rate. The Department does not accept lower State wage rates not specifically included in the Federal minimum wage determinations. This includes helper, or other classifications based on hours of experience, or any other classification not appearing in the Federal wage determinations. Where Federal wage determinations do not contain the State wage rate determination otherwise available for use by the Contractor and subcontractors, the Contractor and subcontractors must not pay less than the Federal minimum wage rate that most closely approximates the duties of the employees in question.

The Department has made available Notices of Suspension and Proposed Debarment from the Federal Highway Administration. For a copy of the notices go to http://www.dot.ca.gov/hq/esc/oe/contractor_info. Additional information is listed in the Excluded Parties List System at <https://www.epls.gov>.

DEPARTMENT OF TRANSPORTATION

NT

COPY OF BID ITEM LIST

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
1	070012	PROGRESS SCHEDULE (CRITICAL PATH METHOD)	LS	LUMP SUM
2	024076	CONTRACTOR-FURNISHED RESIDENT ENGINEER'S OFFICE	LS	LUMP SUM
3	071321	TEMPORARY FENCE (TYPE CL-6)	LF	4,020
4	024077	TEMPORARY DRAINAGE SAN FERNANDO AVENUE EXCAVATION	LS	LUMP SUM
5	074016	CONSTRUCTION SITE MANAGEMENT	LS	LUMP SUM
6	074019	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	LUMP SUM
7	074026	TEMPORARY MULCH	SQYD	11,400
8	074027	TEMPORARY EROSION CONTROL BLANKET	SQYD	3,000
9	074028	TEMPORARY FIBER ROLL	LF	13,500
10	074029	TEMPORARY SILT FENCE	LF	9,800
11	074031	TEMPORARY GRAVEL BAG BERM	LF	22,500
12	074033	TEMPORARY CONSTRUCTION ENTRANCE	EA	30
13	074034	TEMPORARY COVER	SQYD	5,000
14	074037	MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)	EA	24
15	074038	TEMPORARY DRAINAGE INLET PROTECTION	EA	200
16	074041	STREET SWEEPING	LS	LUMP SUM
17	074042	TEMPORARY CONCRETE WASHOUT (PORTABLE)	LS	LUMP SUM
18	074051	TEMPORARY HYDRAULIC MULCH	SQYD	4,700
19	074053	TEMPORARY HYDROSEED	SQYD	8,000
20	074055	TEMPORARY SOIL BINDER	SQYD	46,000

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
21	074056	RAIN EVENT ACTION PLAN	EA	82
22	074057	STORM WATER ANNUAL REPORT	EA	4
23	074058	STORM WATER SAMPLING AND ANALYSIS DAY	EA	52
24	090100	TIME-RELATED OVERHEAD (WDAY)	WDAY	900
25	120090	CONSTRUCTION AREA SIGNS	LS	LUMP SUM
26	120100	TRAFFIC CONTROL SYSTEM	LS	LUMP SUM
27	120120	TYPE III BARRICADE	EA	50
28	120159	TEMPORARY TRAFFIC STRIPE (PAINT)	LF	112,000
29	120165	CHANNELIZER (SURFACE MOUNTED)	EA	700
30	128601	TEMPORARY SIGNAL SYSTEM	LS	LUMP SUM
31	129000	TEMPORARY RAILING (TYPE K)	LF	122,000
32	129100	TEMPORARY CRASH CUSHION MODULE	EA	830
33	141103	REMOVE YELLOW THERMOPLASTIC TRAFFIC STRIPE (HAZARDOUS WASTE)	LF	56,400
34	148005	NOISE MONITORING	LS	LUMP SUM
35	150305	OBLITERATE SURFACING	SQYD	26,700
36	150608	REMOVE CHAIN LINK FENCE	LF	33,900
37	150662	REMOVE METAL BEAM GUARD RAILING	LF	4,360
38	150676	REMOVE CABLE RAILING	LF	1,680
39	024078	REMOVE HANDRAIL	LF	260
40	150711	REMOVE PAINTED TRAFFIC STRIPE	LF	387,000

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
41	150712	REMOVE PAINTED PAVEMENT MARKING	SQFT	1,610
42	150714	REMOVE THERMOPLASTIC TRAFFIC STRIPE	LF	64,700
43	150715	REMOVE THERMOPLASTIC PAVEMENT MARKING	SQFT	1,950
44	150722	REMOVE PAVEMENT MARKER	EA	23,100
45	150742	REMOVE ROADSIDE SIGN	EA	292
46	150757	REMOVE SIGN STRUCTURE (EA)	EA	12
47	024079	REMOVE SLOTTED CORRUGATED STEEL PIPE	LF	1,290
48	150812	REMOVE PIPE (LF)	LF	750
49	150820	REMOVE INLET	EA	16
50	150821	REMOVE HEADWALL	EA	2
51	150833	REMOVE RETAINING WALL (LF)	LF	3,660
52	150853	REMOVE CONCRETE PAVEMENT (SQYD)	SQYD	92,900
53	024080	REPLACE UNDERLYING BASE	CY	400
54	024081	REMOVE EXISTING TRACK, TIES AND BALLAST AND INSTALL BUMPING POST	TF	27,600
55	024082	REMOVE GRADE CROSSING (SHOOFLY AND MAINLINE)	TF	370
56	024083	SALVAGE TURN-OUT	EA	1
57	024084	HAUL OFF AND RE-USE OF BALLAST	CY	30,700
58	024085	TEST AND STORE EXISTING RAILS AND TIES FOR RE-USE	TF	17,200
59	152390	RELOCATE ROADSIDE SIGN	EA	5
60	152430	ADJUST INLET	EA	6

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
61	153103	COLD PLANE ASPHALT CONCRETE PAVEMENT	SQYD	2,700
62	153130	REMOVE CONCRETE CURB (LF)	LF	60,200
63	153139	REMOVE CONCRETE SIDEWALK (LF)	LF	9,760
64	153221	REMOVE CONCRETE BARRIER	LF	18,000
65	153225	PREPARE CONCRETE BRIDGE DECK SURFACE	SQFT	65,800
66	153247	REMOVE CONCRETE (MISCELLANEOUS) (CY)	CY	420
67	153251	REMOVE SOUND WALL (LF)	LF	5,840
68	153531	ACCESS OPENING, SOFFIT	EA	2
69	155003	CAP INLET	EA	150
70	157551	BRIDGE REMOVAL, LOCATION A	LS	LUMP SUM
71	157554	BRIDGE REMOVAL, LOCATION D	LS	LUMP SUM
72	157562	BRIDGE REMOVAL (PORTION), LOCATION B	LS	LUMP SUM
73	157563	BRIDGE REMOVAL (PORTION), LOCATION C	LS	LUMP SUM
74	157565	BRIDGE REMOVAL (PORTION), LOCATION E	LS	LUMP SUM
75	157566	BRIDGE REMOVAL (PORTION), LOCATION F	LS	LUMP SUM
76	157567	BRIDGE REMOVAL (PORTION), LOCATION G	LS	LUMP SUM
77	024086	REMOVE EXISTING RAILROAD BRIDGES OVER SAN FERNANDO	LS	LUMP SUM
78	024087	EMPIRE CENTER RESTORATION	LS	LUMP SUM
79	024088	CLEARING AND DEMOLITION	ACRE	2
80	024089	ROADWAY EXCAVATION (VOLATILE ORGANIC COMPOUNDS, PETROLEUM HYDROCARBONS AND METALS)	CY	3,170

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
81	190101	ROADWAY EXCAVATION	CY	206,000
82	024090	TRACKBED EXCAVATION (PETROLEUM HYDROCARBON COMPOUNDS AND METALS)	CY	21,400
83	190106	ROADWAY EXCAVATION (TYPE Z-3) (AERIALY DEPOSITED LEAD)	CY	3,390
84	190107	ROADWAY EXCAVATION (TYPE Y-1) (AERIALY DEPOSITED LEAD)	CY	21,600
85	190108	ROADWAY EXCAVATION (TYPE Y-2) (AERIALY DEPOSITED LEAD)	CY	2,750
86	190110	LEAD COMPLIANCE PLAN	LS	LUMP SUM
87	190111	ADL BURIAL LOCATION REPORT	LS	LUMP SUM
88	024091	ROADWAY EXCAVATION (PETROLEUM HYDROCARBON)	CY	25,400
89	024092	ROADWAY EXCAVATION (PETROLEUM HYDROCARBON AND AERIALY DEPOSITED LEAD)	CY	370
90 (F)	024093	STRUCTURE EXCAVATION (PETROLEUM HYDROCARBON AND AERIALY DEPOSITED LEAD)	CY	3,048
91 (F)	044017	STRUCTURE EXCAVATION (PETROLEUM HYRDOCARBON)	CY	548
92 (F)	044018	STRUCTURE EXCAVATION (VOLATILE ORGANIC COMPOUNDS, PETROLEUM HYDROCARBONS AND METALS)	CY	4,100
93 (F)	192003	STRUCTURE EXCAVATION (BRIDGE)	CY	31,425
94 (F)	192025	STRUCTURE EXCAVATION (CULVERT)	CY	1,404
95 (F)	192037	STRUCTURE EXCAVATION (RETAINING WALL)	CY	89,314
96 (F)	024093	STRUCTURE EXCAVATION (AUSTIN VAULT)	CY	3,055
97 (F)	192054	STRUCTURE EXCAVATION (TYPE Z-3) (AERIALY DEPOSITED LEAD)	CY	990
98 (F)	192057	STRUCTURE EXCAVATION (TYPE Y-1) (AERIALY DEPOSITED LEAD)	CY	6,504
99 (F)	192058	STRUCTURE EXCAVATION (TYPE Y-2) (AERIALY DEPOSITED LEAD)	CY	1,430
100	024094	TEMPORARY SHORING FOR UNDERPASS EXCAVATION	SQFT	42,800

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
101 (F)	024095	FILTER MEDIA (SAND BED) (AUSTIN VAULT)	CY	190
102 (F)	024096	STRUCTURE BACKFILL (AUSTIN VAULT)	CY	469
103 (F)	193003	STRUCTURE BACKFILL (BRIDGE)	CY	22,349
104 (F)	193004	STRUCTURE BACKFILL (CULVERT)	CY	623
105 (F)	193006	STRUCTURE BACKFILL (SLURRY CEMENT)	CY	2,538
106 (F)	193013	STRUCTURE BACKFILL (RETAINING WALL)	CY	130,327
107 (F)	193030	PERVIOUS BACKFILL MATERIAL	CY	4,413
108	198010	IMPORTED BORROW (CY)	CY	279,000
109	043924	LIGHTWEIGHT FILL (EPS BLOCK)	CY	11,711
110	043925	GASOLINE RESISTANT GEOMEMBRANE	SQYD	4,477
111	200001	HIGHWAY PLANTING	LS	LUMP SUM
112	204099	PLANT ESTABLISHMENT WORK	LS	LUMP SUM
113	208000	IRRIGATION SYSTEM	LS	LUMP SUM
114 (F)	208026	2" SUPPLY LINE (BRIDGE)	LF	299
115	208304	WATER METER	EA	2
116 (F)	208738	8" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE CONDUIT	LF	695
117 (F)	208739	10" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE CONDUIT	LF	990
118	024097	AGGREGATE BASE CEMENT SLURRY	CY	960
119 (F)	260210	AGGREGATE BASE (APPROACH SLAB)	CY	31
120	260303	CLASS 3 AGGREGATE BASE (CY)	CY	96,000

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
121	024098	CRUSHED MISCELLANEOUS BASE	CY	1,680
122	280000	LEAN CONCRETE BASE	CY	51,700
123	024099	LEAN CONCRETE BASE RAPID SETTING	CY	3,840
124	043926	FURNISH HOT MIX ASPHALT (CHANNEL)	TON	124
125	043927	PLACE HOT MIX ASPHALT (CHANNEL)	SQYD	735
126	390131	HOT MIX ASPHALT	TON	48,500
127	390137	RUBBERIZED HOT MIX ASPHALT (GAP GRADED)	TON	63
128	391007	PAVING ASPHALT (BINDER, GEOSYNTHETIC PAVEMENT INTERLAYER)	TON	1
129 (F)	393004	GEOSYNTHETIC PAVEMENT INTERLAYER (PAVING FABRIC)	SQYD	5,075
130	394060	DATA CORE	LS	LUMP SUM
131	394073	PLACE HOT MIX ASPHALT DIKE (TYPE A)	LF	740
132	394074	PLACE HOT MIX ASPHALT DIKE (TYPE C)	LF	800
133	394075	PLACE HOT MIX ASPHALT DIKE (TYPE D)	LF	3,370
134	394076	PLACE HOT MIX ASPHALT DIKE (TYPE E)	LF	4,580
135	394077	PLACE HOT MIX ASPHALT DIKE (TYPE F)	LF	1,800
136	397005	TACK COAT	TON	31
137	401050	JOINTED PLAIN CONCRETE PAVEMENT	CY	79,100
138	024100	JOINTED PLAIN CONCRETE PAVEMENT (RAPID STRENGTH CONCRETE)	CY	6,290
139	404092	SEAL PAVEMENT JOINT	LF	281,000
140	404093	SEAL ISOLATION JOINT	LF	1,500

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
141 (F)	406050	DOWEL BAR (DRILL AND BOND)	EA	8,426
142	411105	INDIVIDUAL SLAB REPLACEMENT (RSC)	CY	900
143	413113	REPAIR SPALLED JOINTS, POLYESTER GROUT	SQYD	710
144	024101	SEAL JOINT (EXISTING CONCRETE PAVEMENT)	LF	28,400
145	420201	GRIND EXISTING CONCRETE PAVEMENT	SQYD	23,400
146	043928	TIEDOWN ANCHOR	EA	49
147 (F)	477021	MECHANICALLY STABILIZED EMBANKMENT, LOCATION A	SQFT	18,191
148 (F)	477022	MECHANICALLY STABILIZED EMBANKMENT, LOCATION B	SQFT	14,750
149 (F)	477023	MECHANICALLY STABILIZED EMBANKMENT, LOCATION C	SQFT	8,454
150 (F)	477024	MECHANICALLY STABILIZED EMBANKMENT, LOCATION D	SQFT	9,799
151	490411	FURNISH STEEL PILING (PP 16 X 0.500)	LF	8,130
152	490412	DRIVE STEEL PILE (PP 16 X 0.500)	EA	187
153	490550	FURNISH 24" STEEL PIPE PILING	LF	11,795
154	490555	DRIVE 24" STEEL PIPE PILE	EA	296
155	024102	JACKED CASING - 60" OUTSIDE DIAMETER STEEL CASING	LF	340
156	490601	16" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	10,679
157	490603	24" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	40,389
158	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	18,573
159	490606	42" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	1,460
160	490609	60" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	127

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
161	490780	FURNISH PILING (CLASS 200)	LF	6,490
162	490781	DRIVE PILE (CLASS 200)	EA	156
163	500001	PRESTRESSING CAST-IN-PLACE CONCRETE	LS	LUMP SUM
164 (F)	510051	STRUCTURAL CONCRETE, BRIDGE FOOTING	CY	4,926
165 (F)	510053	STRUCTURAL CONCRETE, BRIDGE	CY	19,422
166 (F)	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	29,869
167 (F)	510072	STRUCTURAL CONCRETE, BARRIER SLAB	CY	1,219
168 (F)	024103	STRUCTURAL CONCRETE, APPROACH SLAB (RAILROAD)	CY	133
169 (F)	510085	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE EQ)	CY	290
170 (F)	510086	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	CY	625
171 (F)	510087	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE R)	CY	303
172 (F)	510088	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N MODIFIED)	CY	750
173 (F)	024104	STRUCTURAL CONCRETE (AUSTIN VAULT)	CY	583
174 (F)	510502	MINOR CONCRETE (MINOR STRUCTURE)	CY	327
175	510800	PAVING NOTCH EXTENSION	CF	225
176 (F)	511035	ARCHITECTURAL TREATMENT	SQFT	161,417
177	511106	DRILL AND BOND DOWEL	LF	1,608
178	512354	FURNISH PRECAST PRESTRESSED CONCRETE SLAB (TYPE SIV)	SQFT	65,800
179	024105	PRECAST CONCRETE, MECHANICALLY STABILIZED EARTH WALL	SQFT	175,000
180	024106	PRECAST CONCRETE FASCIA	SQFT	7,230

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
181 (F)	512510	ERECT PRECAST PRESTRESSED CONCRETE DECK UNIT	EA	206
182	024107	GRADE CROSSING PANELS	LF	190
183	024108	TRACK ON BRIDGE	TF	500
184	024109	CUTOVER TRACK FROM MAINLINE TO SHOOFLY AND REVERSE	LS	LUMP SUM
185	515020	REFINISH BRIDGE DECK	SQFT	1,279
186	515041	FURNISH POLYESTER CONCRETE OVERLAY	CF	5,483
187 (F)	515042	PLACE POLYESTER CONCRETE OVERLAY	SQFT	65,800
188 (F)	518002	SOUND WALL (MASONRY BLOCK)	SQFT	90,690
189	519081	JOINT SEAL (MR 1/2")	LF	5,410
190	519091	JOINT SEAL (MR 1 1/2")	LF	203
191	519100	JOINT SEAL (MR 2")	LF	1,248
192 (F)	520102	BAR REINFORCING STEEL (BRIDGE)	LB	6,802,291
193 (F)	520103	BAR REINFORCING STEEL (RETAINING WALL)	LB	4,000,622
194 (F)	024110	BAR REINFORCING STEEL (AUSTIN VAULT)	LB	137,540
195	024111	BALLASTED TRACK	TF	30,500
196	024112	BALLASTED TURN-OUT	LS	LUMP SUM
197	024113	WOOD TIES	EA	6,700
198	024114	CONCRETE TIES	EA	8,860
199	024115	RUNNING RAIL	TF	31,100
200	024116	BALLAST	CY	13,200

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
201 (F)	540101	ASPHALT MEMBRANE WATERPROOFING	SQFT	926
202 (F)	540104	WATERPROOFING AND COVER	SQFT	12,840
203	043929	PUBLIC SAFETY PLAN	LS	LUMP SUM
204 (F)	550110	COLUMN CASING	LB	76,134
205 (F)	550203	FURNISH STRUCTURAL STEEL (BRIDGE)	LB	2,713,914
206 (F)	550204	ERECT STRUCTURAL STEEL (BRIDGE)	LB	2,713,914
207	024117	INSTALL BRIDGE MOUNTED VERTICAL CLEARANCE SIGN	EA	4
208	560203	FURNISH SIGN STRUCTURE (BRIDGE MOUNTED WITH WALKWAY)	LB	6,940
209	560204	INSTALL SIGN STRUCTURE (BRIDGE MOUNTED WITH WALKWAY)	LB	6,940
210	560213	FURNISH SIGN STRUCTURE (LIGHTWEIGHT)	LB	21,400
211	560214	INSTALL SIGN STRUCTURE (LIGHTWEIGHT)	LB	21,400
212	560218	FURNISH SIGN STRUCTURE (TRUSS)	LB	295,000
213	560219	INSTALL SIGN STRUCTURE (TRUSS)	LB	295,000
214	560233	FURNISH FORMED PANEL SIGN (OVERHEAD)	SQFT	3,780
215	560244	FURNISH LAMINATED PANEL SIGN (1"-TYPE A)	SQFT	470
216	560245	FURNISH LAMINATED PANEL SIGN (1"-TYPE B)	SQFT	280
217	560248	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-UNFRAMED)	SQFT	1,620
218	560249	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-UNFRAMED)	SQFT	990
219	560251	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-FRAMED)	SQFT	180
220	560252	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-FRAMED)	SQFT	570

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
221	561005	36" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION)	LF	60
222	561016	60" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION)	LF	240
223	024118	METAL SIGN (BARRIER/WALL MOUNTED)	LB	3,850
224	024119	ROADSIDE SIGN - ONE POST (METAL)	EA	31
225	566011	ROADSIDE SIGN - ONE POST	EA	121
226	566012	ROADSIDE SIGN - TWO POST	EA	21
227	568001	INSTALL SIGN (STRAP AND SADDLE BRACKET METHOD)	EA	53
228	024120	INSTALL PANEL (BARRIER/WALL MOUNTED)	EA	2
229	024121	6" PLASTIC PIPE	LF	260
230	650010	12" REINFORCED CONCRETE PIPE	LF	110
231	650012	15" REINFORCED CONCRETE PIPE	LF	100
232	650014	18" REINFORCED CONCRETE PIPE	LF	2,700
233	650018	24" REINFORCED CONCRETE PIPE	LF	2,530
234	650030	42" REINFORCED CONCRETE PIPE	LF	660
235	650034	48" REINFORCED CONCRETE PIPE	LF	1,160
236	665024	24" CORRUGATED STEEL PIPE (.109" THICK)	LF	50
237	665717	18" SLOTTED CORRUGATED STEEL PIPE (.079" THICK)	LF	6,050
238	024123	12" CORRUGATED PERFORATED HIGH DENSITY POLYETHYLENE PIPE	LF	15,100
239	024124	12" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	LF	1,350
240	024125	6" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	LF	130

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
241	024126	2 1/2" PLASTIC PIPE (DECK DRAIN)	LF	190
242	024127	6" GALVANIZED STEEL PIPE (DECK DRAIN)	LF	100
243	024128	30" CONCRETE ENCASEMENT	LF	50
244	024129	STORM DRAIN PROTECTION FOR 18" REINFORCED CONCRETE PIPE	LF	160
245	024130	STORM DRAIN PROTECTION FOR 4'X2.5' REINFORCED CONCRETE BOX	LF	140
246	024131	6" PERFORATED DRAIN PIPE	LF	430
247	024132	8" PVC PIPE (SCHEDULE 80)	LF	220
248	024134	UNDERDRAIN CLEANOUT	LF	220
249	024135	6" PLASTIC PIPE UNDERDRAIN PERFORATED (AUSTIN VAULT)	LF	570
250	680903	6" NON-PERFORATED PLASTIC PIPE UNDERDRAIN	LF	12
251	680905	8" PERFORATED PLASTIC PIPE UNDERDRAIN	LF	10,000
252	024136	18" HIGH DENSITY POLYETHYLENE DOWNDRAIN	LF	85
253	024137	FILTER FABRIC (AUSTIN VAULT)	SQYD	440
254 (F)	024138	PERMEABLE MATERIAL (AUSTIN VAULT)	CY	165
255	024139	CORRUGATED STEEL PIPE DROP INLET	LF	44
256	024133	PARKWAY DRAIN	LF	20
257	024140	24" DUCTILE IRON PIPE - FORCE MAIN PIPING	LF	600
258	024141	4" DUCTILE IRON PIPE - SUMP PUMP PIPING	LF	620
259	719300	MANHOLE	LF	170
260	721810	SLOPE PAVING (CONCRETE)	CY	27

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
261 (F)	024142	GABION (AUSTIN VAULT)	CY	33
262	024143	MINOR CONCRETE (CURB, SIDEWALK, AND DRIVEWAY)	CY	1,780
263	730045	MINOR CONCRETE (GUTTER) (CY)	CY	290
264	731502	MINOR CONCRETE (MISCELLANEOUS CONSTRUCTION)	CY	130
265	731530	MINOR CONCRETE (TEXTURED PAVING)	SQFT	49,300
266	731623	MINOR CONCRETE (CURB RAMP)	CY	11
267 (F)	750001	MISCELLANEOUS IRON AND STEEL	LB	42,999
268 (F)	750041	ISOLATION CASING	LB	261,480
269 (F)	750498	MISCELLANEOUS METAL (RESTRAINER - CABLE TYPE)	LB	1,450
270 (F)	750501	MISCELLANEOUS METAL (BRIDGE)	LB	582,960
271	024144	BRIDGE DECK DRAINAGE SYSTEM (RAILROAD)	LF	2,080
272 (F)	750505	BRIDGE DECK DRAINAGE SYSTEM	LB	9,757
273 (F)	024145	MISCELLANEOUS METAL (AUSTIN VAULT)	LB	230
274	024146	HYDRODYNAMIC SEPARATOR	EA	1
275	800320	CHAIN LINK FENCE (TYPE CL-4)	LF	380
276	800360	CHAIN LINK FENCE (TYPE CL-6)	LF	14,500
277 (F)	043930	CHAIN LINK FENCE (TYPE CL-6) (MODIFIED)	LF	39
278	802510	5' CHAIN LINK GATE (TYPE CL-6)	EA	1
279	802601	14' CHAIN LINK GATE (TYPE CL-6)	EA	1
280	802640	18' CHAIN LINK GATE (TYPE CL-6)	EA	2

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
281	820107	DELINEATOR (CLASS 1)	EA	30
282	024147	INSTALL MEDIAN MILEAGE PANEL	EA	22
283	832003	METAL BEAM GUARD RAILING (WOOD POST)	LF	1,800
284 (F)	833032	CHAIN LINK RAILING (TYPE 7)	LF	4,063
285 (F)	833088	TUBULAR HANDRAILING	LF	896
286 (F)	833142	CONCRETE BARRIER (TYPE 26 MODIFIED)	LF	482
287 (F)	024148	CABLE RAILING (AUSTIN VAULT)	LF	438
288 (F)	839521	CABLE RAILING	LF	17,111
289	839541	TRANSITION RAILING (TYPE WB)	EA	8
290	839581	END ANCHOR ASSEMBLY (TYPE SFT)	EA	7
291	839584	ALTERNATIVE IN-LINE TERMINAL SYSTEM	EA	8
292	839585	ALTERNATIVE FLARED TERMINAL SYSTEM	EA	4
293	839604	CRASH CUSHION (REACT 9CBB)	EA	1
294	839703	CONCRETE BARRIER (TYPE 60C)	LF	3,220
295 (F)	839704	CONCRETE BARRIER (TYPE 60D)	LF	6,623
296 (F)	043931	CONCRETE BARRIER (TYPE 60D MODIFIED)	LF	1,197
297	024149	CONCRETE BARRIER (TYPE 60W MODIFIED)	LF	6,380
298 (F)	839717	CONCRETE BARRIER (TYPE 732 MODIFIED)	LF	164
299	024150	CONCRETE BARRIER (TYPE 60E)	LF	200
300 (F)	043932	CONCRETE BARRIER (TYPE 60A MODIFIED)	LF	842

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
301 (F)	043933	CONCRETE BARRIER (TYPE 60C MODIFIED)	LF	120
302 (F)	839725	CONCRETE BARRIER (TYPE 736)	LF	1,601
303 (F)	839726	CONCRETE BARRIER (TYPE 736A)	LF	665
304 (F)	839727	CONCRETE BARRIER (TYPE 736 MODIFIED)	LF	2,241
305 (F)	043934	CONCRETE BARRIER (TYPE 736A MODIFIED)	LF	7,694
306 (F)	043935	CONCRETE BARRIER (TYPE 60E MODIFIED)	LF	278
307 (F)	839731	CONCRETE BARRIER (TYPE 736B)	LF	4,728
308	024151	CONCRETE BARRIER (TYPE 60GE MODIFIED)	LF	350
309 (F)	043936	CONCRETE BARRIER (TYPE 736SV MODIFIED)	LF	920
310 (F)	839734	CONCRETE BARRIER (TYPE 736SV)	LF	3,802
311	840504	4" THERMOPLASTIC TRAFFIC STRIPE	LF	189,000
312	840506	8" THERMOPLASTIC TRAFFIC STRIPE	LF	17,000
313	840508	8" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 12-3)	LF	6,370
314	840515	THERMOPLASTIC PAVEMENT MARKING	SQFT	11,500
315	840521	4" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 6-1)	LF	2,410
316	840525	4" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 36-12)	LF	118,000
317	840526	4" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 17-7)	LF	22,100
318	840550	8" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 36-12)	LF	4,260
319	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	740,000
320	840666	PAINT PAVEMENT MARKING (2-COAT)	SQFT	2,230

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
321	850101	PAVEMENT MARKER (NON-REFLECTIVE)	EA	9,550
322	850111	PAVEMENT MARKER (RETROREFLECTIVE)	EA	26,000
323	860090	MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION	LS	LUMP SUM
324	024152	FURNISH AND INSTALL TRAFFIC SIGNAL SYSTEM COMPLETE	LS	LUMP SUM
325	860251	SIGNAL AND LIGHTING (LOCATION 1)	LS	LUMP SUM
326	860252	SIGNAL AND LIGHTING (LOCATION 2)	LS	LUMP SUM
327	860400	LIGHTING (TEMPORARY)	LS	LUMP SUM
328	860402	LIGHTING (CITY STREET)	LS	LUMP SUM
329	024153	RAILROAD LIGHTING	EA	16
330	860705	INTERCONNECTION CONDUIT AND CABLE (LS)	LS	LUMP SUM
331	860775	SPRINKLER CONTROL CONDUIT (BRIDGE) (LS)	LS	LUMP SUM
332	860797	ELECTRIC SERVICE (IRRIGATION)	LS	LUMP SUM
333	024154	MICROWAVE VEHICLE DETECTION SYSTEM (TEMPORARY)	LS	LUMP SUM
334	024155	MODIFY COMMUNICATION SYSTEM	LS	LUMP SUM
335	861088	MODIFY RAMP METERING SYSTEM	LS	LUMP SUM
336	861497	MODIFY SIGNAL AND LIGHTING (LOCATION 1)	LS	LUMP SUM
337	861498	MODIFY SIGNAL AND LIGHTING (LOCATION 2)	LS	LUMP SUM
338	861499	MODIFY SIGNAL AND LIGHTING (LOCATION 3)	LS	LUMP SUM
339	861500	MODIFY SIGNAL AND LIGHTING (LOCATION 4)	LS	LUMP SUM
340	861504	MODIFY LIGHTING AND SIGN ILLUMINATION	LS	LUMP SUM

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
341	861505	MODIFY SIGNAL AND LIGHTING (LOCATION 5)	LS	LUMP SUM
342	024156	RAILROAD SIGNALING	LS	LUMP SUM
343	994650	BUILDING WORK	LS	LUMP SUM
344	999990	MOBILIZATION	LS	LUMP SUM

SPECIAL PROVISIONS

SECTION 1. (BLANK)

SECTION 2. BIDDING

2-1.01 MANDATORY PREBID MEETING

The Department will conduct a mandatory prebid meeting for this contract. The purpose of the meeting is to provide small businesses the opportunity to meet and interact with prospective bidders and increase participation in the performance of contracts.

Prospective bidders must attend the mandatory prebid meeting. The bidder's representative must be a company officer, project superintendent, or project estimator. For a joint venture, one of the parties must attend the mandatory prebid meeting. The Department will not accept bids from bidders who do not attend the mandatory prebid meeting.

A sign-up sheet will be used to identify all prospective bidders including name and title of the company representative attending the mandatory prebid meeting. The Department may hold a single prebid meeting for more than one contract. Make sure you sign the sign-up sheet for the contract you intend to bid on. If bidding multiple contracts, sign each sign-up sheet for each contract you intend to bid on.

The successful bidder will be required to report small businesses hired to work on this contract as a result of the mandatory prebid meeting.

2-1.02 TIE BID RESOLUTION

After bid verification, if there is a tie between 2 or more bidders, the Department breaks the tie by tossing a coin.

2-1.03 DISADVANTAGED BUSINESS ENTERPRISES

Under 49 CFR 26.13(b):

The contractor, sub recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate.

Take necessary and reasonable steps to ensure that DBEs have opportunity to participate in the contract (49 CFR 26).

To ensure equal participation of DBEs provided in 49 CFR 26.5, the Department shows a goal for DBEs.

Make work available to DBEs and select work parts consistent with available DBE subcontractors and suppliers.

Meet the DBE goal shown in the Notice to Bidders or demonstrate that you made adequate good faith efforts to meet this goal.

It is your responsibility to verify that the DBE firm is certified as DBE at date of bid opening. For a list of DBEs certified by the California Unified Certification Program, go to:

http://www.dot.ca.gov/hq/bep/find_certified.htm

All DBE participation will count toward the Department's federally mandated statewide overall DBE goal. Credit for materials or supplies you purchase from DBEs counts towards the goal in the following manner:

1. 100 percent counts if the materials or supplies are obtained from a DBE manufacturer.
2. 60 percent counts if the materials or supplies are obtained from a DBE regular dealer.
3. Only fees, commissions, and charges for assistance in the procurement and delivery of materials or supplies count if obtained from a DBE that is neither a manufacturer or regular dealer. 49 CFR 26.55 defines "manufacturer" and "regular dealer."

You receive credit towards the goal if you employ a DBE trucking company that performs a commercially useful function as defined in 49 CFR 26.55(d)(1) through (4) and (6).

DBE Commitment Submittal

Submit DBE information on the Caltrans Bidder - DBE - Commitment form included in the Bid book. If the form is not submitted with the bid, remove the form from the Bid book before submitting your bid.

If the DBE Commitment form is not submitted with the bid, the apparent low bidder, the 2nd low bidder, and the 3rd low bidder must complete and submit the DBE Commitment form to Office Engineer. DBE Commitment form must be received by the Department no later than 4:00 p.m. on the 4th business day after bid opening.

Other bidders do not need to submit the DBE Commitment form unless the Department requests it. If the Department requests you to submit a DBE Commitment form, submit the completed form within 4 business days of the request.

Submit written confirmation from each DBE stating that it is participating in the contract. Include confirmation with the DBE Commitment form. A copy of a DBE's quote will serve as written confirmation that the DBE is participating in the contract.

If you do not submit the DBE Commitment form within the specified time, the Department finds your bid nonresponsive.

Good Faith Efforts Submittal

If you have not met the DBE goal, complete and submit the Good Faith Efforts Documentation form with the bid showing that you made adequate good faith efforts to meet the goal. Only good faith efforts directed towards obtaining participation by DBEs will be considered. If good faith efforts documentation is not submitted with the bid, it must be received by the Department no later than 4:00 p.m. on the 4th business day after bid opening.

If your DBE Commitment form shows that you have met the DBE goal or if you are required to submit the DBE Commitment form, you must also submit good faith efforts documentation within the specified time to protect your eligibility for award of the contract in the event the Department finds that the DBE goal has not been met.

Good faith efforts documentation must include the following information and supporting documents, as necessary:

1. Items of work you have made available to DBE firms. Identify those items of work you might otherwise perform with its own forces and those items that have been broken down into economically feasible units to facilitate DBE participation. For each item listed, show the dollar value and percentage of the total contract. It is your responsibility to demonstrate that sufficient work to meet the goal was made available to DBE firms.
2. Names of certified DBEs and dates on which they were solicited to bid on the project. Include the items of work offered. Describe the methods used for following up initial solicitations to determine with certainty if the DBEs were interested, and the dates of the follow-up. Attach supporting documents such as copies of letters, memos, facsimiles sent, telephone logs, telephone billing statements, and other evidence of solicitation. You are reminded to solicit certified DBEs through all reasonable and available means and provide sufficient time to allow DBEs to respond.
3. Name of selected firm and its status as a DBE for each item of work made available. Include name, address, and telephone number of each DBE that provided a quote and their price quote. If the firm selected for the item is not a DBE, provide the reasons for the selection.
4. Name and date of each publication in which you requested DBE participation for the project. Attach copies of the published advertisements.
5. Names of agencies and dates on which they were contacted to provide assistance in contacting, recruiting, and using DBE firms. If the agencies were contacted in writing, provide copies of supporting documents.
6. List of efforts made to provide interested DBEs with adequate information about the plans, specifications, and requirements of the contract to assist them in responding to a solicitation. If you have provided information, identify the name of the DBE assisted, the nature of the information provided, and date of contact. Provide copies of supporting documents, as appropriate.
7. List of efforts made to assist interested DBEs in obtaining bonding, lines of credit, insurance, necessary equipment, supplies, and materials, excluding supplies and equipment that the DBE subcontractor purchases or leases from the prime contractor or its affiliate. If such assistance is provided by you, identify the name of the DBE assisted, nature of the assistance offered, and date assistance was provided. Provide copies of supporting documents, as appropriate.
8. Any additional data to support demonstration of good faith efforts.

The Department may consider DBE commitments of the 2nd and 3rd bidders when determining whether the low bidder made good faith efforts to meet the DBE goal.

2-1.04 OPT OUT OF PAYMENT ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS

You may opt out of the payment adjustments for price index fluctuations as specified in "Payment Adjustments for Price Index Fluctuations" of these special provisions. If you elect to opt out of the provisions of this specification, you must complete the "Opt Out of Payment Adjustments for Price Index Fluctuations" form. The completed form must be submitted with your bid.

SECTION 3. CONTRACT AWARD AND EXECUTION

3-1.01 SMALL BUSINESS PARTICIPATION REPORT

The Department has established an overall 25 percent small business participation goal. To determine if the goal is achieved, the Department is tracking small business participation on all contracts.

Complete and sign the Small Business (SB) Participation Report form included in the contract documents even if no small business participation is reported. Submit it with the executed contract.

3-1.02 CALTRANS BIDDER - DBE INFORMATION FORM

Complete and sign the Caltrans Bidder - DBE Information form included in the contract documents even if no DBE participation is reported. Submit it with the executed contract.

Provide written confirmation from each DBE that the DBE is participating in the contract. A copy of a DBE's quote serves as written confirmation. If a DBE is participating as a joint venture partner, the Department encourages you to submit a copy of the joint venture agreement.

SECTION 4. BEGINNING OF WORK, TIME OF COMPLETION, AND LIQUIDATED DAMAGES

The 1st working day is the earlier of (1) the 55th day after contract approval or (2) the day you start work other than the measurement of controlling field dimensions or the location of utilities.

Do not start work at the job site until the Engineer approves your submittal for:

1. Baseline Progress Schedule (Critical Path Method)
2. Storm Water Pollution Prevention Plan (SWPPP)
3. Notification of Dispute Resolution Advisor (DRA) or Dispute Review Board (DRB) nominee and disclosure statement as specified in Section 5-1.15, "Dispute Resolution," of the Standard Specifications

You may enter the job site only to measure controlling field dimensions and locating utilities. Do not start other work activities until all the submittals from the above list are approved and the following information is submitted:

1. Notice of Materials To Be Used.
2. Contingency plan for reopening closures to public traffic.
3. Written statement from the vendor that the order for the sign panels has been received and accepted by the vendor. The statement must show the dates that the materials will be shipped.
4. Written statement from the vendor that the order for electrical material has been received and accepted by the vendor. The statement must show the dates that the materials will be shipped.
5. Written statement from the vendor that the order for structural steel has been received and accepted by the vendor. The statement must show the dates that the materials will be shipped.

You may start work at the job site before the 55th day after contract approval if:

1. You obtain required approval for each submittal before the 55th day
2. The Engineer authorizes it in writing

The Department grants a time extension if a delay is beyond your control and prevents you from starting work at the job site on the 1st working day.

Complete the work, except plant establishment work, within 900 working days.

Complete the work, including plant establishment work, within 1150 working days.

INCENTIVES AND DISINCENTIVES

Incentive payments and disincentive deductions apply to the completion of the work specified in the Incentive / Disincentive table.

Comply with "Maintaining Traffic" and "Closure Requirements and Conditions" of these special provisions.

Incentive payments and disincentive deductions are independent of liquidated damages and damages specified in "Closure Requirements and Conditions" of these special provisions.

Complete the work specified within the time specified in the Incentive / Disincentive table starting on the day specified. If you complete the work within the specified time, you will receive the incentive shown for each day less than the time specified. If you do not complete the work within the specified time, the Department will deduct the disincentive shown for each day needed to complete the work.

Incentive/Disincentive Table for Shoofly Operation

	Work	Start of Work	Time of Completion of Work (Working Days)	Incentive Payment per Day	Disincentive Deduction per Day
A	Construct New Mainline Tracks; Train operating on shoofly	First day train traffic operates on temporary shoofly	285	\$25,000	\$25,000

Incentive/Disincentive Table for Empire Avenue

	Work	Start of Work	Time of Completion of Work (Working Days)	Incentive Payment per Day	Disincentive Deduction per Day
B	All work on Empire Avenue completed as shown on plans on Stages 2, 3, and 4 with all Empire Avenue lanes safely open to traffic including ramps servicing Route 5.	First Working Day	575	\$20,000	\$20,000

Incentive/Disincentive Table for Burbank Blvd

	Work	Start of Work	Time of Completion of Work (Working Days)	Incentive Payment per Day	Disincentive Deduction per Day
C	All work on Burbank Blvd completed as shown on plans on Stages 5, 6, and 7 with all Burbank Boulevard lanes safely open to traffic including ramps servicing Route 5.	First day closure of Burbank Blvd after completion of Empire Ave	320	\$30,000	\$30,000

Total incentive payment A will not exceed \$1,100,000.
Total incentive payment B will not exceed \$1,800,000.
Total incentive payment C will not exceed \$2,100,000.
Total disincentive deduction A will not exceed \$1,100,000.
Total disincentive deduction B will not exceed \$1,800,000.
Total disincentive deduction C will not exceed \$2,100,000.

The time limit specified for the completion of the work is considered insufficient to permit completion of the work by working a normal number of hours per day or week on a single shift basis. Should you fail to maintain the progress of the work in conformance with "Progress Schedule (Critical Path Method)" of these special provisions, additional shifts will be required to the extent necessary to ensure that the progress conforms to the above mentioned schedule and that the work will be completed within the time limit specified.

Actions required by the Engineer to perform normal inspection and testing duties will not be considered as contributing to any delay in awarding incentives or to any delay that will require charging disincentives.

Full compensation for any additional costs incurred by compliance with the provisions in this section is included in the prices paid for the various contract items of work and no additional compensation will be allowed.

SECTION 5. GENERAL

5-1.01 EMISSIONS REDUCTION

Contract execution constitutes submittal of the following certification:

I am aware of the emissions reduction regulations being mandated by the California Air Resources Board. I will comply with such regulations before commencing the performance of the work and maintain compliance throughout the duration of this contract.

5-1.02 SUBCONTRACTOR AND DISADVANTAGED BUSINESS ENTERPRISE RECORDS

Use each DBE subcontractor as listed on the Subcontractor List form and the Caltrans Bidder - DBE Information form unless you receive authorization for a substitution.

The Department requests the Contractor to:

1. Notify the Engineer of any changes to its anticipated DBE participation
2. Provide this notification before starting the affected work

Maintain records including:

1. Name and business address of each 1st-tier subcontractor
2. Name and business address of each DBE subcontractor, DBE vendor, and DBE trucking company, regardless of tier
3. Date of payment and total amount paid to each business

If you are a DBE contractor, include the date of work performed by your own forces and the corresponding value of the work.

Before the 15th of each month, submit a Monthly DBE Trucking Verification form.

If a DBE is decertified before completing its work, the DBE must notify you in writing of the decertification date. If a business becomes a certified DBE before completing its work, the business must notify you in writing of the certification date. Submit the notifications. On work completion, complete a Disadvantaged Business Enterprises (DBE) Certification Status Change form. Submit the form within 30 days of contract acceptance.

Upon work completion, complete a Final Report – Utilization of Disadvantaged Business Enterprises (DBE), First-Tier Subcontractors form. Submit it within 90 days of contract acceptance. The Department withholds \$10,000 until the form is submitted. The Department releases the withhold upon submission of the completed form.

5-1.03 PERFORMANCE OF DISADVANTAGED BUSINESS ENTERPRISES

DBEs must perform work or supply materials as listed in the Caltrans Bidder - DBE - Commitment form specified in Section 2, "Bidding," of these special provisions.

Do not terminate or substitute a listed DBE for convenience and perform the work with your own forces or obtain materials from other sources without authorization from the Department.

The Department authorizes a request to use other forces or sources of materials if it shows any of the following justifications:

1. Listed DBE fails or refuses to execute a written contract based on plans and specifications for the project.
2. You stipulated that a bond is a condition of executing the subcontract and the listed DBE fails to meet your bond requirements.
3. Work requires a contractor's license and listed DBE does not have a valid license under Contractors License Law.
4. Listed DBE fails or refuses to perform the work or furnish the listed materials.
5. Listed DBE's work is unsatisfactory and not in compliance with the contract.
6. Listed DBE is ineligible to work on the project because of suspension or debarment.
7. Listed DBE becomes bankrupt or insolvent.
8. Listed DBE voluntarily withdraws with written notice from the Contract
9. Listed DBE is ineligible to receive credit for the type of work required.
10. Listed DBE owner dies or becomes disabled resulting in the inability to perform the work on the Contract.
11. Department determines other documented good cause.

Notify the original DBE of your intent to use other forces or material sources and provide the reasons. Provide the DBE with 5 days to respond to your notice and advise you and the Department of the reasons why the use of other forces or sources of materials should not occur. Your request to use other forces or material sources must include:

1. 1 or more of the reasons listed in the preceding paragraph
2. Notices from you to the DBE regarding the request
3. Notices from the DBE to you regarding the request

If a listed DBE is terminated or substituted, make good faith efforts to find another DBE to substitute for the original DBE. The substitute DBE must perform at least the same amount of work as the original DBE under the contract to the extent needed to meet the DBE goal.

The substitute DBE must be certified as a DBE at the time of request for substitution.

Unless the Department authorizes (1) a request to use other forces or sources of materials or (2) a good faith effort for a substitution of a terminated DBE, the Department does not pay for work listed on the Caltrans Bidder - DBE - Commitment form unless it is performed or supplied by the listed DBE or an authorized substitute.

5-1.04 PARTNERING DISPUTE RESOLUTION

The Department encourages the project team to exhaust the use of partnering in dispute resolution before engagement of an objective third party. Comply with Section 5-1.012, "Partnering," of the Standard Specifications.

For certain disputes, facilitated partnering session or facilitated dispute resolution session may be appropriate and effective in clarifying issues and resolving all or part of a dispute.

To afford the project team enough time to plan and hold the session, a maximum of 20 days may be added to the dispute resolution board (DRB) referral time following the Engineer's written response to a supplemental potential claim record as specified in Section 5-1.15, "Dispute Resolution," of the Standard Specifications.

To allow this additional referral time, the project team must document its agreement and intention in the dispute resolution plan of the partnering charter. The team may further document agreement of any associated criteria to be met for use of the additional referral time.

If the session is not held, the DRB referral time remains in effect as specified in Section 5-1.15, "Dispute Resolution," of the Standard Specifications.

5-1.05 PAYMENT ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS

GENERAL

Summary

This section applies to asphalt contained in materials for pavement structural sections and pavement surface treatments such as hot mix asphalt (HMA), tack coat, asphaltic emulsions, bituminous seals, asphalt binders, and modified asphalt binders placed in the work. This section does not apply if you opted out of payment adjustment for price index fluctuations at the time of bid.

The Engineer adjusts payment if the California Statewide Crude Oil Price Index for the month the material is placed is more than 5 percent higher or lower than the price index at the time of bid.

The California Statewide Crude Oil Price Index is determined each month on or about the 1st business day of the month by the Department using the average of the posted prices in effect for the previous month as posted by Chevron, ExxonMobil, and ConocoPhillips for the Buena Vista, Huntington Beach, and Midway Sunset fields.

If a company discontinues posting its prices for a field, the Department determines the index from the remaining posted prices. The Department may include additional fields to determine the index.

For the California Statewide Crude Oil Price Index, go to:

<http://www.dot.ca.gov/hq/construc/crudeoilindex/>

If the adjustment is a decrease in payment, the Department deducts the amount from the monthly progress payment.

The Department includes payment adjustments for price index fluctuations when making adjustments under Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications.

If you do not complete the work within the contract time, payment adjustments during the overrun period are determined using the California Statewide Crude Oil Price Index in effect for the month in which the overrun period began.

If the price index at the time of placement increases:

1. 50 percent or more over the price index at bid opening, notify the Engineer.
2. 100 percent or more over the price index at bid opening, do not furnish material containing asphalt until the Engineer authorizes you to proceed with that work. The Department may decrease Bid item quantities, eliminate Bid items, or terminate the contract.

Submittals

Before placing material containing asphalt, submit the current sales and use tax rate in effect in the tax jurisdiction where the material is to be placed.

Submit certified weight slips for HMA, tack coat, asphaltic emulsions, and modified asphalt binders, including those materials not paid for by weight, as specified in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications. For slurry seals, submit certified weight slips separately for the asphaltic emulsion.

ASPHALT QUANTITIES

General

Interpret the term "ton" as "tonne" for projects using metric units.

Hot Mix Asphalt

The Engineer calculates the quantity of asphalt in HMA using the following formula:

$$Q_h = HMATT \times [X_a / (100 + X_a)]$$

where:

Q_h = quantity in tons of asphalt used in HMA
HMATT = HMA total tons placed
X_a = theoretical asphalt content from job mix formula expressed as percentage of the weight of dry aggregate

Rubberized Hot Mix Asphalt

The Engineer calculates the quantity of asphalt in rubberized HMA (RHMA) using the following formula:

$$Q_{rh} = RHMATT \times 0.80 \times [X_{arb} / (100 + X_{arb})]$$

where:

Q_{rh} = quantity in tons of asphalt in asphalt rubber binder used in RHMA
RHMATT = RHMA total tons placed
X_{arb} = theoretical asphalt rubber binder content from the job mix formula expressed as percentage of the weight of dry aggregate

Modified Asphalt Binder in Hot Mix Asphalt

The Engineer calculates the quantity of asphalt in modified asphalt binder using the following formula:

$$Q_{mh} = MHMATT \times [(100 - X_{am}) / 100] \times [X_{mab} / (100 + X_{mab})]$$

where:

- Q_{mh} = quantity in tons of asphalt in modified asphalt binder used in HMA
- MHMATT = modified asphalt binder HMA total tons placed
- X_{am} = specified percentage of asphalt modifier
- X_{mab} = theoretical modified asphalt binder content from the job mix formula expressed as percentage of the weight of dry aggregate

Hot Mix Asphalt Containing Reclaimed Asphalt Pavement (RAP)

The Engineer calculates the quantity of asphalt in HMA containing RAP using the following formulas:

$$Q_{rap} = HMATT \times [X_{aa} / (100 + X_{aa})]$$

where:

$$X_{aa} = X_{ta} - [(100 - X_{new}) \times (X_{ra} / 100)]$$

and

- Q_{rap} = quantity in tons of asphalt used in HMA containing RAP
- HMATT = HMA total tons placed
- X_{aa} = asphalt content of HMA adjusted to account for the asphalt content in RAP expressed as percentage of the weight of dry aggregate
- X_{ta} = total asphalt content of HMA expressed as percentage of the weight of dry aggregate
- X_{new} = theoretical percentage of new aggregate in the HMA containing RAP determined from RAP percentage in the job mix formula
- X_{ra} = asphalt content of RAP expressed as percentage

Tack Coat

The Engineer calculates the quantity of asphalt in tack coat (Q_{tc}) as either:

1. Asphalt binder using the asphalt binder total tons placed as tack coat
2. Asphaltic emulsion by applying the formula in "Asphaltic Emulsion" to the asphaltic emulsion total tons placed as tack coat

Asphaltic Emulsion

The Engineer calculates the quantity of asphalt in asphaltic emulsions, including fog seals and tack coat, using the following formula:

$$Q_e = AETT \times (X_e / 100)$$

where:

- Q_e = quantity in tons of asphalt used in asphaltic emulsions
- AETT = undiluted asphaltic emulsions total tons placed
- X_e = minimum percent residue specified in Section 94, "Asphaltic Emulsions," of the Standard Specifications based on the type of emulsion used

You may, as an option, determine "X_e" by submitting actual daily test results for asphalt residue for the asphaltic emulsion used. If you choose this option, you must:

1. Take 1 sample every 200 tons but not less than 1 sample per day in the presence of the Engineer from the delivery truck, at midload from a sampling tap or thief, and in the following order:
 - 1.1. Draw and discard the 1st gallon
 - 1.2. Take two separate 1/2-gallon samples
2. Submit 1st sample at the time of sampling

3. Provide 2nd sample within 3 business days of sampling to an independent testing laboratory that participates in the AASHTO Proficiency Sample Program
4. Submit test results from independent testing laboratory within 10 business days of sample date

Slurry Seal

The Engineer calculates the quantity of asphalt in slurry seals (Q_{ss}) by applying the formula in "Asphaltic Emulsion" to the actual quantity of asphaltic emulsion used in producing the slurry seal mix.

Modified Asphalt Binder

The Engineer calculates the quantity of asphalt in modified asphalt binder using the following formula:

$$Q_{mab} = MABTT \times [(100 - X_{am}) / 100]$$

where:

- Q_{mab} = quantity in tons of asphalt used in modified asphalt binder
- MABTT = modified asphalt binder total tons placed
- X_{am} = specified percentage of asphalt modifier

Other Materials

For other materials containing asphalt not covered above, the Engineer determines the quantity of asphalt (Q_o).

PAYMENT ADJUSTMENTS

The Engineer includes payment adjustments for price index fluctuations in progress pay estimates. If material containing asphalt is placed within 2 months during 1 estimate period, the Engineer calculates 2 separate adjustments. Each adjustment is calculated using the price index for the month in which the quantity of material containing asphalt subject to adjustment is placed in the work. The sum of the 2 adjustments is used for increasing or decreasing payment in the progress pay estimate.

The Engineer calculates each payment adjustment as follows:

$$PA = Q_t \times A$$

where:

PA = Payment adjustment in dollars for asphalt contained in materials placed in the work for a given month.

Q_t = Sum of quantities of asphalt (Q_h + Q_{rh} + Q_{mh} + Q_{rap} + Q_{tc} + Q_e + Q_{ss} + Q_{mab} + Q_o).

A = Adjustment in dollars per ton of asphalt used to produce materials placed in the work rounded to the nearest \$0.01.

For US Customary projects, use:

- A = [(I_u / I_b) - 1.05] x I_b x [1 + (T / 100)] for an increase in the crude oil price index exceeding 5 percent
- A = [(I_u / I_b) - 0.95] x I_b x [1 + (T / 100)] for a decrease in the crude oil price index exceeding 5 percent

For metric projects, use:

- A = 1.1023 x [(I_u / I_b) - 1.05] x I_b x [1 + (T / 100)] for an increase in the crude oil price index exceeding 5 percent
- A = 1.1023 x [(I_u / I_b) - 0.95] x I_b x [1 + (T / 100)] for a decrease in the crude oil price index exceeding 5 percent

I_u = California Statewide Crude Oil Price Index for the month in which the quantity of asphalt subject to adjustment was placed in the work.

I_b = California Statewide Crude Oil Price Index for the month in which the bid opening for the project occurred

T = Sales and use tax rate, expressed as a percent, currently in effect in the tax jurisdiction where the material is placed. If the tax rate information is not submitted timely, the statewide sales and use tax rate is used in the payment adjustment calculations until the tax rate information is submitted.

5-1.06 SURFACE MINING AND RECLAMATION ACT

Imported borrow or aggregate material must come from a surface mine permitted under the Surface Mining and Reclamation Act of 1975 (SMARA), Pub Res Code § 2710, et seq., or from an exempt site.

The Department of Conservation, Office of Mine Reclamation maintains a list of permitted mine sites. For the list of permitted sites, go to:

http://www.conservation.ca.gov/omr/ab_3098_list

If you import borrow or aggregate material from a surface mine not on this list, submit proof the mine is exempt from SMARA.

5-1.07 ELECTRONIC SUBMISSION OF PAYROLL RECORDS

In lieu of submitting weekly payroll records to the Engineer as specified in Section 7-1.01A(3), "Payroll Records," of the Standard Specifications, you may submit weekly payroll records electronically.

Before submitting payroll records electronically, you must complete and sign the Contractor's Acknowledgement and submit it to the District where your project is located. Submit your signed acknowledgement to the corresponding District electronic mailbox shown in the following table:

Electronic Mailboxes

District	Address
1	district1.payrolls@dot.ca.gov
2	district2.payrolls@dot.ca.gov
3	district3.payrolls@dot.ca.gov
4	district4.payrolls@dot.ca.gov
5	district5.payrolls@dot.ca.gov
6	district6.payrolls@dot.ca.gov
7	district7.payrolls@dot.ca.gov
8	district8.payrolls@dot.ca.gov
9	district9.payrolls@dot.ca.gov
10	district10.payrolls@dot.ca.gov
11	district11.payrolls@dot.ca.gov
12	district12.payrolls@dot.ca.gov

The Department responds with an e-mail containing a Caltrans Internet Certificate to be used for the electronic submission of payroll records. You must agree to accept this certificate and reply to the e-mail. After you accept the certificate and reply to the e-mail, the Department is ready to accept your electronic submissions.

Each electronic submission must:

1. Include payroll records in a nonmodifiable PDF image format. No spreadsheets, word documents, or password protected documents are accepted.
2. Include payroll records with all data elements required by the Labor Code § 1776.
3. Include a signed Statement of Compliance form with each weekly record.
4. Be received by the Department by close of business on the 15th day of the month for the prior month's work.
5. Be encrypted before submission.
6. Contain the following information in the subject line:
 - 6.1. Contract number
 - 6.2. Week ending date as W/E mm/dd/yy
7. Contain 1 contract number and week ending date per submission.

For additional information on electronic submission of payroll records, go to:

<http://www.dot.ca.gov/hq/construc/LaborCompliance/index.htm>

5-1.08 TRAINING

For the Federal training program, the number of trainees or apprentices is 36.

5-1.09 FORCE ACCOUNT PAYMENT

Payment for extra work at force account will be determined by either non-subcontracted or subcontracted force account payment unless otherwise specified.

Non-Subcontracted Force Account Payment

When extra work to be paid for on a force account basis is performed by the Contractor, compensation will be determined as specified in Section 9-1.03, "Force Account Payment," of the Standard Specifications except for the markups. The markups specified in Section 9-1.03B, "Labor," Section 9-1.03C, "Materials," and Section 9-1.03D, "Equipment Rental" are changed to the following markups:

Cost	Percent Markup
Labor	30
Materials	10
Equipment Rental	10

The above markups shall be applied to work performed on a force account basis, regardless of whether the work revises the current contract completion date.

The above markups, together with payments made for time-related overhead under "Time-Related Overhead" of these special provisions, shall constitute full compensation for all overhead costs for work performed on a force account basis.

Full compensation for overhead costs for work performed on a force account basis, and for which no adjustment is made to the quantity for time-related overhead conforming to the provisions in "Time-Related Overhead" of these special provisions, shall be considered as included in the markups specified above, and no additional compensation will be allowed therefor.

Subcontracted Force Account Payment

When extra work to be paid for on a force account basis is performed by a subcontractor approved in conformance with the provisions in Section 5-1.055, "Subcontracting," of the Standard Specifications, compensation will be determined in accordance with the provisions in Section 9-1.03, "Force Account Payment," of the Standard Specifications.

5-1.10 AREAS FOR CONTRACTOR'S USE

Attention is directed to the provisions in Section 7-1.19, "Rights in Land and Improvements," of the Standard Specifications and these special provisions.

The highway right of way shall be used only for purposes that are necessary to perform the required work. The Contractor shall not occupy the right of way, or allow others to occupy the right of way, for purposes which are not necessary to perform the required work.

No State-owned parcels adjacent to the right of way are available for the exclusive use of the Contractor within the contract limits. The Contractor shall secure, at the Contractor's own expense, areas required for plant sites, storage of equipment or materials, or for other purposes.

No area is available within the contract limits for the exclusive use of the Contractor. However, temporary storage of equipment and materials on State property may be arranged with the Engineer, subject to the prior demands of State maintenance forces and to other contract requirements. Use of the Contractor's work areas and other State-owned property shall be at the Contractor's own risk, and the State shall not be held liable for damage to or loss of materials or equipment located within such areas.

5-1.11 CONTRACTOR-FURNISHED RESIDENT ENGINEER'S (RE) OFFICE

GOVERNING LAWS

Contractor-furnished RE office must comply with applicable federal, state, county, municipal and local utility laws, rules, and regulations. Nothing in these special provisions must be construed to permit work not conforming to codes and regulations.

LEASE OR RENTAL OF SPACE AGREEMENT

Make all arrangements, and obtain a lease or rental of space agreement for placement of a temporary office facility and its enclosure as approved by the Engineer. Obtain all agreements, permits and licenses required for the lease or rental of space agreement, including payment of all applicable fees, prior to preparation of the site location enclosure of the Contractor-furnished resident engineer's (RE) office, herein referred to as "RE office."

PREPARATION OF SITE

Furnish weatherproof temporary RE office facilities for use by Department personnel for the duration of the project within 2 miles of the project limits outside of State Right of Way and adjacent to your field office. The Contractor-furnished RE office location will be approved by the Engineer, and must remain on-site until released by the Engineer.

DRAWINGS, DATA, AND COST-BREAKDOWN

Within 5 days after contract approval, submit drawings and data to describe details of the RE office. Provide a cost break-down of the RE office as required by this special provision. The Engineer will review and approve or reject the drawings and data within 5 days. If rejected, the subsequent submittal and review must be completed within 2 days. The drawings, data, and cost-breakdown must be approved within 15 days of contract approval. Upon approval of the drawings, data, and cost-breakdown, deliver, set up, and install the RE office within 40 days of contract approval.

Consult with the Engineer prior to preparing the drawings and data submittals. The drawings and data submittals must consist of the following:

1. Data that completely describes the equipment, machines, and furnishings.
2. Location of RE office, layout of office space and conference room, and manufacturer, model number, and description of the RE office. The drawings must include layouts for lighting, parking, entrances, listing of furnishings and equipment, locations of electrical receptacles and cable infrastructure for voice and data for each desk or office, and both conference rooms, and a delivery schedule for the facilities.

UTILITY CONNECTIONS

Provide utility connections for heating and cooling and electrical power specified in provisions "Temporary Utilities" of these special provisions. Connect and maintain electricity, and provide water, sewage disposal, and propane. Electrical service equipment must be rated 100A minimum to provide power for electrical equipment within the RE office.

Provide a weatherhead and raceway for service conductors used for overhead electrical service, and a combination service entrance panel mounted on the exterior of the office to supply all the loads within and on the office. The combination service panel must include a location for the meter, a main disconnect switch and a distribution panelboard.

Provide a weatherhead and raceway for overhead telephone service to a demarcation box mounted on the exterior of the RE office to connect to phone lines inside. The demarcation box must be a metal enclosure with insulated backboard. Pay connection and monthly utility charges and do not disconnect utilities without 7-day advance notification to the Engineer.

Obtain permits and licenses required for the extension of and connection to each utility service, furnish labor and materials necessary for extensions not performed or provided by the utility, and furnish and install intermediate equipment required by the serving utilities.

STRUCTURE

The RE office shall have a minimum ceiling height of 8 feet and a minimum 6000 square feet of floor space, screened weatherproof windows with window treatment, and lockable doors with at least 15 sets of keys. Distribute 15 sets of keys to the Engineer. Each window shall be equipped with interior shades, curtains, or blinds, shall have a minimum area of 8 square feet and able to open and close.

The RE office must have at least 16 rooms, including 8 separate 12' x 12' office rooms, one 10' x 10' storage room, one 18' x 30' conference room, one 12' x 12' conference room, kitchen, pantry, one communication equipment room, one men's restroom, and one women's rest room. Raised entrances, at least 4 feet wide, and exits, except for the ramp exit, must have stairs. A landing of minimum 4' x 4' shall be provided at each doorway with integral railings with steps or ramp. The RE office must be tied down to prevent damage or overturning. The tie-down must be supported by adequate blocking to prevent settlement. A photocell and motion-sensor activated exterior light must be provided at each entrance. The Contractor shall install and maintain an electronic security system that will respond to any breach of exterior doors and windows with an on-site alarm.

Communication equipment room must have two 20 amp power outlets and 2 cooling vents. Door to this room must have a separate lock. Distribute 2 keys.

TEMPORARY SANITARY FACILITIES

Provide adequate toilet conveniences, washing facilities, and water. Provide self-contained water storage tank with fresh, potable water as required. Refill when tank is down to 1/4 full. Work must conform to the California Plumbing Code, California Code of Regulations, Title 24, Part 5.

Office sewage must be self-contained in a holding tank. The holding tank must be emptied and cleaned every 3 days.

The rest rooms must contain suitable on-site sanitary facilities meeting Federal, State, and local health department requirements, must be maintained clean and sanitary, and in good working condition, and must be stocked with lavatory and sanitary supplies. The rest rooms must have a toilet, lavatory with hot and cold water, toilet paper holder, paper towel dispenser and paper toweling, mirror, soap dispenser, sharps container, lighting, and mechanical ventilation. Provide 2 urinals and 2 lavatories in the men's restroom. Provide a sanitary supply disposal receptacle for the women's restroom. At completion of the work, sanitary facilities must be disinfected.

Provide a minimum 120 square foot kitchen with an outside venting exhaust fan, a coffee bar, a sink with hot and cold water faucets, cupboards above the coffee bar, and cupboards underneath. The exhaust fan must have its own on/off switch. The coffee bar must have 2-ground fault interrupt circuits. Provide a hot and cold drinking water dispenser and potable bottled water delivery service for 30 people.

Provide 100 square foot pantry adjacent to kitchen with a table and 6 chairs.

EQUIPMENT AND FURNISHINGS

Provide equipment and furnishings for the office as follows:

1. 30 desks with minimum working surface 42" x 30" each and 30 non-folding chairs with upholstered seats and backs and on rollers.
2. 30 desks with minimum working surface 42" x 30" with height adjustment of 23 to 30 inches for computer use.
3. 32 phones capable of making conference calls.
4. Ten phones at minimum will have a speakerphones and 8 will have answering machines.
5. Five conference tables, 4' x 6' minimum size, with 28 non-folding chairs with upholstered seats and backs and on rollers.
6. One plan rack capable of holding full-size drawings.
7. Thirtyfive bookcases with the following minimum dimensions: 4 feet in width, 6 feet in height, and 1 foot in depth. The units must be anchored to a wall.
8. One 12 cubic feet, minimum, refrigerator with a freezer unit.
9. One microwave oven (1100 watt minimum).
10. Four 10.5 gallon waste baskets and 30 wastebaskets large enough for daily pick-up service.
11. Ten whiteboards, erasable felt marker type, 30" x 48", minimum size.
12. Eight metal filing cabinets, five drawer legal size, minimum 27 inches deep, with enamel finish.
13. At least 5 fire extinguishers with a minimum underwriter's laboratory rating of 4A60BC and shall be placed in an easily accessible location, as approved by the Engineer.
14. Provide cable infrastructure for voice and data lines (24U network rack; Cat 6 Ethernet Wiring, AMP Cat 6 patch panels - 48 port, rack mount kit) to accommodate 2 data ports (one voice and one data) for each desk and conference room.
15. A DSL internet service with at least 25/25 mbps download and upload speed must be provided for the first 6 months or until the T-1 line is in operation.

Provide communication equipment and office machines in good working condition as follows:

1. Electrical equipment shall be furnished with surge protection.
2. One facsimile machine, plain-paper type capable of 15 ppm print speed, 50 sheet automatic document feeder, 350 sheet paper capacity, 30 quick dials and 100 speed dials with paper for life of project.
3. One dry process photocopying machine with 11" x 17" copy features capable of reproducing prints from nontransparent master sheets, as black lines on white paper, scanning to pdf file in color and send file to email addresses through network cable, multi-sheet feed and collate output copies, copying and network printing at least 45 pages per minute, and 1000 sheet paper capacity with reproduction paper for the life of the project, activating agent, and power source.

Interior walls and ceilings must receive a prime coat and 2 coats of white enamel paint unless otherwise approved. Furnishings may be of manufacturer's standard color or must be painted as specified for walls and ceilings. The materials used in construction of temporary facilities for using the above facilities and services must be in accordance with applicable building codes. Do not use materials that give off noxious chemical odors.

ENCLOSURE

You must provide security fencing to establish the Contractor-furnished RE office enclosure. The RE office must be enclosed with chain link fencing, a minimum 6 feet high, with one coded drive-through gate with 2 electric remote controls a minimum of 12 feet wide and 6 feet high, one walk-through gate, a minimum 4 feet wide, and locks with 4 sets of keys. The gates must be set at easily accessible locations, as approved by the Engineer. Repair damaged paving at your expense. The fence must be constructed at least 20 feet from the office front where entrances are located and at least 10 feet from the other sides of the RE office. The fenced area enclosure must provide for parking up to 40 vehicles with striping and sufficient space for turnaround or exit within the parking facility when parked vehicles are present. An accessible parking space, marking and sign must be placed next to the ADA ramp entrance.

HEATING AND LIGHTING

Heating must provide a minimum 70 °F inside temperature at the 2 1/2 percentile design temperature. A distribution system for uniform heating and comfort must be provided. Ventilation must be mechanical-type for comfort during the change between heating and cooling seasons. The air-conditioning system must provide a 76 °F inside temperature at the 2 1/2 percentile design temperature. Electric energy for power and lighting must be provided. Electric lighting, with non-glare luminaries must provide a minimum of 75 foot-candles of illumination at desk height level. Each room must be provided with 2 duplex outlets. Utilities must be connected and disconnected in accordance with local codes and industry standards.

MAINTENANCE

Maintain adequate operation and supplies of equipment in the office. Provide same day service/repair or replacement when equipment is out of working order. Supply landscape maintenance once per month, as approved by the Engineer, and janitorial service every working day, including cleanup, trash removal, and supply of paper towels, toilet paper, and soap.

OFFICE RELEASE AND CONTRACT ACCEPTANCE

The RE office, including furnishings and utility connections, must be removed and will become your property within 30 days after project completion or when released by the Engineer. After removal of the RE office, the site must be restored to its original or an improved condition, including finish grading to smooth and properly draining contours. The site must be cleaned of trash, recyclables, and green waste. The Engineer must be notified at least 7 days in advance of the start of removal of the contractor-furnished RE office. Acceptance of the contract will be made after removal of the contractor-furnished RE office and restoration of the facilities site to its original or improved condition.

COST BREAK-DOWN

Include a break-down of costs prior to installation of the contractor furnished RE office which itemizes the contract item price for contractor-furnished RE office. Use the line items provided in this section as the basis for applying values for the cost break-down and be responsible for the accuracy of the values. Partial payment for this contract item will not be made until the RE office cost break-down is approved by the Engineer. Line items indicated in the cost break-down with a specified estimated quantity must be considered minimum requirements. Incorporate minimum requirements with your designated values into the cost break-down for line items indicated. The sum of values for the line items of work listed in the cost break-down must be equal to the contract lump sum price for "Contractor-Furnished RE Office." Overhead and profit must be included in the individual line items listed in the cost break-down.

CONTRACTOR-FURNISHED RE OFFICE COST BREAK-DOWN
07-1218W4

LINE ITEM	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	VALUE
1	LEASE OR RENTAL OF SPACE AGREEMENT	LS	LUMP SUM	
2	PREPARATION OF SITE	LS	LUMP SUM	
3	DRAWINGS, DATA, AND COST-BREAKDOWN	LS	LUMP SUM	
4	UTILITY CONNECTIONS	LS	LUMP SUM	
5	STRUCTURE	LS	LUMP SUM	
6	TEMPORARY SANITARY FACILITIES	LS	LUMP SUM	
7	EQUIPMENT AND FURNISHINGS	LS	LUMP SUM	
8	ENCLOSURE	LS	LUMP SUM	
9	HEATING AND LIGHTING	LS	LUMP SUM	
10	MAINTENANCE	LS	LUMP SUM	
11	OFFICE RELEASE AND REMOVAL	LS	LUMP SUM	

TOTAL _____

The approved cost break-down will be used to determine partial payments during the progress of the work and as the basis for calculating the adjustment in compensation for the item of contractor-furnished RE office due to increases or decreases of work as ordered by the Engineer. When an ordered change increases or decreases the work involved in an approved cost break-down item, the adjustment in compensation will be determined in the same manner specified for increases and decreases in the quantity of a contract item of work under Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications. If an ordered change requires a new item that is not on the approved cost break-down, the adjustment in compensation will be determined in the same manner specified for extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

The Department may withhold liquidated damages of \$500 per day if RE office is not furnished within 40 days of contract approval.

TEMPORARY WITHHOLDING AND PERMANENT DEDUCTIONS

Compensate the Department for provision and maintenance requirements not achieved and services not provided. Payment for contractor-furnished RE Office will not be made unless compliance with requirements of this section is achieved. Amounts owed to the Department will be reimbursed by deductions of partial payments. Deductions for requirements not satisfied will be as estimated by the Engineer. 25% of the estimated amount owed to you may be withheld on the next monthly partial payment to ensure compliance with these requirements. No interest for withholding will be due to you. Amounts withheld will be returned to you in the next monthly progress estimate after compliance with requirements of this section is achieved.

PAYMENT

The Contractor-furnished RE office, fully equipped as specified, as approved by the Engineer, will be paid on a monthly basis until the RE office is released by the Engineer, provided the RE office, equipment and supplies, and utilities are furnished and maintained. No payment will be made for contractor-furnished RE office when the contract is suspended due to your failure to comply with the provisions of the contract.

The contract lump sum price paid for contractor-furnished RE office shall include full compensation for obtaining permits and licenses for all utility connections, furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in contractor-furnished RE office, complete in place, including all utility costs, and installation, maintenance, and removal of the office, and must reflect the salvage value of the office, equipment and furniture which becomes your property after release by the Engineer.

The costs you incur for the extensions of utilities beyond the limits of the contractor-furnished RE office and for furnishing and installing intermediate equipment required by serving utilities, will be paid for as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

The Engineer will make an adjustment in compensation under Section 4-1.03C, "Changes in Character of Work," of the Standard Specifications for additional work required to meet requirements of a lease or rental of space agreement.

No adjustment in compensation will be made for ordered changes to correct work resulting from your operations or negligence.

You must repair extraordinary damage to the RE office attributed to State operations during the course of the project and repairs will be paid as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications. No extra payment will be made for systems and equipment maintenance or supplies, repairs or replacement, or for damages incurred as a result of vandalism, theft, or other criminal activities.

5-1.12 RELATIONS WITH CITY OF BURBANK

A portion of this project is located within the jurisdiction of the City of Burbank. You must obtain the necessary no fee and Excavation/Construction Permit (General) from the City of Burbank prior to performing any construction work on City's facilities. A copy of the conditional Excavation Permit (General) issued by the City of Burbank has been prepared for this contract and is available as described in section, "Supplemental Project Information" of these special provisions. You must obtain any excavation, construction, encroachment, transportation, or street use permits from the City of Burbank prior to performing work on City's facilities outside of the limits of work at your expense. You must comply with the requirements, rules, regulations, and conditions that may govern your operations in these areas and must conduct the work accordingly.

You must maintain a copy of the permits at the worksite during period of active work and must present them upon request.

Changes in the condition set in the Permit proposed by you must be submitted to the Engineer for transmittal to the City for approval. Changes shall not be implemented until approved in writing by the City.

Work on local public right-of-way or impacting the public right of way including utilities relocation will require meetings to discuss the implementation and coordination of work with the City, the State, Metrolink, and you. You must attend weekly coordination meetings during phases of work that impact City right of way and facilities. Meetings will be scheduled once per week unless City, the State, Metrolink, and you agree to an alternative schedule.

You must provide 15-day advance notice to the City and the State prior to performing the following items of work:

1. Closure of San Fernando Blvd
2. Construction of Buena Vista St UP
3. Construction at San Fernando UP or UC
4. Construction of Victory Place Separation
5. Construction at Empire Ave interchange
6. Construction of Pumping Plant
7. Construction of Burbank Blvd interchange

Full compensation for conforming to the provisions in this section is considered as included in prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.13 RESPONSIBILITY TO OTHER ENTITIES

The Contractor shall be responsible for any liability imposed by law and for injuries to or death of any person including, but not limited to, workers and the public or damage to property, and shall indemnify and save harmless, and name as additional insureds under the general liability insurance policy, any county, city or district, including Southern California Regional Rail Authority, a joint powers authority existing under the laws of the State of California and Los Angeles County Metropolitan Transportation Authority, its officers and employees connected with the work, within the limits of which county, city or district the work is being performed, all in the same manner and to the same extent conforming to the provisions in Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications, for the protection of the State of California and all officers and employees thereof connected with the work.

5-1.14 PAYMENTS

In determining the partial payments to be made to the Contractor, only the following listed materials will be considered for inclusion in the payment as materials furnished but not incorporated in the work:

- A. Control and Neutral Conductors
- B. Irrigation controller and irrigation controller cabinet enclosure
- C. Pipe (irrigation systems)
- D. 2" Supply line (Bridge)
- E. Valves and sprinklers
- F. Metal sign structures
- G. Culvert pipes
- H. Underdrain pipes
- I. DOWNDRAIN pipes
- J. Drainage pipes
- K. Filter fabric
- L. Miscellaneous drainage facilities
- M. Precast concrete members
- N. Prestressing steel
- O. Geosynthetic pavement interlayer (Paving Fabric)
- P. Ground anchors
- Q. Mechanically stabilized embankment
- R. Tie bars and basket
- S. Pavement dowel bars
- T. Piling except Cast-In-Drilled-Hole (CIDH) piling
- U. Sound wall (masonry block)
- V. Type B Joint Seals
- W. Bar reinforcing steel
- X. Structural steel
- Y. Welded steel pipe
- Z. Miscellaneous iron and steel

- AA. Miscellaneous metal
- BB. Pumping plant equipment
- CC. Pumping plant electrical equipment
- DD. Pumping plant metal work
- EE. Fences and gates
- FF. Railing and appurtenances (Chan link, Cable, and Handrailing)
- GG. Metal beam guard railing
- HH. Transition railing (Type WB)
- II. Crash cushions
- JJ. Bridge deck drainage system
- KK. Steel and Column casing
- LL. Isolation casing
- MM. Pavement markers
- NN. Lighting fixtures
- OO. Lighting fixtures (City and Metrolink)
- PP. Luminaires
- QQ. Camera assemblies
- RR. Splice vault
- SS. Fiber optic cables and conduits
- TT. Innerducts

5-1.15 SUPPLEMENTAL PROJECT INFORMATION

The Department makes the following supplemental project information available:

Supplemental Project Information

Means	Description
<p>Included in the Information Handout (the State)</p>	<p>Foundation Report for Burbank Blvd OC (Replace), Bridge No. 53-3057. Revised Foundation Report for Burbank Blvd OC, Bridge No. 53-3057 Foundation Report for Abut3-Right Retaining Wall. Foundation Report for Abut3-Left Retaining Wall. Foundation Report for Retaining Wall No.1561(L-shaped Wall). Foundation Report for MSE Wall No.1565. Foundation Report for MSE Wall No.1567. Foundation Report for Type 1 Wall No.1576. Foundation Report for MSE Wall No.1585. Foundation Report for Stough Canyon Culvert Cover Structure No. 53-3077M. Foundation Report for Retaining Wall No.1575 from STA 575+68 to STA 580+58. Foundation Report for Retaining Wall 1575 over Stough Canyon Channel and Burbank Western Channel, from STA 573+73 to STA 575+68. Foundation Report for Buena Vista - Winona Undercrossing Widening, Bridge No.53-1110. Foundation Report for Empire Ave Undercrossing, Bridge No.53-2920. Foundation Report for Victory Place Separation (New), Bridge No.53C-2171. Foundation Report for LAFCD Burbank Western Channel (Cover), Bridge No. 53-3078. Foundation Report for Retaining Wall No.25 with Addendum. Foundation Report for Retaining Wall No.26 with Addendum. Foundation Report for Soundwall No.1584. Foundation Report for Retaining Wall No.1595. Foundation Report for Retaining Wall No.1601. Foundation Report for Retaining Wall No.1604 with Addendum. Foundation Report for Retaining Wall No.1605. Foundation Report for Retaining Wall No.1606 with Addendum. Foundation Report for Retaining Wall No.1607. Foundation Report for Retaining Wall No.1610. Foundation Report for Retaining Wall No.1613 with Addendum. Foundation Report for Retaining Wall No.1615. Foundation Report for Retaining Wall No.1630. Foundation Report for Retaining Wall No.1635. Foundation Report for Retaining Wall No.1655. Foundation Report for Retaining Wall No.1662. Foundation Report for Retaining Wall No.1665. Foundation Report for Retaining Wall No.1670. Structure Hydraulics and Hydrology Preliminary Hydraulic Report, Burbank Western Channel. Foundation Report for Victory Place Separation (New), Bridge No. 53C-2171. Lead Site Investigation Report. Parcel Acquisition Site Investigation Report. Revised Site Investigation Report. Addendum to Revised Site Investigation Report. California Environmental Protection Agency, Department of Toxic Substances Control - Variance No. V09HQSCD006</p>

Included in the Information Handout (Los Angeles County, Metrolink, and the City of Burbank)	Los Angeles County Flood Control Permit No. PCFL T201200741. Los Angeles County Flood Control Permit No. PCFL T201200801. Right of Entry and Construction Permit ROE 012013. City of Burbank Offsite Excavation Permit No. PW1208293. Geotechnical Exploration for the Empire Avenue Storm Water Pump Station. The American Railway Engineering and Maintenance-of-Way Association (Manual). Burbank Department of Power and Water Standard Plans. Geotechnical Investigation. Addendum to Geotechnical Investigation report. LADOT Camera Poles Details. SCRRRA Excavation support Guidelines. SCRRRA Engineering Standards. SCRRRA Form 6. Temporary Right of way Entry. SCRRRA Track Charts 2008. Site Investigation - Phase II Hazardous Waste. Standard Specifications for Public Works Construction. SCRRRA Form 37 Rules
Available as specified in the Standard Specifications	Cross sections Bridge as-built drawings

5-1.16 NOISE CONTROL

General

This section applies to equipment on the project or associated with the project, including trucks, transit mixers, stationary equipment, and transient equipment.

The noise level from the Contractor's operations must not exceed 86 dBA at 50 feet from the project limits from 7 p.m. to 7 a.m.

This requirement shall not relieve the Contractor from responsibility for complying with local ordinances regulating noise levels.

The noise requirement shall apply to the equipment on the job or related to the job, including but not limited to trucks, transit mixers or transient equipment that may or may not be owned by the Contractor. Full compensation for conforming to the requirements of this section shall be considered as included in the prices paid for various contract items of work involved and no additional compensation will be allowed thereof.

To prevent adverse noise and vibration impacts to the Liberman Broadcasting buildings during construction, no impact pile driving or shoring vibratory sheet piling construction methods may be used at Empire Avenue. Cast-In-Drilled-Hole (CIDH) methods must be employed to construct the structures at Route 5 and Empire Avenue. All construction activities will be performed to minimize noise and vibration. Where applicable, Liberman Broadcasting will be involved in the process of developing work plans and specifications for the Contractor who will conduct the necessary work, and will have the opportunity to provide input to the Contractor.

All construction activities will be conducted in accordance with all applicable provisions of City of Burbank's noise codes and ordinances:

1. Use of pavement breaker and vibratory roller shall not be used south of Victory Place from 5 a.m. to 11 a.m. and 10 a.m. to 3 p.m.
2. There shall not be any major construction activities within 165 feet of the KRCA building during live news broadcasts from Video Production 1 room.
3. Contractors must coordinate the time of heavy-duty equipment usage near both buildings with studio personnel to avoid interference with other special live broadcasting that may be taking place outside of the normal schedule.
4. Rubber-tired loader must be used.
5. Avoid unnecessary slamming of drill bit during CIDH piling.
6. Conduct vibration monitoring during vibration intensive activities. Corrective actions must be taken if results of monitoring indicated high vibration level.
7. Perform all construction in a manner to minimize noise. The Contractor shall be required to select construction processes and techniques that create the lowest noise levels.
8. Route haul trucks away from the Liberman Broadcasting buildings. Where applicable, Liberman Broadcasting will be provided with the opportunity to be involved in locating the staging and haul routes,

as well as the approach and departure routes for trucks and equipment in proximity to the Liberman facilities. The staging area and the haul routes must be determined to minimize interruption or interference with the normal operation of the Liberman Broadcasting facilities.

9. Use equipment with effective mufflers. The Contractor shall be required to employ equipment fitted with the most effective commercially available mufflers.

Liberman Broadcasting must be provided with no less than 24 hours prior notice of any work that may or is reasonably projected to exceed the permitted noise and vibration levels, including detail regarding the noise and vibration expected, and the specific hours that the work will be conducted. This will enable Liberman Broadcasting to take the necessary measures to safeguard their broadcast and stage operations and schedule programming as appropriate.

Noise Monitoring

Provide 1 Type 1 sound level meter and 1 acoustic calibrator to be used by the Department until contract acceptance. Provide training by a person trained in noise monitoring to 1 Department employee designated by the Engineer. The sound level meter must be calibrated and certified by the manufacturer or other independent acoustical laboratory before delivery to the Department. Provide annual recalibration by the manufacturer or other independent acoustical laboratory. The sound level meter must be capable of taking measurements using the A-weighting network and the slow response settings. The measurement microphone must be fitted with a windscreen. The Department returns the equipment to you at contract acceptance.

The contract lump sum price paid for noise monitoring includes full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all work involved in noise monitoring including noise monitoring work plan, conducting noise measurements, preparing and reviewing noise monitoring reports until approved by the Engineer.

5-1.17 PROJECT APPEARANCE

The Contractor shall maintain a neat appearance to the work.

In areas visible to the public, the following shall apply:

- A. When practicable, broken concrete and debris developed during clearing and grubbing shall be disposed of concurrently with its removal. If stockpiling is necessary, the material shall be removed or disposed of weekly.
- B. Trash bins shall be furnished for debris from structure construction. Debris shall be placed in trash bins daily. Forms or falsework that are to be re-used shall be stacked neatly concurrently with their removal. Forms and falsework that are not to be re-used shall be disposed of concurrently with their removal.

Full compensation for conforming to the provisions in this section, not otherwise provided for, shall be considered as included in prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

5-1.18 BIRD PROTECTION

The Department anticipates nesting or attempted nesting by migratory and nongame birds from February 15th to September 1st.

Stop all work within a 100-foot radius of the discovery except as specified in the following table:

Radii Exceptions	
Species	Work stoppage radii (feet)
Songbirds	150
Raptors	500

5-1.19 RELATIONS WITH CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

This project lies within the boundaries of the Lahontan Regional Water Quality Control Board (RWQCB).

The State Water Resources Control Board (SWRCB) has issued to the Department a permit that governs storm water and non-storm water discharges from the Department's properties, facilities, and activities. The Department's permit is entitled "Order No. 99 - 06 - DWQ, NPDES No. CAS000003, National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)." Copies of the Department's permit are available for review

from the SWRCB, Division of Water Quality, 1001 "I" Street, P.O. Box 100, Sacramento, California 95812-0100, Telephone fax: (916) 341-5463 and may also be obtained at:

http://www.waterboards.ca.gov/water_issues/programs/stormwater/caltrans.shtml

The Department's permit references and incorporates by reference the current statewide general permit issued by the SWRCB entitled "Order No. 2009-0009-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements for Discharges of Storm Water Runoff Associated with Construction and Land Disturbance Activities" that regulates discharges of storm water and non-storm water from construction activities disturbing one acre or more of soil in a common plan of development. Copies of the statewide permit and modifications thereto are available for review from the SWRCB, Division of Water Quality, 1001 "I" Street, P.O. Box 100, Sacramento, California 95812-0100, Telephone fax: (916) 341-5463 and may also be obtained at:

http://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.shtml

The NPDES permits that regulate this project, as referenced above, are collectively referred to in this section as the "permits."

This project shall conform to the permits and modifications thereto. The Contractor shall maintain copies of the permits at the project site and shall make them available during construction.

The Contractor shall know and comply with provisions of Federal, State, and local regulations and requirements that govern the Contractor's operations and storm water and non-storm water discharges from the project site and areas of disturbance outside the project limits during construction. Attention is directed to Sections 7-1.01, "Laws to be Observed," 5-1.18, "Property and Facility Preservation," 7-1.12, "Indemnification and Insurance," and 9-1.07E(5), "Penalty Withholds," of the Standard Specifications.

The Contractor shall notify the Engineer immediately upon request from the regulatory agencies to enter, inspect, sample, monitor, or otherwise access the project site or the Contractor's records pertaining to water pollution control work. The Contractor and the Department shall provide copies of correspondence, notices of violation, enforcement actions, or proposed fines by regulatory agencies to the requesting regulatory agency.

5-1.20 MATERIAL SITES

Local material sites used by the Contractor shall be graded so that, at the time of final inspection of the contract, the sites will drain and will blend in with the surrounding terrain.

5-1.21 AIR QUALITY –NESHAP NOTIFICATION

In compliance with Standard Specifications Section 14-9.01, the Contractor must notify the Air Pollution Control District (APCD) or Air Quality Management District (AQMD) identified below as required by the National Emission Standards for Hazardous Air Pollutants (NESHAP) at 40 CFR Part 61, Subpart M, and California Health and Safety Code section 39658(b)(1). A copy of the notification form and attachments must be provided to the Engineer prior to submittal. Notification must take place a minimum of 10 working days prior to starting demolition or renovation activities as defined in the NESHAP regulations. Notification forms and other information are available from the air district at the address below.

South Coast AQMD
21865 Copley Drive.
Diamond Bar, CA 91765-4182

Forms and information may also be obtained from the air district's web site at:

<http://www.aqmd.gov/>

The Contractor must mail or otherwise deliver the original notification form with any necessary attachments to:

South Coast AQMD
21865 Copley Dr.
Diamond Bar, CA 91765-4182

The Contractor must also notify other local permit agencies and utility companies prior to starting any demolition activities. A copy of the notification form and attachments must be provided to the Engineer a minimum of 30 days prior to the start of work.

If the Contractor does not receive direction from the Engineer within 20 days after submittal that changes to the notification are required, or written confirmation of receipt and approval by the local APCD or AQMD, then an extension of time commensurate with the delay in completion of the work thus caused will be granted and the Contractor will be relieved from any claim for liquidated damages, or engineering and inspection charges or other penalties for the period covered by that extension of time; provided that the Contractor notifies the Engineer in writing of the causes of delay within 15 days from the beginning of the delay. The Engineer will ascertain the facts and the extent of the delay, and the Engineer's findings thereof must be final and conclusive.

Full compensation for complying with requirements of this section, including the payment of any notification fees, will be included in the contract price paid for the items involved, and no additional compensation will be allowed therefor.

5-1.22 AERIALY DEPOSITED LEAD

Aerially deposited lead is present within the project limits. Aerially deposited lead is lead deposited within unpaved areas or formerly unpaved areas, primarily due to vehicle emissions.

Attention is directed to "Material Containing Hazardous Waste Concentrations of Aerially Deposited Lead" and "Supplemental Project Information" of these special provisions.

The complete site investigation report, entitled "Revised site investigation I-5 HOV/Empire Interchange" and "Lead Site Investigation I-5 HOV, North of SR-134 to 3.0 kilometers South of SR-170," is included in the "Material Information" handout.

The Department has received from the California Department of Toxic Substances Control (DTSC) a Variance regarding the use of material containing aerially deposited lead. The variance applies if the project includes Type Y-1 or Y-2 material. The Variance is included in the "Material Information" handout.

Once the Contractor has completed the placement of material containing aerially deposited lead in conformance with these special provisions and as directed by the Engineer, the Contractor shall have no responsibility for such materials. The Department will not consider the Contractor a generator of such contaminated materials.

Excavation, reuse, and disposal of material with aerially deposited lead shall be in conformance with all rules and regulations including, but not limited to, those of the following agencies:

- A. United States Department of Transportation,
- B. United States Environmental Protection Agency,
- C. California Environmental Protection Agency,
- D. California Department of Health Services,
- E. Department of Toxic Substances Control,
- F. California Division of Occupational Safety and Health Administration,
- G. Department of Resources Recycling and Recovery,
- H. Regional Water Quality Control Board, Region 4, Los Angeles,
- I. State Air Resources Control Board, and
- J. South Coast Air Quality Management District.

Materials containing hazardous levels of lead shall be transported and disposed of in conformance with Federal and State laws and regulations, as amended, and county and municipal ordinances and regulations, as amended. Laws and regulations that govern this work include, but are not limited to:

- A. Health and Safety Code, Division 20, Chapter 6.5 (California Hazardous Waste Control Act),
- B. Title 22, California Code of Regulations, Division 4.5 (Environmental Health Standards for the Management of Hazardous Waste), and

5-1.23 NONHIGHWAY FACILITIES (INCLUDING UTILITIES)

Utility Relocation and Date of the Relocation

Utility	Location	Date
Southern California Gas-4"	From Magnolia Blvd.	5/1/2013
Pacific Pipe Line (Plains All-American) 20" Pacific Pipe Line (Plains All American)	From railroad station 1576+00 to main line station 1588+00	3/22/2013
Qwest/Sprint Fiber Optic Line	Along Railroad ROW	9/22/2013
City of Burbank W 12" CI CL 250 water	From Magnolia Blvd.	5/1/2013
City of Burbank W 4" CI	Across Route 5	5/1/2013
City of Burbank W 16" DIP reclaimed	Near Magnolia Blvd.	5/1/2013
City of Burbank-S 30" VCP	Along Railroad ROW	5/1/2013
City of Burbank-W 16" DIP water in 30" steel casing	Across Freeway near Station 1559+40	5/1/2013
City of Burbank-W 12" CI Main	Across Freeway near Station 1559+40	5/1/2013
City of Burbank-S Manhole serving 24" VCP	Across Freeway near Station 1586+60	5/1/2013
City of Burbank- T 12 /34.5 KV Underground Electric	At Burbank Bridge	6/1/2014
City of Burbank-Comm Fiber Conduit (2" SMFO)1	At Burbank Bridge	6/1/2014
AT&T/Sprint Fiber Optic in 36" steel casing	At Burbank Bridge	10/30/2012
City of Burbank- D/T Overhead 4/34.5 KV Transmission Line	At Walnut Ave.	5/1/2013
City of Burbank-W 16" concrete cyl pipe with 22" steel tubing	Across Route 5 at Station 1581+30	5/1/2013
City of Burbank-W 16" concrete cyl pipe with 24" steel tubing	Across Route 5 at Station 1581+30	5/1/2013
City of Burbank-W 24" CI pipe	Across Route 5 along Empire Ave.	5/1/2013
City of Burbank-W 24" DIP Water	Relocation of Water & Sewer at various locations via Jack&Bore Crossing railroad right of way	8/1/2014
City of Burbank-W 12" Recycled Water	Crossing Route 5 at Empire Ave.	8/1/2014
Southern California Gas 12" M pipe and 12" H pipe	Along Empire Ave. crossing Route 5 and the railroad	5/1/2013
Pacific Pipe Line (plains All American) 8" Oil M in 12" casing	Along Empire Ave. crossing Route 5	2/22/2013
Southern California Gas 4" line	Along Empire Ave to Victory Place	11/1/2013
Southern California Gas 4" M line	Along Empire Ave to Victory Place	5/1/2013
Sprint Relocation of Fiber Optics into 8"&12" Steel Casing	Along the railroad right of way	9/22/2013
Qwest Relocation of Fiber Optics into 8"&12" Steel Casing	Along the railroad right of way	9/22/2013
Sprint Fiber Optic in 16" casing	Across Route 5 SCRRA	9/22/2013
City of Burbank-D/T 35.5 KV Underground Electric	Along Empire Ave. crossing Route 5 and the railroad	8/1/2013
AT&T/Sprint Relocation of Fiber Optics via Jack&Bore at 2 locations underneath SCRRA R/W; 6-4" ducts in a 16" steel casing	Crossing the railroad right of way	2/1/2013
AT&T/Sprint Relocation of Fiber Optics along Empire Ave	Crossing the railroad right of way	2/1/2013
Southern California Gas 4" pipe	Along Victory Place near Lincoln St.	2/1/2013

Southern California Gas 6" pipe	Along Victory Place near Lincoln St.	2/1/2013
Southern California Gas 12" M pipe	Along Victory Place near Lincoln St.	2/1/2013
City of Burbank-T Several Power poles/Electrolier	San Fernando Road	2/1/2013
City of Burbank-W 18" CI Water	Crossing Railroad ROW	5/1/2013
Southern California Gas-2" pipe	Along Buena Vista St	2/1/2013
MCI, now Verizon bussiness 4" fiber optic conduit	Across the railroad to Winona Ave.	2/1/2013
Charter Communication Overhead cable	Across the railroad to Winona Ave.	2/1/2013
City of Burbank-D Overhead distribution	Across the railroad to Winona Ave.	2/1/2013
City of Burbank-W 24" CI pipe with concrete encasement	Across Route 5 near Station 1665+70	2/1/2013
City of Burbank-S 8" PVC	Empire Ave.	5/1/2013
City of Burbank-S 14" PVC	Empire Ave.	5/1/2013
City of Burbank-S 14" VCP	Empire Ave.	5/1/2013
City of Burbank-S 15" VCP	Empire Ave.	5/1/2013
City of Burbank-D Electrical underground	Empire Ave.	5/1/2013
City of Burbank-W 24" CI pipe	Near Ontario	2/1/2013
City of Burbank-S 8" PVC Sewer	Ontario	2/1/2013

Installation of the utilities shown in the following table requires coordination with your activities. Make the necessary arrangements with the utility company through the Engineer and submit a schedule:

1. Verified by a representative of the utility company
2. Allowing at least the time shown for the utility owner to complete its work

Utility Relocation and Contractor-Arranged Time for the Relocation

Utility	Utility Address	Location	Days
1,350 ft. 24" DIP Water	City of Burbank 333 East Olive Ave. Burbank, CA 91510-6459	Empire Avenue crossing Victory Place/SCRRA/Route 5/San Fernando	30 days
12" Recycled Water	City of Burbank 333 East Olive Ave. Burbank, CA 91510- 6459	Empire Avenue crossing Victory Place/SCRRA/Route 5/San Fernando	30 days

The utilities shown in the following table may interfere with pile driving, drilling activities, or subsurface construction, but the utility owner will not rearrange them. If you want any of them rearranged or temporarily deactivated, make arrangements with the utility owner.

Utilities Not Rearranged for Pile Driving, Drilling Activities, or Subsurface Construction

Utility	Location
48"RCP City of Burbank (Storm Drain)	Along Victory Place and south of railroad track and next to two fiber optics
Southern California Gas-12" M Pipeline	Along Empire Ave.
Southern California Gas-12-3/4" M pipeline	Along Empire Ave.

5-1.24 RAILROAD FACILITIES (INCLUDING UTILITIES)

Installation of the railroad utilities shown in the following table requires coordination with your activities. Make the necessary arrangements with the utility company through the Engineer and submit a schedule:

1. Verified by a representative of the utility company
2. Allowing at least the time shown for the utility owner to complete its work

Railroad Utility Relocation and Contractor-Arranged Time for the Relocation

Utility	Utility Address	Location	Days
Exist 26" Abnd SC Gas	9400 Oakdale Ave Chatsworth, CA 91311	UGPa 1, Plan Sheet RR-U-005	06/01/2012
Exist FO Sprint Line	Tibor Laky 2592 Dupont Dr Irvine, CA 92612	UGPa 2, Plan Sheet RR-U-005	09/22/2013
Exist 24" CI Water Line	City of Burbank Water & Power Bassil Nahhas P.O. Box 631 Burbank, CA 91503	UGP 6, Plan Sheet RR-U-007	11/15/2012
Exist to ATT Telephone Line	ATT Erick Javier 271 N. Carmelo Ave Pasadena, CA 91107	UGP 7, Plan Sheet RR-U-007	12/15/2012
Exist FO MCI Telephone Line	MCI Ded Boyers 2400 N. Glenville Richardson, TX 75082	UGP 8, Plan Sheet RR-U-007	12/01/2012
Exist ATT (Former SBC) Telephone Line	ATT Erick Javier 271 N. Carmelo Ave Pasadena, CA 91107	UGP 15, Plan Sheet RR-U-007	12/15/2012
Overhead Electrical Line	City of Burbank Water & Power Daniel Lippert P.O. Box 631 Burbank, CA 91503	OHP 1, Plan Sheet RR-U-007	12/15/2012
Overhead Electrical Line	City of Burbank Water & Power Daniel Lippert P.O. Box 631 Burbank, CA 91503	OHP 2, Plan Sheet RR-U-007	11/15/2012
Overhead Electrical Line	City of Burbank Water & Power Daniel Lippert P.O. Box 631 Burbank, CA 91503	OHP 5a, Plan Sheet RR-U-009	12/15/2012
Overhead Electrical Line	City of Burbank Water & Power Daniel Lippert P.O. Box 631 Burbank, CA 91503	OHP 5b, Plan Sheet RR-U-009	12/15/2012
Overhead Electrical Line	City of Burbank Water & Power Daniel Lippert P.O. Box 631 Burbank, CA 91503	OHP 6a-6c and OHP 6e – 6g, Plan Sheet RR-U-012	12/15/2012

Overhead Charter TV Cable	Charter Communication Ed Guzman 3111 Winon Ave Burbank, CA 91504	OHP 6b, Plan Sheet RR-U-012	12/15/2012
Overhead City Electrical Line	City of Burbank Water & Power Daniel Lippert P.O. Box 631 Burbank, CA 91503	OHP 7a, 7b, 7e – 7g, Plan Sheet RR-U-014	12/15/2012
Overhead Time Warner Cable	Time Warner Cable Wenefrido Ugalde 6357 Arizona Circle Westchester	OHP 7c – 7d, Plan Sheet RR-U-014	12/15/2012
Overhead City Electrical Lines	City of Burbank Water & Power Daniel Lippert P.O. Box 631 Burbank, CA 91503	OHP 8a – 8c, Plan Sheet RR-U-014	12/15/2012
Proposed Sprint Fiber Optic Line	Sprint Tibor Laky 2592 Dupont Dr Irvine, CA 92612	Plant Sheet RR-U-017	09/22/2013

The utilities shown in the following table may interfere with pile driving, drilling activities, or subsurface construction, but the utility owner will not rearrange them. If you want any of them rearranged or temporarily deactivated, make arrangements with the utility owner.

Railroad Utilities Not Rearranged for Pile Driving, Drilling Activities, or Subsurface Construction

Utility	Location
Exist 16" Conc Water Line	UGP 23, Plan Sheet RR-U-004
Exist 24" VCP Sanitary Sewer	UGP 21, Plans Sheet RR-U-005
Exist 18" RCP Storm Drain	UGP 10, Plans Sheet RR-U-009
Exist 4' x 2.5' RC Box Culvert Storm Drain	UGP 12, Plans Sheet RR-U-010
Exist 6" SC GAS	UGP 14, Plan Sheet RR-U-011

5-1.25 DAMAGE REPAIR

Attention is directed to Section 7-1.16, "Contractor's Responsibility for the Work and Materials," and Section 7-1.165, "Damage by Storm, Flood, Tsunami or Earthquake," of the Standard Specifications and these special provisions.

When as a result of freezing conditions (as defined herein) during the plant establishment period, plants have died or, in the opinion of the Engineer, have deteriorated to a point beyond which the plants will not mature as typical examples of their species, the Engineer may direct replacement of the affected plants. The total cost of ordered plant replacement work will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. A freezing condition, for the purpose of this specification, occurs when the temperature at or near the affected area has been officially recorded below 32° F and plants have been killed or damaged to the degree described above.

When, as a result of drought conditions (as defined herein) during the plant establishment period, plants have died or, in the opinion of the Engineer, have deteriorated to a point beyond which the plants will not mature as typical examples of their species, the Engineer may direct replacement of the affected plants. The total cost of ordered plant replacements, after water has been restricted or stopped, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. Restriction or shutoff of available water shall not relieve the Contractor from performing other contract work. A drought condition occurs when the Department, or its supplier, restricts or stops delivery of water to the Contractor to the degree that plants have died or deteriorated as described above.

When the provisions in Section 7-1.165, "Damage by Storm, Flood, Tsunami or Earthquake," of the Standard Specifications are applicable, the provisions above for payment of costs for repair of damage due to rain, freezing conditions and drought shall not apply.

5-1.26 RELIEF FROM MAINTENANCE AND RESPONSIBILITY

The Contractor may be relieved of the duty of maintenance and protection for those items not directly connected with plant establishment work in conformance with the provisions in Section 7-1.15, "Relief From Maintenance and Responsibility," of the Standard Specifications. Water pollution control, maintain existing planted areas, maintain existing irrigation facilities, transplant trees, and transplant palm trees shall not be relieved of maintenance.

5-1.27 TUNNEL SAFETY ORDERS

The work to be performed at the following location where a 60" diameter steel casing to accommodate approximately 338 feet of carrier pipes to install by jack and bore method under Route 5 north of the intersection of Victory Place and Empire Avenue has been classified "Potentially Gassy" by the State Division of Occupational Safety and Health under Section 8422 of the Tunnel Safety Orders of the California Code of Regulations.

The Contractor's attention is directed to Section 7-1.06, "Safety and Health Provisions," of the Standard Specifications. A change to the work as a direct result of the Contractor's planned operations that would cause work activities to fall under the requirements of the Tunnel Safety Orders, and that has not been shown on the plans or specified in these special provisions shall be reason for suspension of the work. The Contractor shall notify the Engineer not less than 20 days prior to worker exposure to a facility meeting the definition of a tunnel or shaft as described in Sections 8403 or 8405 of the Tunnel Safety Orders. The Department will obtain additional location classifications as may be necessary to allow the work to proceed.

The Contractor shall prominently post a notice of the classification and any special orders, rules, special conditions, or regulations at the tunnel work site, and all personnel shall be informed of the classification.

At least 7 days prior to beginning work covered by these provisions, the Contractor shall submit the name of the person designated as the on-site Safety Representative to the Engineer along with proof of certification by the Division of Occupational Safety and Health as having met the requirements of Section 8406 of the Tunnel Safety Orders of the California Code of Regulations.

SECTION 6. (BLANK)

SECTION 7. (BLANK)

SECTION 8. MATERIALS

SECTION 8-1. MISCELLANEOUS

8-1.01 PREQUALIFIED AND TESTED SIGNING AND DELINEATION MATERIALS

The Department maintains the following list of Prequalified and Tested Signing and Delineation Materials. The Engineer shall not be precluded from sampling and testing products on the list of Prequalified and Tested Signing and Delineation Materials.

The manufacturer of products on the list of Prequalified and Tested Signing and Delineation Materials shall furnish the Engineer a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each type of traffic product supplied.

For those categories of materials included on the list of Prequalified and Tested Signing and Delineation Materials, only those products shown within the listing may be used in the work. Other categories of products, not included on the list of Prequalified and Tested Signing and Delineation Materials, may be used in the work provided they conform to the requirements of the Standard Specifications.

Materials and products may be added to the list of Prequalified and Tested Signing and Delineation Materials if the manufacturer submits a New Product Information Form to the New Product Coordinator at the Transportation Laboratory. Upon a Departmental request for samples, sufficient samples shall be submitted to permit performance of required tests. Approval of materials or products will depend upon compliance with the specifications and tests the Department may elect to perform.

PAVEMENT MARKERS, PERMANENT TYPE

Retroreflective With Abrasion Resistant Surface (ARS)

("length along the direction of travel" x "marker width")

1. Apex, Model 921AR (4" x 4")
2. Ennis Paint, Models C88 (4" x 4"), 911 (4" x 4") and C80FH (3.1" x 4.5")
3. Ray-O-Lite, Models "AA" ARC II (4" x 4") and ARC Round Shoulder (4" x 4")

4. 3M Series 290 (3.5" x 4")
5. 3M Series 290 PSA
6. Glowlite, Inc Model 988AR (4" x 4")

Retroreflective With Abrasion Resistant Surface (ARS)

(for recessed applications only)

1. Ennis Paint, Model 948 (2.3" x 4.7")
 2. Ennis Paint, Model 944SB (2" x 4")*
 3. Ray-O-Lite, Model 2002 (2" x 4.6")
 4. Ray-O-Lite, Model 2004 (2" x 4")*
- *For use only in 4.5 inch wide (older) recessed slots

Non-Reflective, 4-inch Round

1. Apex Universal (Ceramic)
2. Apex Universal, Models 929 (ABS) and 929PP (Polypropylene)
3. Glowlite, Inc. (Ceramic) and PP (Polypropylene)
4. Hi-Way Safety, Inc., Models P20-2000W and 2001Y (ABS)
5. Interstate Sales, "Diamond Back" (Polypropylene)
6. Novabrite Models Cdot (White) Cdot-y (Yellow), Ceramic
7. Novabrite Models Pdot-w (White) Pdot-y (Yellow), Polypropylene
8. Three D Traffic Works TD10000 (ABS), TD10500 (Polypropylene)
9. Ray-O-Lite, Ray-O-Dot (Polypropylene)

PAVEMENT MARKERS, TEMPORARY TYPE

Temporary Markers For Long Term Day/Night Use (180 days or less)

1. Vega Molded Products "Temporary Road Marker" (3" x 4")
2. Pexco LLC, Halftrack model 25, 26 and 35

Temporary Markers For Short Term Day/Night Use (14 days or less)

(For seal coat or chip seal applications, clear protective covers are required)

1. Apex Universal, Model 932
2. Pexco LLC, Models T.O.M., T.R.P.M., and "HH" (High Heat)
3. Hi-Way Safety, Inc., Model 1280/1281
4. Glowlite, Inc., Model 932

STRIPING AND PAVEMENT MARKING MATERIAL

Permanent Traffic Striping and Pavement Marking Tape

1. Advanced Traffic Marking, Series 300 and 400
2. Brite-Line, Series 1000
3. Brite-Line, "DeltaLine XRP"
4. Swarco Industries, "Director 35" (For transverse application only)
5. Swarco Industries, "Director 60"
6. 3M, "Stamark" Series 380 and 270 ES
7. 3M, "Stamark" Series 420 (For transverse application only)

Temporary (Removable) Striping and Pavement Marking Tape (180 days or less)

1. Advanced Traffic Marking, Series 200
2. Brite-Line, "Series 100", "Deltaline TWR"
3. Garlock Rubber Technologies, Series 2000
4. P.B. Laminations, Aztec, Grade 102
5. Swarco Industries, "Director-2", "Director 2-Wet Reflective"
6. Trelleborg Industries, R140 Series
7. 3M Series 620 "CR", Series 780 and Series 710
8. 3M Series A145, Removable Black Line Mask
(Black Tape: for use only on Hot mix asphalt surfaces)
9. Advanced Traffic Marking Black "Hide-A-Line"
(Black Tape: for use only on Hot mix asphalt surfaces)

10. Brite-Line "BTR" Black Removable Tape
(Black Tape: for use only on Hot mix asphalt surfaces)
11. Trelleborg Industries, RB-140
(Black Tape: for use only on Hot mix asphalt surfaces)

Preformed Thermoplastic (Heated in place)

1. Flint Trading Inc., "Hot Tape"
2. Flint Trading Inc., "Premark Plus"
3. Flint Trading Inc., "Flametape"

Ceramic Surfacing Laminate, 6" x 6"

1. Highway Ceramics, Inc.

CLASS 1 DELINEATORS

One Piece Driveable Flexible Type, 66-inch

1. Pexco LLC, "Flexi-Guide Models 400 and 566"
2. Carsonite, Curve-Flex CFRM-400
3. Carsonite, Roadmarker CRM-375
4. FlexStake, Model 654 TM
5. GreenLine Model CGD1-66

Special Use Type, 66-inch

1. Pexco LLC, Model FG 560 (with 18-inch U-Channel base)
2. Carsonite, "Survivor" (with 18-inch U-Channel base)
3. Carsonite, Roadmarker CRM-375 (with 18-inch U-Channel base)
4. FlexStake, Model 604
5. GreenLine Model CGD (with 18-inch U-Channel base)
6. Impact Recovery Model D36, with #105 Driveable Base
7. Safe-Hit with 8-inch pavement anchor (SH248-GP1)
8. Safe-Hit with 15-inch soil anchor (SH248-GP2) and with 18-inch soil anchor (SH248-GP3)
9. Safe-Hit RT 360 Post with Soil Mount Anchor (GPS)
10. Shur-Tite Products, Shur-Flex Drivable

Surface Mount Type, 48-inch

1. Bent Manufacturing Company, Masterflex Model MFEX 180-48
2. Carsonite, "Channelizer"
3. FlexStake, Models 704, 754 TM, and EB4
4. Impact Recovery Model D48, with #101 Fixed (Surface-Mount) Base
5. Three D Traffic Works "Channelflex" ID No. 522248W
6. Flexible Marker Support, Flexistiff Model C-9484
7. Safe-Hit, SH 248 SMR

CHANNELIZERS

Surface Mount Type, 36-inch

1. Bent Manufacturing Company, Masterflex Models MF-360-36 (Round) MF-180-36 (Flat) and MFEX 180—36
2. Pexco LLC, Flexi-Guide Models FG300PE, FG300UR, and FG300EFX
3. Carsonite, "Super Duck" (Round SDR-336)
4. Carsonite, Model SDCF03601MB "Channelizer"
5. FlexStake, Models 703, 753 TM, and EB3
6. GreenLine, Model SMD-36
7. Hi-way Safety, Inc. "Channel Guide Channelizer" Model CGC36
8. Impact Recovery Model D36, with #101 Fixed (Surface-Mount) Base
9. Safe-Hit, Guide Post, Model SH236SMA and Dura-Post, Model SHL36SMA
10. Three D Traffic Works "Boomerang" 5200 Series
11. Flexible Marker Support, Flexistiff Model C-9484-36
12. Shur-Tite Products, Shur-Flex

Lane Separation System

1. Pexco LLC, "Flexi-Guide (FG) 300 Curb System"
2. Qwick Kurb, "Klemmfix Guide System"
3. Dura-Curb System
4. Tuff Curb
5. FG 300 Turnpike Curb
6. Shur-Tite Products, SHUR-Curb , Model No. SF0200

CONICAL DELINEATORS, 42-inch

(For 28-inch Traffic Cones, see Standard Specifications)

1. Bent Manufacturing Company "T-Top", TDSC Series
2. Plastic Safety Systems "Navigator-42"
3. Traffix Devices "Grabber"
4. Three D Traffic Works "Ringtop" TD7000, ID No. 742143
5. Three D Traffic Works, TD7500
6. Work Area Protection Corp. C-42
7. Custom-Pak 4600 (Part No. 93005-0001)
8. Plasticade, Navicade, 650 R1

OBJECT MARKERS

Type "K", 18-inch

1. Pexco LLC, Model FG318PE
2. Carsonite, Model SMD 615
3. FlexStake, Model 701 KM
4. Safe-Hit, Model SH718SMA

Type "Q" Object Markers, 24-inch

1. Bent Manufacturing "Masterflex" Model MF-360-24
2. Pexco LLC, Model FG324PE
3. Carsonite, "Channelizer"
4. FlexStake, Model 701KM
5. Safe-Hit, Models SH824SMA_WA and SH824GP3_WA
6. Three D Traffic Works ID No. 531702W and TD 5200
7. Three D Traffic Works ID No. 520896W
8. Safe-Hit, Dura-Post SHLQ-24"
9. Flexible Marker Support, IMC 9484-24

CONCRETE BARRIER MARKERS AND TEMPORARY RAILING (TYPE K) REFLECTORS

Impactable Type

1. ARTUK, "FB"
2. Pexco LLC, Models PCBM-12 and PCBM-T12, PCBM 912
3. Duraflex Corp., "Flexx 2020" and "Electriflexx"
4. Hi-Way Safety, Inc., Model GMKRM100
5. Plastic Safety Systems "BAM" Models OM-BARR and OM-BWAR
6. Three D Traffic Works "Roadguide" Model TD 9300

Non-Impactable Type

1. ARTUK, JD Series
2. Plastic Safety Systems "BAM" Models OM-BITARW and OM-BITARA
3. Vega Molded Products, Models GBM and JD
4. Plastic Vacuum Forming, "Cap-It C400"

METAL BEAM GUARD RAIL POST MARKERS

(For use to the left of traffic)

1. Pexco LLC, "Mini" (3" x 10"), I-Flex
2. Creative Building Products, "Dura-Bull, Model 11201"
3. Duraflex Corp., "Railrider"
4. Plastic Vacuum Forming, "Cap-It C300"

CONCRETE BARRIER DELINEATORS, 16-inch

(For use to the right of traffic)

1. Pexco LLC, Model PCBM T-16
2. Safe-Hit, Model SH216RBM
3. Three D Traffic Works "Roadguide" Model 9400

CONCRETE BARRIER-MOUNTED MINI-DRUM (10" x 14" x 22")

1. Stinson Equipment Company "SaddleMarker"

GUARD RAILING DELINEATOR

(Place top of reflective element at 48 inches above plane of roadway)

Wood Post Type, 27-inch

1. Pexco LLC, FG 427 and FG 527
2. Carsonite, Model 427
3. FlexStake, Model 102 GR
4. GreenLine GRD 27
5. Safe-Hit, Model SH227GRD
6. Three D Traffic Works "Guardflex" TD9100
7. New Directions Mfg, NDM27
8. Shur-Tite Products, Shur-Tite Flat Mount
9. Glasforms, Hiway-Flex, GR-27-00

Barrier, Guardrail Visibility Enhancement

1. UltraGuard Safety System, Potters Industries, Inc.

Steel Post Type

1. Carsonite, Model CFGR-327

RETROREFLECTIVE SHEETING

Channelizers, Barrier Markers, and Delineators

1. Avery Dennison T-6500 Series (For rigid substrate devices only)
2. Avery Dennison WR-7100 Series
3. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
4. Reflexite, PC-1000 Metalized Polycarbonate
5. Reflexite, AC-1000 Acrylic
6. Reflexite, AP-1000 Metalized Polyester
7. Reflexite, Conformalight, AR-1000 Abrasion Resistant Coating
8. 3M, High Intensity

Traffic Cones, 4-inch and 6-inch Sleeves

1. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
2. Reflexite, Vinyl, "TR" (Semi-transparent) or "Conformalight", C85
3. 3M Series 3840, Series 3340
4. Avery Dennison S-9000C

Drums

1. Avery Dennison WR-6100
2. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II

3. Reflexite, "Conformalight", "Super High Intensity" or "High Impact Drum Sheeting"
4. 3M Series 3810

Barricade Sheeting: Type I, Medium-Intensity (Typically Enclosed Lens, Glass-Bead Element)

1. Nippon Carbide Industries, CN8117
2. Avery Dennison, W 1100 series
3. 3M Series CW 44

Barricade Sheeting: Type II, Medium-High-Intensity (Typically Enclosed Lens, Glass-Bead Element)

1. Avery Dennison, W-2100 Series

Barricade Sheeting: Type IV, High Intensity (Typically Unmetalized Microprismatic Retroreflective Element)

1. 3M Series 3334/3336

Vertical Clearance Signs: Structure Mounted

1. 3M Model 4061, Diamond Grade DG3, Fluorescent Yellow

Signs: Type II, Medium-High-Intensity (Typically Enclosed Lens, Glass-Bead Element)

1. Avery Dennison, T-2500 Series
2. Nippon Carbide Industries, Nikkalite 18000

Signs: Type III, High-Intensity (Typically Encapsulated Glass-Bead Element)

1. Avery Dennison, T-5500A and T-6500 Series
2. Nippon Carbide Industries, Nikkalite Brand Ultralite Grade II
3. 3M 3870 and 3930 Series
4. Changzhou Hua R Sheng, Series TM 1200
5. Oracal, Oralite Series 5800

Signs: Type IV, High-Intensity (Typically Unmetallized Microprismatic Element)

1. Avery Dennison, T-6500 Series
2. Nippon Carbide Industries, Crystal Grade, 94000 Series
3. Nippon Carbide Industries, Model No. 94847 Fluorescent Orange
4. 3M Series 3930 and Series 3924S

Signs: Type VI, Elastomeric (Roll-Up) High-Intensity, without Adhesive

1. Avery Dennison, WU-6014
2. Novabrite LLC, "Econobrite"
3. Reflexite "Vinyl"
4. Reflexite "SuperBright"
5. Reflexite "Marathon"
6. 3M Series RS20

Signs: Type VIII, Super-High-Intensity (Typically Unmetallized Microprismatic Element)

1. Avery Dennison, T-7500 Series
2. Avery Dennison, T-7511 Fluorescent Yellow
3. Avery Dennison, T-7513 Fluorescent Yellow Green
4. Avery Dennison, W-7514 Fluorescent Orange
5. Nippon Carbide Industries, Nikkalite Crystal Grade Series 92800
6. Nippon Carbide Industries, Nikkalite Crystal Grade Model 92847 Fluorescent Orange

Signs: Type IX, Very-High-Intensity (Typically Unmetallized Microprismatic Element)

1. 3M VIP Series 3981 Diamond Grade Fluorescent Yellow
2. 3M VIP Series 3983 Diamond Grade Fluorescent Yellow/Green
3. 3M VIP Series 3990 Diamond Grade
4. Avery Dennison T-9500 Series

5. Avery Dennison, T9513, Fluorescent Yellow Green
6. Avery Dennison, W9514, Fluorescent Orange
7. Avery Dennison, T-9511 Fluorescent Yellow

Signs: Type XI, Very High Intensity (Typically Unmetallized Microprismatic Element)

1. 3M Diamond Grade, DG3, Series 4000
2. 3M Diamond Grade, DG3, Series 4081, Fluorescent Yellow
3. 3M Diamond Grade, DG3, Series 4083, Fluorescent Yellow/Green
4. 3M Diamond Grade, DG3, Series 4084, Fluorescent Orange
5. Avery Dennison, OmniCube, T-11500 Series
6. Avery Dennison, OmniCube, T-11511, Fluorescent Yellow
7. Avery Dennison, OmniCube, T-11513, Fluorescent Yellow Green
8. Avery Dennison, OmniCube, W-11514 Fluorescent Orange

SPECIALTY SIGNS

1. Reflexite "Endurance" Work Zone Sign (with Semi-Rigid Plastic Substrate)

ALTERNATIVE SIGN SUBSTRATES

Fiberglass Reinforced Plastic (FRP) and Expanded Foam PVC

1. Fiber-Brite (FRP)
2. Sequentia, "Polyplate" (FRP)
3. Inteplast Group "InteCel" (0.5 inch for Post-Mounted CZ Signs, 48-inch or less)(PVC)

Aluminum Composite, Temporary Construction Signs and Permanent Signs up to 4 foot, 7 Inches

1. Alcan Composites "Dibond Material, 80 mils"
2. Mitsubishi Chemical America, Alpolic 350
3. Bone Safety Signs, Bone Light ACM (temporary construction signs only)
4. Kommerling, USA, KomAlu 3 mm

8-1.02 STATE-FURNISHED MATERIALS

The State furnishes you with:

- Loop detector sensor units
- Model 2070 and 170E controller assemblies, including controller unit, completely wired controller cabinet, and detector sensor units
- Model 2070-6B Modems
- Components of battery backup system as follows:

Inverter/charger unit
 Power transfer relay
 Manually-operated bypass switch
 Battery harness
 Utility interconnect wires
 Battery temperature probe
 Relay contact wires

- Components of railroad signaling equipments and warning devices:
 1. 8 foot x 10 foot Prewired Main Crossing House for Roadway/ Pedestrian Crossing. Batteries Included.
 2. 10 foot x 10 foot Prewired North East End of Siding House for CP Hollywood. Batteries Included.
 3. (8) Safetran S-40 Gate Complete with 5 inch x 16 foot Mast, Split (clamp) Base, S-40 Gate
 4. Mechanism with Hardware, 2-way flasher assembly, Complete Gate Assembly,
 5. Electronic Bell, Cross bucks, Pedestrian Crossing Sign and Hardware (see Standard 8309).
 6. Adjust Wind guard, and 60 inch foundation.
 7. (2) 6 foot x 6 foot Prewired House for Intermediate Single Track. Batteries Included.
 8. 6 foot x 6 foot Prewired House for Intermediate Double Track. Batteries Included.
 9. M-23A Switch Machine and #24 LH Layout.

The State furnishes you with completely wired controller cabinets with auxiliary equipment and controller unit for ramp metering systems and traffic monitoring stations at the Department of Transportation, District Maintenance Yard at 7310 East Bandini Boulevard, Commerce, CA 90040. At least 48 hours before you pick up the materials, inform the Engineer what you will pick up and when you will pick it up.

The State furnishes you with components of railroad signaling equipments and warning devices at SCRRA Free On Board (F.O.B.) Contractor's trucks at 186 University Parkway, Pomona, CA 91768. At least 48 hours before you pick up the materials, inform the Engineer what you will pick up and when you will pick it up.

8-1.03 SLAG AGGREGATE

Air-cooled iron blast furnace slag shall not be used to produce aggregate for:

1. Structure backfill material.
2. Pervious backfill material.
3. Permeable material.
4. Reinforced or prestressed portland cement concrete component or structure.
5. Nonreinforced portland cement concrete component or structure for which a Class 1 Surface Finish is required by the provisions in Section 51-1.18B, "Class 1 Surface Finish," of the Standard Specifications.

Aggregate produced from slag resulting from a steel-making process shall not be used for a highway construction project except for the following items:

1. Imported Borrow.
2. Aggregate Subbase.
3. Class 2 Aggregate Base.
4. Hot Mix Asphalt.

Steel slag to be used to produce aggregate for aggregate subbase and Class 2 aggregate base shall be crushed so that 100 percent of the material will pass a 3/4-inch sieve and then shall be control aged for a period of at least 3 months under conditions that will maintain all portions of the stockpiled material at a moisture content in excess of 6 percent of the dry weight of the aggregate.

A supplier of steel slag aggregate shall provide separate stockpiles for controlled aging of the slag. An individual stockpile shall contain not less than 10,000 tons nor more than 50,000 tons of slag. The material in each individual stockpile shall be assigned a unique lot number and each stockpile shall be identified with a permanent system of signs. The supplier shall maintain a permanent record of the dates on which stockpiles are completed and controlled aging begun, of the dates when controlled aging was completed, and of the dates tests were made and the results of these tests. Moisture tests shall be made at least once each week. No credit for aging will be given for the time period covered by tests which show a moisture content of 6 percent or less. The stockpiles and records shall be available to the Engineer during normal working hours for inspection, check testing and review.

The supplier shall notify the Transportation Laboratory when each stockpile is completed and controlled aging begun. No more aggregate shall be added to the stockpile unless a new aging period is initiated. A further notification shall be sent when controlled aging is completed.

The supplier shall provide a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. Each stockpile or portion of a stockpile that is used in the work will be considered a lot. The Certificates of Compliance shall state that the steel slag aggregate has been aged in a stockpile for at least 3 months at a moisture content in excess of 6 percent of the dry weight of the aggregate.

Steel slag used for imported borrow shall be weathered for at least 3 months. Prior to the use of steel slag as imported borrow, the supplier shall furnish a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall state that the steel slag has been weathered for at least 3 months.

Each delivery of aggregate containing steel slag for use as aggregate subbase or Class 2 aggregate base shall be accompanied by a delivery tag for each load which will identify the lot of material by stockpile number, where the slag was aged, and the date that the stockpile was completed and controlled aging begun.

Air-cooled iron blast furnace slag or natural aggregate may be blended in proper combinations with steel slag aggregate to produce the specified gradings, for those items for which steel slag aggregate is permitted, unless otherwise provided.

Aggregate containing slag shall meet the applicable quality requirements for the items in which the aggregate is used.

The combined slag aggregate shall conform to the specified grading for the item in which it is used. The grading will be determined by California Test 202, modified by California Test 105 when there is a difference in specific gravity of 0.2 or more between the coarse and fine portion of the aggregate or between blends of different aggregates.

No aggregate produced from slag shall be placed within one foot, measured in any direction, of a non-cathodically protected pipe or structure unless the aggregate is incorporated in portland cement concrete pavement, in hot mix asphalt, or in treated base.

When slag is used as aggregate in hot mix asphalt, the K_C factor requirements, as determined by California Test 303, will not apply.

When slag aggregate is used for imported borrow, a layer of not less than 1 foot of topsoil, measured after compaction, shall be placed over the slag aggregate in areas where highway planting is to be performed. In other areas, slag aggregate used for embankment construction shall not be placed within 18 inches of finished slope lines, measured normal to the plane of the slope. Full compensation for furnishing and placing topsoil and cover, as provided herein, shall be considered as included in the contract price paid per cubic yard for imported borrow and no additional compensation will be allowed therefor.

If steel slag aggregates are used to make hot mix asphalt, there shall be no other aggregates used in the mixture, except that up to 50 percent of the material passing the No. 4 sieve may consist of iron blast furnace slag aggregates or natural aggregates, or a combination thereof. If iron blast furnace aggregates or natural aggregates or a combination thereof are used in the mix, each type of aggregate shall be fed to the drier at a uniform rate. The rate of feed of each type of aggregate shall be maintained within 10 percent of the amount set. Adequate means shall be provided for controlling and checking the accuracy of the feeder.

Steel slag aggregate shall be stored separately from iron blast furnace slag aggregate and each type of slag aggregate shall also be stored separately from natural aggregate.

Hot mix asphalt produced from more than one of the following shall not be placed in the same layer: steel slag aggregates, iron blast furnace slag aggregates, natural aggregates or any combination thereof. Once a type of aggregate or aggregates is selected, it shall not be changed without prior approval by the Engineer.

If steel slag aggregates are used to produce hot mix asphalt, and if the specific gravity of a compacted stabilometer test specimen is in excess of 2.40, the quantity of hot mix asphalt to be paid for will be reduced. The stabilometer test specimen will be fabricated in conformance with the procedures in California Test 304 and the specific gravity of the specimen will be determined in conformance with Method C of California Test 308. The pay quantity of hot mix asphalt will be determined by multiplying the quantity of hot mix asphalt placed in the work by 2.40 and dividing the result by the specific gravity of the compacted stabilometer test specimen. Such reduction in quantity will be determined and applied as often as is necessary to ensure accurate results as determined by the Engineer.

8-1.04 FILTER FABRIC

Filter fabric for retaining walls must be Class A as specified in Section 88-1.02, "Filtration," of the Standard Specifications.

SECTION 8-2. CONCRETE

8-2.01 PORTLAND CEMENT CONCRETE

Portland cement concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions.

STRENGTH DEVELOPMENT TIME

The time allowed to obtain the minimum required compressive strength as specified in Section 90-1.01, "Description," of the Standard Specifications will be 56 days when the Contractor chooses cementitious material that satisfies the following equation:

$$\frac{(41 \times UF) + (19 \times F) + (11 \times SL)}{TC} \geq 7.0$$

Where:

- F = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N, including the amount in blended cement, pounds per cubic yard. F is equivalent to the sum of FA and FB as defined in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications
- SL = GGBFS, including the amount in blended cement, pounds per cubic yard
- UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard
- TC = Total amount of cementitious material used, pounds per cubic yard

For concrete satisfying the equation above, the Contractor shall test for the modulus of rupture or compressive strength specified for the concrete involved, at least once every 500 cubic yards, at 28, 42, and 56 days. The Contractor shall submit test results to the Engineer and the Transportation Laboratory, Attention: Office of Concrete Materials.

SUPPLEMENTARY CEMENTITIOUS MATERIALS

The Contractor may use rice hull ash as a supplementary cementitious material (SCM) to make minor concrete. Rice hull ash shall conform to the requirements in AASHTO Designation: M 321 and the following chemical and physical requirements:

Chemical Requirements	Percent
Silicon Dioxide (SiO ₂) ^a	90 min.
Loss on ignition	5.0 max.
Total Alkalies (as Na ₂ O) equivalent	3.0 max.

Physical Requirements	Percent
Particle size distribution	
Less than 45 microns	95
Less than 10 microns	50
Strength Activity Index with portland cement ^b	
7 days	95 (minimum % of control)
28 days	110 (minimum % of control)
Expansion at 16 days when testing job materials in conformance with ASTM C 1567 ^c	0.10 max.
Surface Area when testing by nitrogen adsorption in conformance with ASTM D 5604	40.0 m ² /g min.

Notes:

^a A maximum of 1.0% of the SiO₂ may exist in crystalline form.

^b When tested in conformance with the requirements for strength activity testing of silica fume in AASHTO Designation: M 307

^c In the test mix, Type II or Type V portland cement shall be replaced with at least 12% RHA by weight.

For the purposes of calculating cementitious material requirements in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications and these special provisions, rice hull ash is considered to be represented by the variable *UF*.

8-2.02 RAPID STRENGTH CONCRETE FOR RAILROAD STRUCTURES

GENERAL

Summary

This section includes specifications for rapid strength concrete (RSC) for railroad structures. You may only use RSC when specified elsewhere in these special provisions.

Definitions

Opening age: The age at which the concrete will achieve the specified strength for opening to public or construction traffic.

Submittals

Mix Design

Submit the RSC mix design at least 10 days before use. If a trial slab is required, submit the RSC mix design at least 10 days before constructing the trial slab. Include the following in the submittal:

1. Compressive strength test results for prequalification of RSC at age of break, at 3 days, and at 28 days
2. Opening age
3. Proposed aggregate grading
4. Mix proportions of cementitious material, aggregate, and water
5. Types and amounts of chemical admixtures, if used
6. Range of ambient temperatures over which the mix design will achieve the required minimum compressive strength
7. Source of materials

Volumetric Proportioning

When using volumetric proportioning, submit the following:

1. Aggregate moisture test results
2. Log of production data

Certificate of Compliance

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications with each delivery of aggregate, cementitious material, and admixtures used for calibration tests. Include certified copies of the weight of each delivery.

The Certificate of Compliance must state that the source of materials used for the calibration tests is from the same source as to be used for the planned work. The Certificate of Compliance must be signed by an authorized representative.

Quality Control and Assurance

Prequalification of RSC

Prequalification of a RSC mix design includes determining the opening age and achieving the minimum specified 28-day compressive strength.

Prequalify RSC under the specifications for prequalification of concrete specified by compressive strength in Section 90-9.01, "General," of the Standard Specifications. Determine the opening age as follows:

1. Fabricate at least 5 test cylinders to be used to determine the age of break.
2. Immediately after fabrication of the 5 test cylinders, store the cylinders in a temperature medium of 70 ± 3 °F until the cylinders are tested.
3. Determine the age of break to achieve an average strength of the 5 test cylinders of not less than 4000 psi. Not more than 2 test cylinders may have a strength of less than 4000 psi.
4. The opening age is the age of break plus 1 hour.

Weighmaster Certifications

Weighmaster certificates for RSC, regardless of the proportioning method used, must include all information necessary to trace the manufacturer and manufacturer's lot number for the cement being used. When proportioned into fabric containers, the weighmaster certificates for the cement must contain the date of proportioning, location of proportioning, and actual net draft weight of the cement. When proportioned at the job site from a storage silo, the weighmaster certificates must contain the date of proportioning, location of proportioning, and the net draft weight of the cement used in the load.

MATERIALS

General

RSC must comply with one of the following:

1. Concrete made with portland cement. The concrete must comply with Section 90, "Portland Cement Concrete," of the Standard Specifications. Type III cement may be used.

2. Concrete made with any cement that complies with the definition of hydraulic cement or blended hydraulic cement in ASTM C 219. The concrete must comply with Section 90, "Portland Cement Concrete," of the Standard Specifications, except that:

2.1. Cementitious material must comply with the following:

Test Description	Test Method	Requirement
Contraction in Air	California Test 527, w/c ratio = 0.39±0.010	0.053%, max.
Mortar Expansion in Water	ASTM C 1038	0.04%, max.
Soluble Chloride*	California Test 422	0.05%, max.
Soluble Sulfate*	California Test 417	0.30%, max.
Thermal Stability	California Test 553	90%, min.
Compressive Strength @ 3 days	ASTM C 109	2500 psi

*Test is to be done on a cube specimen fabricated in conformance with the requirements in ASTM C 109, cured at least 14 days, and then pulverized so that 100% passes the No. 50 sieve.

- 2.2. Citric acid or borax may be used if requested in writing by the cement manufacturer and a sample is submitted to the Engineer. Chemical admixtures, if used, must be included when testing for requirements listed in the table above.

RSC must have a minimum 28-day compressive strength of 3600 psi, except that RSC placed in bridge decks must have a minimum 28-day compressive strength of 4500 psi and must comply with the shrinkage limitations as specified for bridge deck concrete in Section 90-1.01, "Description," of the Standard Specifications.

Supplementary cementitious material is not required.

Penetration requirements of Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications do not apply.

CONSTRUCTION

General

RSC may be proportioned and placed by a volumetric mixer.

Volumetric Proportioning

RSC proportioned by a volumetric mixer must comply with the requirements specified herein.

Proportion liquid admixtures under Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures," of the Standard Specifications, except proportion liquid admixtures with a meter.

Batch-mixer trucks must proportion cement, water, aggregate, and additives by volume. Aggregate feeders must be connected directly to the drive on the cement vane feeder. The cement feed rate must be tied directly to the feed rate for the aggregate and other ingredients. Only change the ratio of cement to aggregate by changing the gate opening for the aggregate feed. The drive shaft of the aggregate feeder must have a revolution counter reading to the nearest full or partial revolution of the aggregate delivery belt.

Proportion aggregate with a belt feeder operated with an adjustable cutoff gate delineated to the nearest quarter increment. The gate opening height must be readily determinable. Proportion cement by any method that complies with the accuracy tolerance specifications. Proportion water with a meter under Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

Calibrate the cutoff gate for each batch-mixer truck used and for each aggregate source. Calibrate batch-mixer trucks at 3 different aggregate gate settings that are commensurate with production needs. Perform at least 2 calibration runs for each aggregate gate.

Individual aggregate delivery rate check-runs must not deviate more than 1.0 percent from the mathematical average of all runs for the same gate and aggregate type. Each test run must be at least 1,000 pounds.

At the time of batching, dry and drain aggregates to a stable moisture content. Do not proportion aggregates with visible separation of water from the aggregate during proportioning. At the time of batching, the free moisture content of fine aggregate must not exceed 8 percent of its saturated, surface-dry weight.

If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust 1 supply before using another supply.

Cover rotating and reciprocating equipment on batch-mixer trucks with metal guards.

Individual cement delivery rate check-runs must not deviate more than 1.0 percent of the mathematical average of 3 runs of at least 1,000 pounds each.

When the water meter operates between 50 percent and 100 percent of production capacity, the indicated weight of water delivered must not differ from the actual weight delivered by more than 1.5 percent for each of 2 runs of 75 gallons. Calibrate the water meter under California Test 109. The water meter must be equipped with a resettable totalizer and display the operating rate.

Conduct calibration tests for aggregate, cement, and water proportioning devices with a platform scale located at the calibration site. Platform scales for weighing test-run calibration material must have a maximum capacity of 2.75 tons with maximum graduations of 1 pound. Error test the platform scale within 8 hours of calibrating the batch-mixer truck proportioning devices. Perform error-testing with test weights under California Test 109. Furnish a witness scale that is within 2 graduations of the test weight load. The witness scale must be available for use at the production site throughout the production period. Equipment needed for the calibration of proportioning systems must remain available at the production site throughout the production period.

The batch-mixer truck must be equipped so that accuracy checks can be made. Recalibrate proportioning devices every 90 days after production begins or when you change the source or type of any ingredient.

A spot calibration is calibration of the cement proportioning system only. Perform a 2-run spot calibration each time 55 tons of cement passes through the batch-mixer truck. If the spot calibration shows the cement proportioning system does not comply with the specifications, complete a full calibration of the cement proportioning system before you resume production.

Locate cement storage immediately before the cement feeder. Equip the system with a device that automatically shuts down power to the cement feeder and aggregate belt feeder when the cement storage level is less than 20 percent of the total volume.

Determine aggregate moisture under California Test 223 at least every 2 hours during proportioning and mixing operations. Record aggregate moisture determinations and submit them at the end of each production shift.

Equip each aggregate bin with a device that automatically shuts down the power to the cement feeder and the aggregate belt feeder when the aggregate discharge rate is less than 95 percent of the scheduled discharge rate.

Proportioning device indicators must be in working order before beginning proportioning and mixing operations and must be visible when standing near the batch-mixer truck.

Identifying numbers of batch-mixer trucks must be at least 3 inches in height, and be located on the front and rear of the vehicle.

Mix volumetric proportioned RSC in a mechanically operated mixer. You may use auger-type mixers. Operate mixers uniformly at the mixing speed recommended by the manufacturer. Do not use mixers that have an accumulation of hard concrete or mortar.

Do not mix more material than will permit complete mixing. Reduce the volume of material in the mixer if complete mixing is not achieved. Continue mixing until a homogeneous mixture is produced at discharge. Do not add water to the RSC after discharge.

Do not use equipment with components made of aluminum or magnesium alloys that may have contact with plastic concrete during mixing or transporting of RSC.

The Engineer determines uniformity of concrete mixtures by differences in penetration measurements made under California Test 533. Differences in penetration are determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load. The differences must not exceed 5/8 inch. Submit samples of freshly mixed concrete. Sampling facilities must be safe, accessible, clean, and produce a sample that is representative of production. Sampling devices and sampling methods must comply with California Test 125.

Do not use ice to cool RSC directly. If ice is used to cool water used in the mix, it must be melted before entering the mixer.

Proportion and charge cement into a mixer such that there is no variance of the required quantity of cement due to wind, accumulation on equipment, or other conditions.

Each mixer must have metal plates that provide the following information:

1. Designed usage
2. Manufacturer's guaranteed mixed concrete volumetric capacity
3. Rotation speed

The device controlling the proportioning of cement, aggregate, and water must produce production data. The production data must be captured at 15-minute intervals throughout daily production. Each capture of production data represents production activity at that time and is not a summation of data. The amount of material represented by each production capture is the amount produced in the period from 7.5 minutes before to 7.5 minutes after the capture time. Submit the daily production data in electronic or printed media at the end of each production shift. Report the data including data titles in the following order:

1. Weight of cement per revolution count
2. Weight of each aggregate size per revolution count
3. Gate openings for each used aggregate size
4. Weight of water added to the concrete per revolution count
5. Moisture content of each used aggregate size
6. Individual volume of other admixtures per revolution count
7. Time of day
8. Day of week
9. Production start and stop times
10. Batch-mixer truck identification
11. Name of supplier
12. Specific type of concrete being produced
13. Source of the individual aggregate sizes
14. Source, brand, and type of cement
15. Source, brand and type of individual admixtures
16. Name and signature of operator

You may input production data by hand into a pre-printed form or it may be captured and printed by the proportioning device. Present electronic media containing recorded production data in a tab delimited format on a CD or DVD. Each capture of production data must be followed by a line-feed carriage-return with sufficient fields for the specified data.

Curing Concrete

For RSC made with a proprietary cement, the curing method must be as recommended by the manufacturer of the cement and as approved by the Engineer.

For RSC made using portland cement concrete, you must:

1. Cure the concrete using the curing compound method under Section 90-7.03, "Curing Structures," of the Standard Specifications. Fogging of the surface with water after the curing compound has been applied will not be required.
2. Repair immediately any damage to the film of the curing compound with additional compound. Do not repair damage to the curing compound after the concrete is opened to public traffic.
3. Cover the surface with an insulating layer or blanket when the ambient temperature is below 65 °F during the curing period. The insulation layer or blanket must have an R-value rating given in the table below. A heating tent may be used in lieu of or in combination with the insulating layer or blanket:

R-Value Ratings

Temperature Range During Curing Period	R-value, minimum
55 °F to 65 °F	1
45 °F to 55 °F	2
39 °F to 45 °F	3

If compressive strength tests are performed in the field showing that the concrete has achieved 4000psi, you may open the lane to traffic at the age of break. Perform the compressive strength tests under the provisions for sampling and testing cylinders in Section 90-9.01, "General," of the Standard Specifications. The decision to use this option must be made in writing to the Engineer before beginning construction.

MEASUREMENT AND PAYMENT

If calibration of volumetric batch trucks is performed more than 100 miles from the project limits, payment for rapid strength concrete is reduced by \$1,000.

8-2.03 PRECAST CONCRETE QUALITY CONTROL

GENERAL

Precast concrete quality control shall conform to these special provisions.

Unless otherwise specified, precast concrete quality control shall apply when any precast concrete members are fabricated in conformance with the provisions in Section 49, "Piling," or Section 51, "Concrete Structures," of the Standard Specifications.

Precast concrete quality control shall not apply to precast concrete members that are fabricated from minor concrete.

Quality Control (QC) shall be the responsibility of the Contractor. The Contractor's QC inspectors shall perform inspection and testing prior to precasting, during precasting, and after precasting, and as specified in this section and additionally as necessary to ensure that materials and workmanship conform to the details shown on the plans, and to the specifications.

Quality Assurance (QA) is the prerogative of the Engineer. Regardless of the acceptance for a given precast element by the Contractor, the Engineer will evaluate the precast element. The Engineer will reject any precast element that does not conform to the approved Precast Concrete Quality Control Plan (PCQCP), the details shown on the plans, or to these special provisions.

The Contractor shall designate in writing a precast Quality Control Manager (QCM) for each precasting facility. The QCM shall be responsible directly to the Contractor for the quality of precasting, including materials and workmanship, performed by the Contractor and all subcontractors. The QCM shall be the sole individual responsible to the Contractor for submitting, receiving, and approving all correspondence, required submittals, and reports to and from the Engineer. The QCM shall not be employed or compensated by any subcontractor, or other persons or entities hired by subcontractors, or suppliers, who will provide other services or materials for the project. The QCM may be an employee of the Contractor.

Prior to submitting the PCQCP required herein, a meeting between the Engineer, the Contractor's QCM, and a representative from each entity performing precast concrete operations for this project, shall be held to discuss the requirements for precast quality control.

QC Inspectors shall either be 1) licensed as Civil Engineers in the State of California, or 2) have a current Plant Quality Personnel Certification, Level II, from the Precast/Prestressed Concrete Institute. A QC Inspector shall witness all precast concrete operations.

PRECAST CONCRETE QUALIFICATION AUDIT

Unless otherwise specified, no Contractors or subcontractors performing precast concrete operations for the project shall commence work without having successfully completed the Department's Precast Fabrication Qualification Audit, hereinafter referred to as the audit. Copies of the audit form, along with procedures for requesting and completing the audit, are available at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbresources.htm>

An audit that was previously approved by the Department no more than 3 years before the award of this contract will be acceptable for the entire period of this contract, provided the Engineer determines the audit is for the same type of work that is to be performed on this contract.

A list of facilities who have successfully completed the audit and are authorized to provide material for this contract is available at:

http://www.dot.ca.gov/hq/esc/Translab/OSM/smdocuments/Internet_auditlisting.pdf

Successful completion of an audit shall not relieve the Contractor of the responsibility for furnishing materials or producing finished work of the quality specified in these special provisions and as shown on the plans.

PRECAST CONCRETE QUALITY CONTROL PLAN

Prior to performing any precasting operations, the Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 3 copies of a separate PCQCP for each item of work to be precast. A separate PCQCP shall be submitted for each facility. As a minimum, each PCQCP shall include the following:

- A. The name of the precasting firm, the concrete plants to be used, and any concrete testing firm to be used;

- B. A manual prepared by the precasting firm that includes equipment, testing procedures, safety plan, and the names, qualifications, and documentation of certifications for all personnel to be used;
- C. The name of the QCM and the names, qualifications, and documentation of certifications for all QC inspection personnel to be used;
- D. An organizational chart showing all QC personnel and their assigned QC responsibilities;
- E. The methods and frequencies for performing all required quality control procedures, including all inspections, material testing, and any required survey procedures for all components of the precast elements including prestressing systems, concrete, grout, reinforcement, steel components embedded or attached to the precast member, miscellaneous metal, and formwork;
- F. A system for identification and tracking of required precast element repairs, and a procedure for the reinspection of any repaired precast element. The system shall have provisions for a method of reporting nonconforming precast elements to the Engineer; and
- G. Forms to be used for Certificates of Compliance, daily production logs, and daily reports.

The Engineer shall have 4 weeks to review the PCQCP submittal after a complete plan has been received. No precasting shall be performed until the PCQCP is approved in writing by the Engineer.

A PCQCP that was previously approved by the Engineer no more than one year prior to the beginning of work on this contract will be acceptable for the entire period of this contract, provided the Engineer determines the PCQCP is for the same type of work that is to be performed on this contract.

An amended PCQCP or addendum shall be submitted to, and approved in writing by the Engineer, for any proposed revisions to the approved PCQCP. An amended PCQCP or addendum will be required for any revisions to the PCQCP, including but not limited to changes in concrete plants or source materials, changes in material testing procedures and testing labs, changes in procedures and equipment, changes in QC personnel, or updated systems for tracking and identifying precast elements. The Engineer shall have 2 weeks to complete the review of the amended PCQCP or addendum, once a complete submittal has been received. Work that is affected by any of the proposed revisions shall not be performed until the amended PCQCP or addendum has been approved.

After final approval of the PCQCP, amended PCQCP, or addendum, the Contractor shall submit 7 copies to the Engineer of each of these approved documents.

It is expressly understood that the Engineer's approval of the Contractor's PCQCP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformance with the requirements of the plans and specifications. The Engineer's approval shall neither constitute a waiver of any of the requirements of the plans and specifications nor relieve the Contractor of any obligation thereunder; and defective work, materials, and equipment may be rejected notwithstanding approval of the PCQCP.

REPORTING

The QC Inspector shall provide reports to the QCM on a daily basis for each day that precasting operations are performed.

A daily production log for precasting shall be kept by the QCM for each day that precasting operations, including setting forms, placing reinforcement, setting prestressing steel, casting, curing, post tensioning, and form release, are performed. The log shall include the facility location, and shall include a specific description of casting or related operations, any problems or deficiencies discovered, any testing or repair work performed, and the names of all QC personnel and the specific QC inspections they performed that day. The daily report from each QC Inspector shall also be included in the log. This daily log shall be available for viewing by the Engineer, at the precasting facility.

All reports regarding material tests and any required survey checks shall be signed by the person who performed the test or check, and then submitted directly to the QCM for review and signature prior to submittal to the Engineer. Corresponding names shall be clearly printed or type-written next to all signatures.

The Engineer shall be notified immediately in writing when any precasting problems or deficiencies are discovered and of the proposed repair or process changes required to correct them. The Engineer shall have 4 weeks to review these procedures. No remedial work shall begin until the Engineer approves these procedures in writing.

The following items shall be included in a precast report that is to be submitted to the Engineer following the completion of any precast element:

- A. Reports of all material tests and any required survey checks;
- B. Documentation that the Contractor has evaluated all tests and corrected all rejected deficiencies, and all repairs have been re-examined with the required tests and found acceptable; and
- C. A daily production log.

At the completion of any precast element, and if the QCM determines that element is in conformance with these special provisions, the QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. This Certificate of Compliance shall be submitted with the precast report. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans and the provisions of the Standard Specifications and these special provisions.

PAYMENT

In the event the Engineer fails to complete the review of 1) a PCQCP, 2) an amended PCQCP or addendum, or 3) a proposed repair or process change, within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

All required repair work or process changes required to correct precasting operation deficiencies, whether discovered by the QCM, QC Inspector, or by the Engineer, and any associated delays or expenses to the Contractor caused by performing these repairs, shall be at the Contractor's expense.

Full compensation for conforming to the requirements of this section shall be considered as included in the contract prices paid for the various items of work involved and no additional compensation will be allowed therefor.

8-2.04 CONTRACTOR QUALITY CONTROL (CONCRETE PAVEMENT)

In addition to the requirements in Section 40-1.03, "Quality Control and Assurance," of the Standard Specifications, provide a quality control (QC) manager.

Assign a QC manager before starting construction activities. The QC manager must be the sole individual responsible for:

1. Receiving, reviewing, and approving all correspondence, submittals, and reports before they are submitted to the Department
2. Signing QC plans
3. Implementing QC plans
4. Maintaining QC records

The QC manager must be responsible directly to you for the quality of the work, including materials and workmanship performed by you and your subcontractors.

The QC manager must be your employee or must be hired by a subcontractor providing only QC services. The QC manager must not be employed or compensated by a subcontractor or by other persons or entities hired by subcontractors who will provide other services or materials for the project.

Notify the Engineer of the name and contact information of the QC manager.

Full compensation for the QC manager is included in the contract price paid per cubic yard for the types of concrete pavement involved and no additional payment will be made therefor.

8-2.05 SELF-CONSOLIDATING CONCRETE FOR PRECAST ELEMENTS

GENERAL

Summary

This section includes specifications for self-consolidating concrete (SCC).

You may use SCC for only the following cases:

1. For precast concrete
2. Where the specifications allow the use of SCC

Definitions

self-consolidating concrete: Flowing concrete capable of spreading to a level state without segregation and without the use of internal or external vibrators.

Submittals

Submit the following for approval before placing SCC:

1. SCC mix design and placement procedures
2. Trial batch test report

Quality Control and Assurance

General

Prepare SCC specimens for compressive strength testing under California Test 540 except fabricate test specimens as follows:

1. Place test molds on a firm, flat surface to prevent distortion of the bottom surface. When more than 1 specimen is to be made from the same batch, make all specimens simultaneously. Fill the mold in 1 lift, pouring the concrete from a larger container. Pat sides of the mold lightly by hand, or jig by rocking the mold from side to side.
2. Strike off the surface of the concrete even with the top edge of the mold. Wipe the sides of the mold free of excess concrete and press the lid on.

Prequalification of SCC Mix Design

Prequalify the SCC mix design with a trial batch using the same materials, mix proportions, mixing equipment, procedures, and size of batch to be used in the production of SCC. The trial batch test report for the SCC mix design must include the following tests and results:

SCC Mix Design Requirements

Property	Requirement	Test Method
Slump Flow	At least 20 inches	ASTM C 1611
Flow Rate - T ₅₀	Between 2 and 7 seconds	ASTM C 1611
Visual Stability Index	1 or less	ASTM C 1611
J-Ring Flow	The difference between J-Ring flow and the slump flow must not exceed 2 inches	ASTM C 1621
Column Segregation	Static segregation must not exceed 15%	ASTM C 1610
Bleeding	Bleeding capacity must not exceed 2.5%	ASTM C 232
Compressive Strength	The average of 5 test cylinders must be at least 600 psi greater than the specified strength. ^a	California Test 521
Minimum Compressive Strength	The minimum for an individual test cylinder must not be less than the specified strength. ^a	California Test 521

Note:

^a At the maximum age specified or allowed

Field Quality Control

Determine the fine aggregate moisture content for each batch of SCC.

Determine slump flow and visual stability index (VSI) under ASTM C 1611 at the beginning of SCC placement and whenever a set of concrete cylinders is prepared. The slump flow must not vary by more than 3 inches from the mix design slump flow, and the minimum allowable slump flow is 20 inches. VSI must be 1.0 or less. If the Engineer rejects SCC for slump flow and VSI, make corrective changes in the SCC mix design or placement procedures before placing additional SCC. Submit revised SCC mix design or placement procedures for approval.

MATERIALS

SCC must comply with Section 90, "Portland Cement Concrete," of the Standard Specifications except Section 90-3, "Aggregate Gradings," of the Standard Specifications does not apply.

PAYMENT

The Department measures and pays for SCC under the specifications requiring or allowing its use.

SECTION 8-3. WELDING

8-3.01 WELDING

GENERAL

Unless otherwise specified, Section 8-3, "Welding," shall apply to any welding that is specified to conform to an AWS welding code.

Requirements of the AWS welding codes shall apply unless otherwise specified in the Standard Specifications, on the plans, or in these special provisions. Wherever the abbreviation AWS is used, it shall be equivalent to the abbreviations ANSI/AWS or AASHTO/AWS.

Wherever reference is made to the following AWS welding codes in the Standard Specifications, on the plans, or in these special provisions, the year of adoption for these codes shall be as listed:

AWS Code	Year of Adoption
D1.1	2008
D1.3	2008
D1.4	2005
D1.5	2008
D1.6	2007
D1.8	2009

Flux cored welding electrodes conforming to the requirements of AWS A5.20 E6XT-4 or E7XT-4 shall not be used to perform welding for this project.

Unless otherwise specified, Clause 6.1.3 of AWS D1.1, paragraph 1 of Section 7.1.2 of AWS D1.4, and Clause 6.1.1.2 of AWS D1.5, are replaced with the following:

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all welding.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

The QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship.

When the term "Inspector" is used without further qualification, it shall refer to the QC Inspector.

Inspection and approval of all joint preparations, assembly practices, joint fit-ups, welding techniques, and the performance of each welder, welding operator, and tack welder shall be documented by the QC Inspector on a daily basis for each day welding is performed. For each inspection, including fit-up, Welding Procedure Specification (WPS) verification, and final weld inspection, the QC Inspector shall confirm and document compliance with the requirements of the AWS or other specified code criteria and the requirements of these special provisions on all welded joints before welding, during welding, and after the completion of each weld.

The Engineer shall have the authority to verify the qualifications or certifications of any welder, QC Inspector, or NDT personnel to specified levels by retests or other means approved by the Engineer.

When joint weld details that are not prequalified to the details of Clause 3 of AWS D1.1 or to the details of Figure 2.4 or 2.5 of AWS D1.5 are proposed for use in the work, the joint details, their intended locations, and the proposed welding parameters and essential variables, shall be approved by the Engineer. The Contractor shall allow the Engineer 15 days to complete the review of the proposed joint detail locations.

In addition to the requirements of AWS D1.1, welding procedure qualifications for work welded in conformance with this code shall conform to the following:

When a nonstandard weld joint is to be made using a combination of WPSs, a single test may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 4.5.

Upon approval of the proposed joint detail locations and qualification of the proposed joint details, welders and welding operators using these details shall perform a qualification test plate using the WPS variables and the joint detail to be used in production. The test plate shall have the maximum thickness to be used in production and a minimum length of 18 inches. The test plate shall be mechanically and radiographically tested. Mechanical and radiographic testing and acceptance criteria shall be as specified in the applicable AWS codes.

The Engineer will witness all qualification tests for WPSs that were not previously approved by the Department.

In addition to the requirements specified in the applicable code, the period of effectiveness for a welder's or welding operator's qualification shall be a maximum of 3 years for the same weld process, welding position, and weld type. If welding will be performed without gas shielding, then qualification shall also be without gas shielding. Excluding welding of fracture critical members, a valid qualification at the beginning of work on a contract will be acceptable for the entire period of the contract, as long as the welder's or welding operator's work remains satisfactory.

The Contractor shall notify the Engineer 7 days prior to performing any procedure qualification tests. Witnessing of qualification tests by the Engineer shall not constitute approval of the intended joint locations, welding parameters, or essential variables. The Contractor shall notify the Engineer using the "Standard TL-38 Inspection Form" located at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm>

Clause 6.14.6, "Personnel Qualification," of AWS D1.1, Section 7.8, "Personnel Qualification," of AWS D1.4, and Clause 6.1.3.4, "Personnel Qualification," of AWS D1.5 are replaced with the following:

Personnel performing nondestructive testing (NDT) shall be qualified and certified in conformance with the requirements of the American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A and the Written Practice of the NDT firm. The Written Practice of the NDT firm shall meet or exceed the guidelines of the ASNT Recommended Practice No. SNT-TC-1A. Individuals who perform NDT, review the results, and prepare the written reports shall be either:

- A. Certified NDT Level II technicians, or;
- B. Level III technicians who hold a current ASNT Level III certificate in that discipline and are authorized and certified to perform the work of Level II technicians.

Clause 6.6.5, "Nonspecified NDT Other than Visual," of AWS D1.1, Section 7.6.5 of AWS D1.4 and Clause 6.6.5 of AWS D1.5 shall not apply.

For any welding, the Engineer may direct the Contractor to perform NDT that is in addition to the visual inspection or NDT specified in the AWS or other specified welding codes, in the Standard Specifications, or in these special provisions. Except as provided for in these special provisions, additional NDT required by the Engineer, and associated repair work, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. Prior to release of welded material by the Engineer, if testing by NDT methods other than those originally specified discloses an attempt to defraud or reveals a gross nonconformance, all costs associated with the repair of the deficient area, including NDT of the weld and of the repair, and any delays caused by the repair, shall be at the Contractor's expense. A gross nonconformance is defined as the sum of planar type rejectable indications in more than 20 percent of the tested length.

When less than 100 percent of NDT is specified for any weld, it is expected that the entire length of weld meet the specified acceptance-rejection criteria. Should any welding deficiencies be discovered by additional NDT directed or performed by the Engineer that utilizes the same NDT method as that originally specified, all costs

associated with the repair of the deficient area, including NDT of the weld and of the weld repair, and any delays caused by the repair, shall be at the Contractor's expense.

Repair work to correct welding deficiencies discovered by visual inspection directed or performed by the Engineer, and any associated delays or expenses caused to the Contractor by performing these repairs, shall be at the Contractor's expense.

WELDING QUALITY CONTROL

Welding quality control shall conform to the requirements in the AWS or other specified welding codes, the Standard Specifications, and these special provisions.

Unless otherwise specified, welding quality control shall apply to work welded in conformance with the provisions in the following:

- A. Section 49, "Piling," Section 52, "Reinforcement," Section 55, "Steel Structures," and Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications
- B. "Structural Steel for Building Work" of these special provisions

Unless otherwise specified, Clauses 6.1.4.1 and 6.1.4.3 of AWS D1.1, paragraph 2 of Section 7.1.2 of AWS D1.4, and Clauses 6.1.3.2 through 6.1.3.3 of AWS D1.5 are replaced with the following:

The QC Inspector shall be currently certified as an AWS Certified Welding Inspector (CWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors."

The QC Inspector may be assisted by an Assistant QC Inspector provided that this individual is currently certified as an AWS Certified Associate Welding Inspector (CAWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors." The Assistant QC Inspector may perform inspection under the direct supervision of the QC Inspector provided the assistant is always within visible and audible range of the QC Inspector. The QC Inspector shall be responsible for signing all reports and for determining if welded materials conform to workmanship and acceptance criteria. The ratio of QC Assistants to QC Inspectors shall not exceed 5 to 1.

The Contractor shall designate in writing a welding Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of welding, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting, receiving, reviewing, and approving all correspondence, required submittals, and reports to and from the Engineer. The QCM shall be a registered professional engineer or shall be currently certified as a CWI.

Unless the QCM is hired by a subcontractor providing only QC services, the QCM shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project. The QCM may be an employee of the Contractor.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each item of work for which welding was performed. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans, the Standard Specifications, and these special provisions.

Welding inspection personnel or NDT firms to be used in the work shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project, except for the following conditions:

- A. The work is welded in conformance with AWS D1.5 and is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program, Category CBR, Major Steel Bridges and Fracture Critical endorsement F, when applicable.
- B. Structural steel for building work is welded in conformance with AWS D1.1 and is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program, Category STD, Standard for Steel Building Structures.

For welding performed at such facilities, the inspection personnel or NDT firms may be employed or compensated by the facility performing the welding provided the facility maintains a QC program that is independent from production.

Unless otherwise specified, an approved independent third party will witness the qualification tests for welders or welding operators. The independent third party shall be a current CWI and shall not be an employee of the

contractor performing the welding. The Contractor shall allow the Engineer 15 days to review the qualifications and copy of the current certification of the independent third party.

Prior to submitting the Welding Quality Control Plan (WQCP) required herein, a prewelding meeting between the Engineer, the Contractor's QCM, and a representative from each entity performing welding or inspection for this project, shall be held to discuss the requirements for the WQCP.

Information regarding the contents, format, and organization of a WQCP, is available at the Transportation Laboratory and at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbresources.htm>

The Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 2 copies of a separate WQCP for each subcontractor or supplier for each item of work for which welding is to be performed.

The Contractor shall allow the Engineer 15 days to review the WQCP submittal after a complete plan has been received. No welding shall be performed until the WQCP is approved in writing by the Engineer.

An amended WQCP or any addendum to the approved WQCP shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved WQCP. An amended WQCP or addendum will be required for revisions to the WQCP, including but not limited to a revised WPS; additional welders; changes in NDT firms, QC, or NDT personnel or procedures; or updated systems for tracking and identifying welds. The Engineer shall have 7 days to complete the review of the amended WQCP or addendum. Work affected by the proposed revisions shall not be performed until the amended WQCP or addendum has been approved.

After final approval of the WQCP, amended WQCP, or addendum, the Contractor shall submit 7 copies to the Engineer of the approved documents. A copy of the Engineer approved document shall be available at each location where welding is to be performed.

All welding will require inspection by the Engineer. The Contractor shall request inspection at least 3 business days prior to the beginning of welding for locations within California and 5 business days for locations outside of California. The Contractor shall request inspection at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm>

Continuous inspection shall be provided when any welding is being performed. Continuous inspection, as a minimum, shall include having a QC Inspector within such close proximity of all welders or welding operators so that inspections by the QC Inspector of each welding operation at each welding location does not lapse for a period exceeding 30 minutes.

A daily production log for welding shall be kept for each day that welding is performed. The log shall clearly indicate the locations of all welding. The log shall include the welders' names, amount of welding performed, any problems or deficiencies discovered, and any testing or repair work performed, at each location. The daily report from each QC Inspector shall also be included in the log.

The following items shall be included in a Welding Report that is to be submitted to the Engineer within 15 days following the performance of any welding:

- A. A daily production log.
- B. Reports of all visual weld inspections and NDT.
- C. Radiographs and radiographic reports, and other required NDT reports.
- D. A summary of welding and NDT activities that occurred during the reporting period.
- E. Reports of each application of heat straightening.
- F. A summarized log listing the rejected lengths of weld by welder, position, process, joint configuration, and piece number.
- G. Documentation that the Contractor has evaluated all radiographs and other nondestructive tests and corrected all rejectable deficiencies, and that all repaired welds have been reexamined using the required NDT and found acceptable.

The following information shall be clearly written on the outside of radiographic envelopes: name of the QCM, name of the nondestructive testing firm, name of the radiographer, date, contract number, complete part description, and all included weld numbers, report numbers, and station markers or views, as detailed in the WQCP. In addition, all interleaves shall have clearly written on them the part description and all included weld numbers and station markers or views, as detailed in the WQCP. A maximum of 2 pieces of film shall be used for each interleave.

Reports of all visual inspections and NDT shall be signed by the inspector or technician and submitted daily to the QCM for review and signature prior to submittal to the Engineer. Corresponding names shall be clearly printed

or typewritten next to all signatures. Reports of all NDT, whether specified, additional, or informational, performed by the Contractor shall be submitted to the Engineer.

The Engineer will review the Welding Report to determine if the Contractor is in conformance with the WQCP. Except for field welded steel pipe piling, the Engineer shall be allowed 15 days to review the report and respond in writing after the complete Welding Report has been received. Prior to receiving notification from the Engineer of the Contractor's conformance with the WQCP, the Contractor may encase in concrete or cover welds for which the Welding Report has been submitted. However, should the Contractor elect to encase or cover those welds prior to receiving notification from the Engineer, it is expressly understood that the Contractor shall not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

For field welded steel pipe piling, including bar reinforcement in the piling, the Contractor shall allow the Engineer 2 business days to review the Welding Report and respond in writing after the required items have been received. No field welded steel pipe piling shall be installed, and no reinforcement in the piling shall be encased in concrete until the Engineer has approved the above requirements in writing.

In addition to the requirements in AWS D1.1 and AWS D1.5, third-time excavations of welds or base metal to repair unacceptable discontinuities, regardless of NDT method, and all repairs of cracks require prior approval of the Engineer.

The Engineer shall be notified immediately in writing when welding problems, deficiencies, base metal repairs, or any other type of repairs not submitted in the WQCP are discovered, and also of the proposed repair procedures to correct them. For requests to perform third-time excavations or repairs of cracks, the Contractor shall include an engineering evaluation of the proposed repair. The engineering evaluation, at a minimum, shall address the following:

- A. What is causing each defect?
- B. Why the repair will not degrade the material properties?
- C. What steps are being taken to prevent similar defects from happening again?

The Contractor shall allow the Engineer 7 days to review these procedures. No remedial work shall begin until the repair procedures are approved in writing by the Engineer.

Clause 6.5.4 of AWS D1.5 is replaced with the following:

The QC Inspector shall inspect and approve each joint preparation, assembly practice, welding technique, joint fit-up, and the performance of each welder, welding operator, and tack welder to make certain that the applicable requirements of this code and the approved Welding Procedure Specification (WPS) are met. The QC Inspector shall examine the work to make certain that it meets the requirements of Clauses 3 and 6.26. The size and contour of all welds shall be measured using suitable gages. Visual inspection for cracks in welds and base metal, and for other discontinuities shall be aided by strong light, magnifiers, or such other devices as may be helpful. Acceptance criteria different from those specified in this code may be used when approved by the Engineer.

In addition to the requirements of AWS D1.5, Clause 5.12 or 5.13, welding procedures qualification for work welded in conformance with that code shall conform to the following requirements:

- A. Unless considered prequalified, fillet welds shall be qualified in each position. The fillet weld soundness test shall be conducted using the essential variables of the WPS as established by the Procedure Qualification Record (PQR).
- B. For qualification of joints that do not conform to Figures 2.4 and 2.5 of AWS D1.5, a minimum of 2 WPS qualification tests are required. The tests shall be conducted using both Figure 5.1 and Figure 5.3. The test conforming to Figure 5.1 shall be conducted in conformance with AWS D1.5, Clause 5.12 or 5.13. The test conforming to Figure 5.3 shall be conducted using the welding electrical parameters that were established for the test conducted conforming to Figure 5.1. The ranges of welding electrical parameters established during welding per Figure 5.1 in conformance with AWS D1.5, Clause 5.12, shall be further restricted according to the limits in Table 5.3 during welding per Figure 5.3.
- C. Multiple zones within a weld joint may be qualified. The travel speed, amperage, and voltage values that are used for tests conducted per AWS D1.5 Clause 5.13 shall be consistent for each pass in a weld joint, and shall in no case vary by more than ± 10 percent for travel speed, ± 10 percent for amperage, and ± 7 percent for voltage as measured from a predetermined target value or average within each weld pass or zone. The travel speed shall in no case vary by more than ± 15 percent when using submerged arc welding.
- D. For a WPS qualified in conformance with AWS D1.5 Clause 5.13, the values to be used for calculating ranges for current and voltage shall be based on the average of all weld passes made in the test. Heat input

- shall be calculated using the average of current and voltage of all weld passes made in the test for a WPS qualified in conformance with Clause 5.12 or 5.13.
- E. Macroetch tests are required for WPS qualification tests, and acceptance shall be per AWS D1.5 Clause 5.19.3.
 - F. When a nonstandard weld joint is to be made using a combination of WPSs, a test conforming to Figure 5.3 may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 5.3.
 - G. Prior to preparing mechanical test specimens, the PQR welds shall be inspected by visual and radiographic tests. Backing bar shall be 3 inches in width and shall remain in place during NDT testing. Results of the visual and radiographic tests shall comply with AWS D1.5 Clause 6.26.2, excluding Clause 6.26.2.2. Test plates that do not comply with both tests shall not be used.

WELDING FOR OVERHEAD SIGN AND POLE STRUCTURES

The Contractor shall meet the following requirements for any work welded in conformance with the provisions in Section 56-1, "Overhead Sign Structures," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

Welding inspection personnel or NDT firms to be used in the work shall not be employed or compensated by any subcontractor or by other persons or entities hired by subcontractors who will provide other services or materials for the project except for when the welding is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program. The AISC Certification category for overhead sign structures shall be Simple Steel Bridge Structures (SBR), and the AISC Certification category for pole structures shall be Simple Steel Bridge Structures (SBR) or Standard for Steel Building Structures (STD).

Welding Qualification Audit

Contractors or subcontractors performing welding operations for overhead sign and pole structures shall have successfully completed the Department's "Manufacturing Qualification Audit for Overhead Sign and Pole Structures." Copies of the audit form and procedures for requesting and completing the audit are available at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbresources.htm>

An audit that was approved by the Engineer no more than 3 years prior to the award of the contract will be acceptable for the entire period of this contract provided the Engineer determines the audit was for the same type of work that is to be performed on this contract.

A list of facilities that have successfully completed the audit and are authorized to provide material for this contract is available at:

http://www.dot.ca.gov/hq/esc/Translab/OSM/smdocuments/Internet_auditlisting.pdf

Successful completion of an audit shall not relieve the Contractor of the responsibility for furnishing materials or producing finished work of the quality specified in these special provisions and as shown on the plans.

Welding Report

For work welded in conformance with the provisions in Section 56-1, "Overhead Sign Structures," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, a Welding Report shall be submitted in conformance with the provisions in "Welding Quality Control" of these special provisions.

STEEL PIPE PILING QUALIFICATION AUDIT

The Contractor shall submit documentation that one of the following steel pipe piling qualification audits has been successfully completed before welding operations are performed, other than field welding, for steel pipe piling:

- A. "Class R Steel Pipe Piling Qualification Audit"
- B. "Class N Steel Pipe Piling Qualification Audit"

An audit shall have been completed for each pipe pile diameter, thickness, grade of steel, and class of piling to be supplied for this project. The procedures for requesting and completing the audit are available at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbresources.htm>

An audit that was approved by the Department no more than 3 years prior to the award of the contract will be acceptable for the entire period of this contract provided the Engineer determines the audit was for the same type of work that is to be performed on this contract.

A list of facilities that have successfully completed the audit and are authorized to provide material for this contract is available at:

http://www.dot.ca.gov/hq/esc/Translab/OSM/smdocuments/Internet_auditlisting.pdf

Successful completion of an audit shall not relieve the Contractor of the responsibility for furnishing materials or producing finished work of the quality specified in these special provisions and as shown on the plans.

PAYMENT

Full compensation for conforming to the requirements of "Welding" shall be considered as included in the contract prices paid for the various items of work involved and no additional compensation will be allowed therefor.

SECTION 9. DESCRIPTION OF BRIDGE WORK

The bridge work consists of widening existing structures, constructing new structures, constructing new retaining walls and soundwalls and modifying channel as shown on the plans of the following structures.

BUENA VISTA - WINONA UC (WIDEN)
Bridge No. 53-1110

EMPIRE AVE UC (REPLACE)
Bridge No. 53-2920

VICTORY PLACE SEPARATION
Bridge No. 53-C2171

BURBANK WESTERN CHANNEL
Bridge No. 53-3078

BURBANK BLVD OC (REPLACE)
Bridge No. 53-3057

STOUGH CANYON CULVERT COVER
Bridge No. 53-3077M

RETAINING WALL 25
Bridge No. RW25

RETAINING WALL 26
Bridge No. RW26

RETAINING WALL 1606
Bridge No. 1606

RETAINING WALL 1665
Bridge No. RW1665

RETAINING WALL 1630
Bridge No. RW1630

RETAINING WALL 1610
Bridge No. RW1610

RETAINING WALL 1604
Bridge No. RW1604

SOUND WALL 1584
Bridge No. SW 1584

RETAINING WALL 1615
Bridge No. RW1615

RETAINING WALL 1635
Bridge No. RW1635

RETAINING WALL 1613
Bridge No. RW1613

RETAINING WALL 1607
Bridge No. RW1607

RETAINING WALL 1595
Bridge No. RW1595

RETAINING WALL 1670
Bridge No. RW1670

RETAINING WALL 1662
Bridge No. RW1662

RETAINING WALL 1655
Bridge No. RW1655

RETAINING WALL 1605
Bridge No. RW1605

RETAINING WALL 1601
Bridge No. RW1601

RETAINING WALL 1565
Bridge No. 53E0161

RETAINING WALL 1567
Bridge No. 53E0162

RETAINING WALL 1575
Bridge No. 53E0163

RETAINING WALL 1585
Bridge No. 53E0164

RETAINING WALL 1576
Bridge No. RW1576

SECTION 10. CONSTRUCTION DETAILS

SECTION 10-1. GENERAL

10-1.01 ORDER OF WORK

Order of work shall conform to the provisions in Section 5-1.05, "Order of Work," of the Standard Specifications and these special provisions.

You must make access in and out of the Apartment complex, 1730 Rogers Place, Burbank, CA 91504 available at all times. The construction hours for the alley at this property, and the construction works adjacent to Leland

Way, N. San Fernando Boulevard/Keeler Street/Landis Street must be between 7 AM and 7 PM from Monday to Friday, and between 8 AM and 5 PM on Saturday, and no work is allowed on Sunday.

You must widen Buena Vista Street NB on-ramp temporarily and then close N San Fernando Blvd as the first order of work, as shown on stage construction plans during stage 1 and Motorist Information plan, and construct shoofly tracks immediately.

Once the shoofly is constructed and fully operational, you must construct railroad mainline tracks, Buena Vista Street and Empire Avenue underpasses, including retaining walls and MSE walls.

After the railroad mainline tracks are constructed, tested and fully operational, and the railroad operation is switched from the shoofly tracks to the mainline tracks, you must remove the shoofly tracks and continue to work on the construction of Empire Avenue interchange until it is fully operational.

Once the Empire Avenue interchange is complete and fully operational, you can close Burbank Blvd OC, except the NB & SB off-ramps. No earlier closure of Burbank Blvd is allowed. Prior to grinding existing concrete pavement shown on the plans, you must replace individual slabs that are broken and in bad condition as determined by the Engineer.

Before you shift construction stages, you must submit the Engineer the request to approve the notice to change stage construction before you proceed to the next stage construction. You must notify the Engineer 5 working days prior to implementing next stage construction work.

Before beginning any work near or above the Burbank Western Channel or the Stough Canyon Channel, a first order of work shall be to perform an initial condition survey including photographic documentation and implementing a settlement monitoring plan for the designated monitoring points along the channels as shown on the plans. For buried channels the photographic documentation shall be performed after excavation of the channels and before any other construction activities. You must monitor the channel for settlement and damage prior to any construction activity beyond any excavations needed to expose buried channels, weekly during construction activity near or over the channel, and 6 months following completion of channel related work. You must submit to the Engineer the cumulative monitoring data on a spreadsheet report within 24 hours after readings are taken for each monitoring phase. A copy of the most current report and the initial condition survey photographs shall be available at the site of the work at all times.

Full compensation for performing initial condition survey including photographic documentation and implementing the settlement monitoring plan shall be considered as included in the contract price paid per cubic yard of the various types of structure excavation involved, and no additional compensation will be allowed therefor.

Attention is directed to "Slope Paving" of these special provisions regarding constructing a 4' x 6' test panel prior to placing the permanent slope paving.

Attention is directed to "Miscellaneous Concrete Construction" of these special provisions regarding constructing a 2' x 2' test panel prior to constructing curb ramps with detectable warning surfaces.

The first order of work shall be to place the order for the electrical equipment.

Prior to commencement of the traffic signal functional test at any location, all items of work related to signal control shall be completed and all roadside signs, pavement delineation, and pavement markings shall be in place at that location.

Attention is directed to "Maintaining Traffic" and "Temporary Pavement Delineation" of these special provisions and to the stage construction sheets of the plans.

The work shall be performed in conformance with the stages of construction shown on the plans. Nonconflicting work in subsequent stages may proceed concurrently with work in preceding stages, provided satisfactory progress is maintained in the preceding stages of construction.

In each stage, after completion of the preceding stage, the first order of work shall be the removal of existing pavement delineation as directed by the Engineer. Pavement delineation removal shall be coordinated with new delineation so that lane lines are provided at all times on traveled ways open to public traffic.

Before obliterating any pavement delineation (traffic stripes, pavement markings, and pavement markers) that is to be replaced on the same alignment and location, as determined by the Engineer, the pavement delineation shall be referenced by the Contractor, with a sufficient number of control points to reestablish the alignment and location of the new pavement delineation. The references shall include the limits or changes in striping pattern, including one- and 2-way barrier lines, limit lines, crosswalks and other pavement markings. Full compensation for referencing existing pavement delineation shall be considered as included in the contract prices paid for new pavement delineation and no additional compensation will be allowed therefor.

Prior to placing hot mix asphalt or rubberized hot mix asphalt, the Contractor shall cover all manholes, valve and monument covers, grates, or other exposed facilities located within the area of application, using a plastic or oil resistant construction paper secured to the facility being covered by tape or adhesive. The covered facilities shall be referenced by the Contractor, with a sufficient number of control points to relocate the facilities after the finished grade hot mix asphalt or rubberized hot mix asphalt has been placed. After completion of the hot mix asphalt or rubberized hot mix asphalt operation, all covers shall be removed and disposed of in a manner satisfactory to the

Engineer. Full compensation for covering manholes, valve and monument covers, grates, or other exposed facilities, referencing, and removing temporary cover shall be considered as included in the contract price paid per ton for hot mix asphalt or rubberized hot mix asphalt, and no additional compensation will be allowed therefor.

At the end of each working day if a difference in excess of 8 foot exists between the elevation of the existing pavement and the elevation of excavations within 8 feet of the traveled way, material shall be placed and compacted against the vertical cuts adjacent to the traveled way. During excavation operations, native material may be used for this purpose; however, once placing of the structural section commences, structural material shall be used. The material shall be placed to the level of the elevation of the top of existing pavement and tapered at a slope of 4:1 (horizontal:vertical) or flatter to the bottom of the excavation. Full compensation for placing the material on a 4:1 slope, regardless of the number of times the material is required, and subsequent removing or reshaping of the material to the lines and grades shown on the plans shall be considered as included in the contract price paid for the materials involved and no additional compensation will be allowed therefor. No payment will be made for material placed in excess of that required for the structural section.

At those locations exposed to public traffic where CIDH sign foundations, piling for structure foundations, guard railings, or barriers are to be constructed, or removed and replaced, the Contractor shall schedule operations so that at the end of each working day there shall be no post holes open nor shall there be any pilings, railing or barrier posts installed without the blocks and rail elements assembled and mounted thereon.

At least 60 days before planting the plants, furnish the Engineer a statement from the vendor that the order for the plants required for this contract, including inspection plants, has been received and accepted by the vendor. The statement from the vendor must include the names, sizes, and quantities of plants ordered and the anticipated date of delivery.

Place orders for replacement plants with the vendor at the appropriate time so that the roots of the replacement plants are not in a root-bound condition.

Locate existing irrigation water line crossovers and conduits before performing work on the irrigation system as specified under "Locate Existing Crossovers and Conduits" of these special provisions.

Unless otherwise shown on the plans or specified in these special provisions, conduits to be jacked or drilled or installed by the open trench method for water line crossovers and sprinkler control crossovers must be installed before the installation of other pipe supply lines.

Do not perform clearing, grubbing, and earthwork operations in areas where existing irrigation facilities are to remain in place until existing irrigation facilities have been checked for proper operation as specified under "Existing Highway Irrigation Facilities" of these special provisions.

Submittal of working drawings for electrical components must comply with Section 20-5.027B, "Wiring Plans and Diagrams," of the Standard Specifications.

Preinstall irrigation components in the irrigation controller enclosure cabinet before field installation as specified under "Irrigation Controller Enclosure Cabinet" of these special provisions.

10-1.02 MATERIAL CONTAINING AERIALY DEPOSITED LEAD

This work shall consist of handling material contaminated by aerially deposited lead in minor excavation areas, such as locations of metal beam guard rails, sign posts, fencing, etc. in conformance with the Standard Specifications and these special provisions.

After the Contractor has completed handling materials containing aerially deposited lead, in conformance with the plans, Standard Specifications, and these special provisions, the Contractor shall have no responsibility for such materials in place and shall not be obligated for further cleanup, removal, or remedial actions for such materials.

LEAD COMPLIANCE PLAN

The Contractor shall prepare a project specific Lead Compliance Plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

The contract lump sum price paid for Lead Compliance Plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in preparing the Lead Compliance Plan, including paying the Certified Industrial Hygienist, and for providing personal protective equipment, training and medical surveillance, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

SOIL HANDLING

Handling of materials containing aerially deposited lead shall result in no visible dust migration. The Contractor shall have a means of dust control available at all times while handling material in work areas containing aerially deposited lead. Apply water to prevent visible dust.

The Contractor shall separate material from vegetation and the soils shall remain on site. This will not be required for vegetation removal performed during plant establishment.

Surplus material excavated from areas containing aurally deposited lead shall remain in the area of soil disturbance. The surplus soil shall not be disposed of outside the highway right of way.

Full compensation for handling material contaminated with aurally deposited lead, except as otherwise provided, shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

10-1.03 WATER POLLUTION CONTROL

GENERAL

Summary

This work includes developing and implementing a storm water pollution prevention plan (SWPPP).

This project is risk level 2.

A storm water information handout has been prepared for this contract and is available as described in "Supplemental Project Information" of these special provisions.

Discharges of stormwater from the project must comply with National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DWQ, NPDES No. CAS000002) referred to herein as "Permit."

Information on forms, reports, and other documents can be found in the following Department manuals:

1. Field Guide for Construction Site Dewatering
2. Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual
3. Construction Site Best Management Practices (BMP) Manual

For the above-referenced manuals, go to the Department's Web site for the Division of Construction, Storm Water and Water Pollution Control Information, or the Department's Publication Distribution Unit.

Do not start job site activities until:

1. The SWPPP is approved.
2. The waste discharge identification number is issued.
3. SWPPP review requirements have been fulfilled. If the Regional Water Quality Control Board (RWQCB) requires time for review, allow 30 days for the review. For projects in the Lake Tahoe Hydrologic Unit and the Mammoth Lakes Hydrologic Unit, the Lahontan RWQCB will review the SWPPP.

If you operate a Contractor-support facility, protect stormwater systems and receiving waters from the discharge of potential pollutants by using water pollution control practices.

Contractor-support facilities include:

1. Staging areas
2. Storage yards for equipment and materials
3. Mobile operations
4. Batch plants for PCC and HMA
5. Crushing plants for rock and aggregate
6. Other facilities installed for your convenience, such as haul roads

Discharges from manufacturing facilities, such as batch plants and crushing plants, must comply with the general waste discharge requirements for Order No. 97-03-DWQ, NPDES General Permit No. CAS000001, issued by the State Water Resources Control Board (SWRCB) for "Discharge of Storm Water Associated with Industrial Activities Excluding Construction Activities" and referred to herein as "General Industrial Permit." For the General Industrial Permit, go to the Web site for the SWRCB.

If you operate a batch plant to manufacture PCC, HMA, or other material or a crushing plant to produce rock or aggregate, obtain coverage under the General Industrial Permit. You must be covered under the General Industrial Permit for batch plants and crushing plants located:

1. Outside of the job site
2. Within the job site that serve 1 or more contracts

If you obtain or dispose of material at a noncommercially operated borrow or disposal site, prevent water pollution due to erosion at the site during and after completion of your activities. Upon completion of your work, leave the site in a condition such that water will not collect or stand therein.

The Department does not pay for water pollution control practices at Contractor-support facilities and noncommercially operated borrow or disposal sites.

Definitions

active area: Area where soil-disturbing work activities have occurred at least once within 15 days.

construction phase: Includes (1) highway construction phase for building roads and structures, (2) plant establishment and maintenance phase for placing vegetation for final stabilization, and (3) suspension phase for suspension of work activities or winter shutdown. The construction phase continues from the start of work activities to contract acceptance.

inactive area: Area where soil-disturbing work activities have not occurred within 15 days.

normal working hours: Hours you normally work on the project.

qualifying rain event: Storm that produces at least 0.5 inch of precipitation with a 48-hour or greater period between rain events.

storm event: Storm that produces or is forecasted to produce at least 0.10 inch of precipitation within a 24-hour period.

Submittals

Storm Water Pollution Prevention Plan

General

Within 20 days of contract approval:

1. Submit 3 copies of your SWPPP for review. Allow 20 days for the Department's review. The Engineer provides comments and specifies the date when the review stopped if revisions are required.
2. Resubmit a revised SWPPP within 15 days of receiving the Engineer's comments. The Department's review resumes when a complete SWPPP has been resubmitted.
3. When the Engineer approves the SWPPP, submit an electronic copy and 4 printed copies of the approved SWPPP.
4. If the RWQCB requires review of the approved SWPPP, the Engineer submits the approved SWPPP to the RWQCB for its review and comment.
5. If the Engineer requests changes to the SWPPP based on the RWQCB's comments, amend the SWPPP within 10 days.

A qualified SWPPP developer (QSD) must develop the SWPPP.

The SWPPP must comply with the Department's Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Plan (WPCP) Preparation Manual. Include the following in the SWPPP:

1. Description of the work involved in the installation, maintenance, repair, and removal of temporary and permanent water pollution control practices.
2. Maps showing:
 - 2.1. Locations of disturbed soil areas
 - 2.2. Water bodies and conveyances
 - 2.3. Locations and types of water pollution control practices that will be used for each Contractor-support facility
 - 2.4. Locations and types of temporary water pollution control practices that will be used in the work for each construction phase
 - 2.5. Locations and types of water pollution control practices that will be installed permanently under the contract
 - 2.6. Pollutant sampling locations
 - 2.7. Locations planned for storage and use of potential nonvisible pollutants
 - 2.8. Receiving water sampling locations

3. Copy of permits obtained by the Department, including Fish & Game permits, US Army Corps of Engineers permits, RWQCB 401 certifications, aerially deposited lead variance from the Department of Toxic Substance Control, aerially deposited lead variance notification, and RWQCB waste discharge requirements for aerially deposited lead reuse.

Include the following items in the SWPPP:

1. For all projects:
 - 1.1. Schedule
 - 1.2. Construction site monitoring program (CSMP)
2. For risk level 2 projects add:
 - 2.1. Adherence to effluent standards for numeric action levels (NALs)
 - 2.2. Rain event action plan (REAP)
3. For risk level 3 projects add:
 - 3.1. Adherence to effluent standards for NALs and numeric effluent levels (NELs)
 - 3.2. REAP

Schedule

The SWPPP schedule must show when:

1. Work activities will be performed that could cause the discharge of pollutants into stormwater
2. Water pollution control practices associated with each construction phase will be implemented
3. Soil stabilization and sediment control practices for disturbed soil areas will be implemented

Construction Site Monitoring Program

A QSD must prepare the CSMP. Change the program to reflect current job site activities as needed. The CSMP must include the following:

1. For all projects:
 - 1.1. Visual monitoring procedures
 - 1.2. Sampling and analysis plan (SAP) for nonvisible pollutants
 - 1.3. SAP for nonstormwater discharges
 - 1.4. SAP for monitoring required by RWQCB
2. For risk level 2 projects add SAP for pH and turbidity
3. For risk level 3 projects add:
 - 3.1. SAP for pH and turbidity
 - 3.2. SAP for temporary active treatment systems

Sampling and Analysis Plan

Include a SAP in the CSMP.

Describe the following water quality sampling procedures in the SAP:

1. Sampling equipment
2. Sample preparation
3. Collection
4. Field measurement methods
5. Analytical methods
6. Quality assurance and quality control
7. Sample preservation and labeling
8. Collection documentation
9. Sample shipping

10. Chain of custody
11. Data management and reporting
12. Precautions from the construction site health and safety plan
13. Laboratory selection and certifications

The SAP must identify the State-certified laboratory, sample containers, preservation requirements, holding times, and analytical method. For a list of State-certified laboratories go to the CDPH Web site.

The SAP must include procedures for sample collection during precipitation.

The SAP must list conditions when you will not be required to physically collect samples such as:

1. Dangerous weather
2. Flooding or electrical storms
3. Times outside of normal working hours

Amend the SAP whenever discharges or sampling locations change because of changed work activities or knowledge of site conditions.

For a risk level 2 or risk level 3 project, include procedures in the SAP for collecting and analyzing at least 3 samples for each day of each qualifying rain event. Describe the collection of effluent samples at all locations where the stormwater is discharged off-site.

The SAP for nonvisible pollutants must describe the sampling and analysis strategy for monitoring nonvisible pollutants.

The SAP for nonvisible pollutants must identify potential nonvisible pollutants present at the job site associated with any of the following:

1. Construction materials and wastes
2. Existing contamination due to historical site usage
3. Application of soil amendments, including soil stabilization materials, with the potential to change pH or contribute toxic pollutants to stormwater

The SAP for nonvisible pollutants must include sampling procedures for the following conditions when observed during a stormwater visual inspection. Include a procedure for collecting at least 1 sample for each storm event for:

1. Materials or wastes containing potential nonvisible pollutants not stored under watertight conditions
2. Materials or wastes containing potential nonvisible pollutants stored under watertight conditions at locations where a breach, leak, malfunction, or spill occurred and was not cleaned up before the precipitation
3. Chemical applications occurring within 24 hours before precipitation or during precipitation that could discharge pollutants to surface waters or drainage systems, including fertilizer, pesticide, herbicide, methyl methacrylate concrete sealant, or nonpigmented curing compound
4. Applied soil amendments, including soil stabilization materials that could change pH levels or contribute toxic pollutants to stormwater runoff and discharge pollutants to surface waters or drainage systems, unless independent test data is available to indicate acceptable concentrations of nonvisible pollutants in the material
5. Stormwater runoff from an area contaminated by historical usage of the site that could discharge pollutants to surface waters or drainage systems

The SAP for nonvisible pollutants must provide sampling procedures and a schedule for:

1. Sample collection during the first 2 hours of rain events that generate runoff
2. Sample collection during normal working hours
3. Each nonvisible pollutant source
4. Uncontaminated control sample

The SAP for nonvisible pollutants must identify locations for sampling downstream and control samples and the reasons for selecting those locations. Select locations for control samples where the sample does not come in contact with materials, wastes, or areas associated with potential nonvisible pollutants or disturbed soil areas.

Amendments

Amend and resubmit the SWPPP:

1. Annually before July 15th
2. Whenever:
 - 2.1. Changes in work activities could affect the discharge of pollutants
 - 2.2. Water pollution control practices are added by Contract Change Order
 - 2.3. Water pollution control practices are added at your discretion
 - 2.4. Changes in the quantity of disturbed soil are substantial
 - 2.5. Objectives for reducing or eliminating pollutants in stormwater discharges have not been achieved
 - 2.6. You receive a written notice of a permit violation for the project from the RWQCB or any other regulatory agency

Allow the same review time for amendments to the SWPPP as for the original SWPPP.

Training Records

Submit water pollution control training records for all employees and subcontractors who will be working at the job site. Include the training subjects, training dates, ongoing training, and tailgate meetings with your submittal. Submit records for:

1. Existing employees within 5 business days of obtaining SWPPP approval
2. New employees within 5 business days of receiving the training
3. A subcontractor's employees at least 5 business days before the subcontractor starts work

Contractor-Support Facility

At least 5 business days before operating any Contractor-support facility, submit:

1. A plan showing the location and quantity of water pollution control practices associated with the Contractor-support facility
2. A copy of the notice of intent approved by the RWQCB and the SWPPP approved by the RWQCB if you will be operating a batch plant or a crushing plant under the General Industrial Permit

Annual Certification

Submit an annual certification of compliance as described in the Department's Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Plan (WPCP) Preparation Manual before July 15th of each year.

Site Inspection Reports

The water pollution control (WPC) manager must submit the following within 24 hours of completing a weekly inspection:

1. Completed Stormwater Site Inspection Report form.
2. Best management practices (BMP) status report. The WPC manager must oversee the preparation of the report. The report must include:
 - 2.1. Location and quantity of installed water pollution control practices
 - 2.2. Location and quantity of disturbed soil for active and inactive areas

Visual Monitoring Reports

Submit a visual monitoring report for:

1. Each storm event. Include:
 - 1.1. Date, time, and rain gauge reading
 - 1.2. Visual observations:

- 1.2.1. Within 2 business days before the storm for:
 - 1.2.1.1. Spills, leaks, and uncontrolled pollutants in drainage areas
 - 1.2.1.2. Proper implementation of water pollution control practices
 - 1.2.1.3. Leaks and adequate freeboard in storage areas
- 1.2.2. Every 24 hours during the storm for:
 - 1.2.2.1. Effective operation of water pollution control practices
 - 1.2.2.2. Water pollution control practices needing maintenance and repair
- 1.2.3. Within 2 business days after a qualifying rain event for:
 - 1.2.3.1. Stormwater discharge locations
 - 1.2.3.2. Evaluation of design, implementation, effectiveness, and locations of water pollution control practices including locations where additional water pollution control practices may be needed
- 2. Nonstormwater discharges during each of the following periods:
 - 2.1. January through March
 - 2.2. April through June
 - 2.3. July through September
 - 2.4. October through December

Use the Stormwater Site Inspection Report form to document visual monitoring. A visual monitoring report must include:

- 1. Name of personnel performing the inspection, inspection date, and date the inspection report is completed
- 2. Storm and weather conditions
- 3. Location of any:
 - 3.1. Floating and suspended material, sheen on the surface, discoloration, turbidity, odor, and source of observed pollutants for flowing and contained stormwater systems
 - 3.2. Nonstormwater discharges and their sources
- 4. Corrective action taken

Retain visual monitoring reports at the job site as part of the SWPPP.

Sampling and Analysis

Whenever sampling is required, submit a printed copy and electronic copy of water quality analysis results, and quality assurance and quality control reports within 48 hours of field sampling, and within 30 days of laboratory analysis. Electronic copies must be in one of the following formats: (1) xls, (2) .txt, (3) .cvs, (4) .dbs, or (5) .mdb. Include an evaluation of whether the downstream samples show levels of the tested parameter that are higher than the control sample. The evaluation must include:

- 1. Sample identification number
- 2. Contract number
- 3. Constituent
- 4. Reported value
- 5. Analytical method
- 6. Method detection limit
- 7. Reported limit

Numeric Action Level Exceedance Reports

Whenever a NAL is exceeded for a risk level 2 or risk level 3 project, notify the Engineer and submit a NAL exceedance report within 48 hours after conclusion of a storm event. The report must include:

1. Field sampling results and inspections, including:
 - 1.1. Analytical methods, reporting units, and detection limits
 - 1.2. Date, location, time of sampling, visual observations, and measurements
 - 1.3. Quantity of precipitation from the storm event
2. Description of BMP and corrective actions taken to manage NAL exceedance

Rain Event Action Plan

For a risk level 2 or risk level 3 project, submit a REAP whenever the National Weather Service is predicting a storm event with at least 50 percent probability of precipitation within 72 hours.

The WPC manager must submit the REAP at least 48 hours before a forecasted storm event.

The REAP must include:

1. Site location
2. Project risk level
3. Contact information including 24-hour emergency phone numbers for:
 - 3.1. WPC manager
 - 3.2. Erosion and sediment control providers or subcontractors
 - 3.3. Stormwater sampling providers or subcontractors
4. Storm information
5. Description of:
 - 5.1. Construction phase, including active and inactive areas
 - 5.2. Active work areas and activities
 - 5.3. Subcontractors and trades on the job site
 - 5.4. Prestorm activities including:
 - 5.4.1. Responsibilities of the WPC manager
 - 5.4.2. Responsibilities of the crew and crew size
 - 5.4.3. Stabilization practices for active and inactive disturbed soil areas
 - 5.4.4. Stockpile management practices
 - 5.4.5. Corrective actions taken for deficiencies identified during prestorm visual inspections
 - 5.5. Activities to be performed during storm events, including:
 - 5.5.1. Responsibilities of the WPC manager
 - 5.5.2. Responsibilities of the crew and crew size
 - 5.5.3. BMP for maintenance and repair
6. Flood contingency measures

Storm Water Annual Report

Submit 2 copies of a storm water annual report that covers the preceeding period from July 1st to June 30th. The report must be submitted before July 15th if construction occurs from July 1st to June 30th or within 15 days after contract acceptance if construction ends before June 30th. Allow 10 days for the Engineer's review. The Engineer provides comments and specifies the date when the review stopped if revisions are required.

Obtain approval for the format of the storm water annual report. The report must include:

1. Project information such as description and work locations
2. Stormwater monitoring information, including:
 - 2.1. Summary and evaluation of sampling and analysis results and laboratory reports
 - 2.2. Analytical methods, reporting units, and detections limits for analytical parameters
 - 2.3. Summary of corrective actions taken

- 2.4. Identification of corrective actions taken and compliance activities not implemented
 - 2.5. Summary of violations
 - 2.6. Names of individuals performing stormwater inspections and sampling
 - 2.7. Logistical information for inspections and sampling, including location, date, time, and precipitation
 - 2.8. Visual observations and sample collection records
3. Documentation of training for individuals responsible for:
 - 3.1. Permit compliance
 - 3.2. BMP installation, inspection, maintenance, and repair
 - 3.3. Preparing, revising, and amending the SWPPP

Submit a revised storm water annual report within 5 business days of receiving the Engineer's comments. The Engineer's review resumes when a complete report has been resubmitted.

When the storm water annual report is approved, submit 1 electronic copy and 2 printed copies of the report signed by the WPC manager.

Information After Storm Event

Within 48 hours after the conclusion of a storm event resulting in a discharge, after a nonstormwater discharge, or after receiving a written notice or an order from the RWQCB or another regulatory agency, the WPC manager must submit the following information:

1. Date, time, location, and nature of the activity and the cause of the notice or order
2. Type and quantity of discharge
3. Water pollution control practices in use before the discharge or before receiving the notice or order
4. Description of water pollution control practices and corrective actions taken to manage the discharge or cause of the notice

Quality Control and Assurance

Training

Employees must receive initial water pollution control training before starting work at the job site.

For your project managers, supervisory personnel, subcontractors, and employees involved in water pollution control work:

1. Provide stormwater training in the following subjects:
 - 1.1. Water pollution control rules and regulations
 - 1.2. Implementation and maintenance for:
 - 1.2.1. Temporary soil stabilization
 - 1.2.2. Temporary sediment control
 - 1.2.3. Tracking control
 - 1.2.4. Wind erosion control
 - 1.2.5. Material pollution prevention and control
 - 1.2.6. Waste management
 - 1.2.7. Nonstormwater management
2. Conduct weekly training meetings covering:
 - 2.1. Deficiencies and corrective actions for water pollution control practices
 - 2.2. Water pollution control practices required for work activities during the week
 - 2.3. Spill prevention and control
 - 2.4. Material delivery, storage, usage, and disposal
 - 2.5. Waste management
 - 2.6. Nonstormwater management procedures

Training for personnel who collect water quality samples must include:

1. CSMP review
2. Health and safety review
3. Sampling simulations

Water Pollution Control Manager

General

The WPC manager must be a QSD. Assign 1 WPC manager to implement the SWPPP. You may assign a QSD other than the WPC manager to develop the SWPPP.

Qualifications

A QSD must:

1. Have completed stormwater management training described in the Department's Web site for the Division of Construction, Storm Water and Water Pollution Control Information
2. Be one or more of the following:
 - 2.1. California registered civil engineer
 - 2.2. California registered professional geologist or engineering geologist
 - 2.3. California licensed landscape architect
 - 2.4. Professional hydrologist registered through the American Institute of Hydrology
 - 2.5. Certified Professional in Erosion and Sediment Control (CPESC)TM registered through Enviro Cert International, Inc.
 - 2.6. Certified Professional in Storm Water Quality (CPSWQ)TM registered through Enviro Cert International, Inc.
 - 2.7. Professional in erosion and sediment control registered through the National Institute for Certification in Engineering Technologies (NICET)
3. Have completed SWRCB approved QSD training and passed the QSD exam

Responsibilities

The WPC manager must:

1. Be responsible for water pollution control work
2. Be the primary contact for water pollution control work
3. Oversee:
 - 3.1. Maintenance of water pollution control practices
 - 3.2. Inspections of water pollution control practices identified in the SWPPP
 - 3.3. Inspections and reports for visual monitoring
 - 3.4. Preparation and implementation of REAPs
 - 3.5. Sampling and analysis
 - 3.6. Preparation and submittal of:
 - 3.6.1. NAL exceedance reports
 - 3.6.2. SWPPP annual certification
 - 3.6.3. Annual reports
 - 3.6.4. BMP status reports
4. Oversee and enforce hazardous waste management practices including spill prevention and control measures
5. Have authority to mobilize crews to make immediate repairs to water pollution control practices
6. Ensure that all employees have current water pollution control training
7. Implement the approved SWPPP
8. Amend the SWPPP if required
9. Be at the job site within 2 hours of being contacted
10. Have the authority to stop construction activities damaging water pollution control practices or causing water pollution

Sampling and Analysis

Assign trained personnel to collect water quality samples. Document the personnel and training in the SAP.

Samples taken by assigned field personnel must comply with the equipment manufacturer's instructions for collection, analytical methods, and equipment calibration.

Samples taken for laboratory analysis must comply with water quality sampling procedures and be analyzed by a State-certified laboratory under 40 CFR part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants.

Whenever downstream samples show increased levels of pollutants, assess water pollution control practices, site conditions, and surrounding influences to determine the probable cause for the increase.

For a risk level 2 or risk level 3 project, obtain samples of pH and turbidity by the test methods shown in the following table:

Parameter	Test method	Detection limit (min)	Unit
pH	Field test with calibrated portable instrument	0.2	pH units
Turbidity	Field test with calibrated portable instrument	1	NTU

Numeric Action Levels

For a risk level 2 or risk level 3 project, NALs must comply with the values shown in the following table:

Numeric Action Levels

Parameter	Test method	Detection limit (min)	Unit	Value
pH	Field test with calibrated portable instrument	0.2	pH	Lower NAL = 6.5 Upper NAL = 8.5
Turbidity	Field test with calibrated portable instrument	1	NTU	250 NTU max

The storm event daily average must not exceed the NAL for pH.

The storm event daily average must not exceed the NAL for turbidity.

MATERIALS

Not Used

CONSTRUCTION

General

Manage work activities to reduce the discharge of pollutants to surface waters, groundwater, and municipal separate storm sewer systems.

Retain a printed copy of the approved SWPPP at the job site.

Install facilities and devices used for water pollution control practices before performing work activities. Install soil stabilization materials for water pollution control practices in all inactive areas or before storm events.

Repair or replace water pollution control practices within 24 hours of discovering any damage, unless a longer period is authorized.

The Department does not pay for the cleanup, repair, removal, disposal, or replacement of water pollution control practices due to improper installation or your negligence.

You may request changes to the water pollution control work or the Engineer may order changes to water pollution control work. Changes may include additional or new water pollution control practices. Additional water

pollution control work is paid for as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

You may request or the Engineer may order laboratory analysis of stormwater samples. If ordered, laboratory analysis of stormwater samples is paid for as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

Continue SWPPP implementation during any suspension of work activities.

Monitoring

Monitor the National Weather Service's forecast on a daily basis. For the National Weather Service's forecast, go to the Web site for the National Weather Service.

Obtain, install, and maintain a rain gauge at the job site. Observe and record daily precipitation.

Inspections

Use the Stormwater Site Inspection Report form for documenting site inspections.

The WPC manager must oversee:

1. Inspections of water pollution control practices identified in SWPPP:
 - 1.1. Before a forecasted storm event
 - 1.2. After a qualifying rain event that produces site runoff
 - 1.3. At 24-hour intervals during extended storm events
 - 1.4. On a predetermined schedule of at least once a week
2. Daily inspections of:
 - 2.1. Storage areas for hazardous materials and waste
 - 2.2. Hazardous waste disposal and transporting activities
 - 2.3. Hazardous material delivery and storage activities
3. Inspections of:
 - 3.1. Vehicle and equipment cleaning facilities:
 - 3.1.1. Daily if vehicle and equipment cleaning occurs daily
 - 3.1.2. Weekly if vehicle and equipment cleaning does not occur daily
 - 3.2. Vehicle and equipment maintenance and fueling areas:
 - 3.2.1. Daily if vehicle and equipment maintenance and fueling occurs daily
 - 3.2.2. Weekly if vehicle and equipment maintenance and fueling does not occur daily
 - 3.3. Vehicles and equipment at the job site for leaks and spills on a daily schedule. Verify that operators are inspecting vehicles and equipment each day of use.
 - 3.4. Demolition sites within 50 feet of storm drain systems and receiving waters daily.
 - 3.5. Pile driving areas for leaks and spills:
 - 3.5.1. Daily if pile driving occurs daily
 - 3.5.2. Weekly if pile driving does not occur daily
 - 3.6. Temporary concrete washouts:
 - 3.6.1. Daily if concrete work occurs daily
 - 3.6.2. Weekly if concrete work does not occur daily
 - 3.7. Paved roads at job site access points for street sweeping:
 - 3.7.1. Daily if earthwork and other sediment or debris-generating activities occur daily
 - 3.7.2. Weekly if earthwork and other sediment or debris-generating activities do not occur daily

3.7.3. Within 24 hours of precipitation forecasted by the National Weather Service

3.8. Dewatering work:

3.8.1. Daily if dewatering work occurs daily

3.8.2. Weekly if dewatering work does not occur daily

3.9. Temporary active treatment system:

3.9.1. Daily if temporary active treatment system activities occur daily

3.9.2. Weekly if temporary active treatment system activities do not occur daily

3.10. Work over water:

3.10.1. Daily if work over water occurs daily

3.10.2. Weekly if work over water does not occur daily

Deficiencies

Whenever you or the Engineer identify a deficiency in the implementation of the approved SWPPP, correct the deficiency:

1. Immediately, unless a later date is authorized
2. Before precipitation occurs

The Department may correct the deficiency and deduct the cost of correcting the deficiency from payment if you fail to correct the deficiency by the agreed date or before the onset of precipitation.

Rain Event Action Plan

For a risk level 2 or risk level 3 project, have the REAP at the job site at least 24 hours before a forecasted storm event. The WPC manager must submit the REAP on the following forms:

1. Rain Event Action Plan Highway Construction Phase
2. Rain Event Action Plan Plant Establishment Phase
3. Rain Event Action Plan For Inactive Project

Retain a printed copy of each REAP at the job site as part of the SWPPP.

Implement the REAP, including mobilizing crews to complete activities, within 24 hours before precipitation occurs.

Sampling and Analysis

Perform sample collection during:

1. Normal working hours
2. Each qualifying rain event
3. First 2 hours of each storm event

Do not physically collect samples during dangerous weather conditions, such as flooding or electrical storms.

Document sample collection during precipitation.

Whenever downstream samples show increased levels of pH, turbidity, and other constituents, assess water pollution control practices, site conditions, and surrounding influences to determine the probable cause for the increase.

Collect samples:

1. During a storm event for:
 - 1.1. Each nonvisible pollutant source and a corresponding uncontaminated control sample
 - 1.2. All locations identified on the Storm Event Sampling and Analyses Plan form

2. During a qualifying rain event for:
 - 2.1. Each nonvisible pollutant source and a corresponding uncontaminated control sample
 - 2.2. pH, turbidity, and other constituents as required
 - 2.3. At least 3 samples for each day of a qualifying rain event
 - 2.4. All locations identified on the Qualifying Rain Event Sampling and Analyses Plan form

Retain documentation of water quality sampling and analysis results with the SWPPP at the job site.

The Department does not pay for the preparation, collection, laboratory analysis, and reporting of stormwater samples for nonvisible pollutants if water pollution control practices are not implemented before precipitation or if you fail to correct a water pollution control practice before precipitation.

MEASUREMENT AND PAYMENT

The contract lump sum price for prepare storm water pollution prevention plan includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in developing and implementing a SWPPP, including providing a WPC manager, conducting water pollution control training, and monitoring, inspecting and correcting water pollution control practices at the job site, as shown on the plans, as specified in the Standard Specifications and these special provisions, and directed by the Engineer.

For projects with 60 working days or less, the Department pays you for prepare stormwater pollution prevention plan as follows:

1. A total of 75 percent of the item total upon approval of the SWPPP
2. A total of 100 percent of the item total upon contract acceptance

For projects with more than 60 working days, the Department pays you for prepare stormwater pollution prevention plan as follows:

1. A total of 50 percent of the item total upon approval of the SWPPP
2. A total of 90 percent of the item total over the life of the contract
3. A total of 100 percent of the item total upon contract acceptance

If risk level 2 or 3, the Department pays \$500 for each rain event action plan submitted. The contract unit price paid for rain event action plan includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in preparing REAPs, including preparing and submitting REAP forms, and monitoring weather forecasts, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The Department does not adjust payment for an increase or decrease in the quantity of rain event action plan. Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications does not apply.

The Department pays \$2,000 for each storm water annual report submitted. The contract unit price paid for storm water annual report includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in preparing and submitting storm water annual reports, including annual certifications, monitoring reports, inspection, and sampling results, and obtaining acceptance of storm water annual reports, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The Department does not adjust payment for an increase or decrease in the quantity of storm water annual report. Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications does not apply.

The work to complete the final storm water annual report contract item is excluded from Section 7-1.17, "Acceptance of Contract," of the Standard Specifications.

If risk level 2 or 3, the contract unit price paid for storm water sampling and analysis day includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in reporting on stormwater quality per storm events and qualifying rain events, including preparation, collection, analysis of stormwater samples for pH, turbidity, and other constituents, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer. A single day of sampling is counted as 1 unit.

The Department does not adjust payment for an increase or decrease in the quantity of storm water sampling and analysis day. Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications does not apply.

The Department does not pay for the preparation, collection, laboratory analysis, and reporting of stormwater samples for nonvisible pollutants if water pollution control practices are not implemented before precipitation or if you fail to correct a water pollution control practice before precipitation.

For each failure to submit a completed storm water annual report, the Department withholds \$10,000. This withhold is in addition to other withholds under Section 9-1.07E(3) "Performance Failure Withholds," of the Standard Specifications.

Each failure to comply with any part of these special provisions and each failure to implement water pollution control practices are considered separate performance failures.

10-1.04 CONSTRUCTION SITE MANAGEMENT

GENERAL

Summary

This work includes preventing and controlling spills, dewatering, and managing materials, waste, and nonstormwater.

Implement effective handling, storage, usage, and disposal practices to control material pollution and manage waste and nonstormwater at the job site before they come in contact with storm drain systems and receiving waters.

The following abbreviations are used in this special provision:

DTSC: Department of Toxic Substance Control.

ELAP: Environmental Laboratory Accreditation Program.

WPC: Water Pollution Control.

Submittals

Before you start dewatering, submit a dewatering and discharge work plan under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications and "Water Pollution Control" of these special provisions. The dewatering and discharge work plan must include:

1. Title sheet and table of contents
2. Description of dewatering and discharge activities detailing locations, quantity of water, equipment, and discharge point
3. Estimated schedule for dewatering and discharge start and end dates of intermittent and continuous activities
4. Discharge alternatives, such as dust control or percolation
5. Visual monitoring procedures with inspection log
6. Copy of written approval to discharge into a sanitary sewer system at least 5 business days before starting discharge activities

Submit the following:

1. Material Safety Data Sheet at least 5 business days before material is used or stored
2. Monthly inventory records for material used or stored

Submit written approval from the local health agency, city, county, and sewer district before discharging from a sanitary or septic system directly into a sanitary sewer system.

MATERIALS

Not Used

CONSTRUCTION

Spill Prevention and Control

General

Keep material or waste storage areas clean, well organized, and equipped with enough cleanup supplies for the material being stored.

Implement spill and leak prevention procedures for chemicals and hazardous substances stored on the job site. Whenever you spill or leak chemicals or hazardous substances at the job site, you are responsible for all associated cleanup costs and related liability.

Report minor, semi-significant, and significant or hazardous spills to the WPC manager. The WPC manager must notify the Engineer immediately.

As soon as it is safe, contain and clean up spills of petroleum materials and sanitary and septic waste substances listed under 40 CFR, Parts 110, 117, and 302.

Minor Spills

Minor spills consist of quantities of oil, gasoline, paint, or other materials that are small enough to be controlled by a 1st responder upon discovery of the spill.

Clean up a minor spill using the following procedures:

1. Contain the spread of the spill
2. Recover the spilled material using absorption
3. Clean the contaminated area
4. Dispose of the contaminated material and absorbents promptly and properly under "Waste Management" of these special provisions

Semi-Significant Spills

Semi-significant spills consist of spills that can be controlled by a 1st responder with help from other personnel.

Clean up a semi-significant spill immediately using the following procedures:

1. Contain the spread of the spill.
2. On paved or impervious surfaces, encircle and recover the spilled material with absorbent materials. Do not allow the spill to spread widely.
3. If the spill occurs on soil, contain the spill by constructing an earthen dike and dig up the contaminated soil for disposal.
4. If the spill occurs during precipitation, cover the spill with 10-mil plastic sheeting or other material to prevent contamination of runoff.
5. Dispose of the contaminated material promptly and properly under "Waste Management" of these special provisions.

Significant or Hazardous Spills

Significant or hazardous spills consist of spills that cannot be controlled by job site personnel.

Immediately notify qualified personnel of a significant or hazardous spill. Take the following steps:

1. Do not attempt to clean up the spill until qualified personnel have arrived
2. Notify the Engineer and follow up with a report
3. Obtain the immediate services of a spill contractor or hazardous material team
4. Notify local emergency response teams by dialing 911 and county officials by using the emergency phone numbers retained at the job site
5. Notify the California Emergency Management Agency State Warning Center at (916) 845-8911
6. Notify the National Response Center at (800) 424-8802 regarding spills of Federal reportable quantities under 40 CFR 110, 119, and 302
7. Notify other agencies as appropriate, including:
 - 7.1. Fire Department
 - 7.2. Public Works Department
 - 7.3. Coast Guard
 - 7.4. Highway Patrol
 - 7.5. City Police or County Sheriff's Department
 - 7.6. Department of Toxic Substances
 - 7.7. California Division of Oil and Gas
 - 7.8. Cal/OSHA
 - 7.9. Regional Water Resources Control Board

Prevent a spill from entering stormwater runoff before and during cleanup activities. Do not bury or wash the spill with water.

Material Management

General

Minimize or eliminate discharge of material into the air, storm drain systems, and receiving waters while taking delivery of, using, or storing the following materials:

1. Hazardous chemicals, including acids, lime, glues, adhesives, paints, solvents, and curing compounds
2. Soil stabilizers and binders
3. Fertilizers
4. Detergents
5. Plaster
6. Petroleum materials, including fuel, oil, and grease
7. Asphalt and concrete components
8. Pesticides and herbicides

Employees trained in emergency spill cleanup procedures must be present during the unloading of hazardous materials or chemicals.

Use less hazardous materials if practicable.

The following activities must be performed at least 100 feet from concentrated flows of stormwater, drainage courses, and inlets if within the floodplain and at least 50 feet if outside the floodplain, unless otherwise approved by the Engineer:

1. Stockpiling materials
2. Storing pile-driving equipment and liquid waste containers
3. Washing vehicles and equipment in outside areas
4. Fueling and maintaining vehicles and equipment

Material Storage

If materials are stored:

1. Store liquids, petroleum materials, and substances listed in 40 CFR 110, 117, and 302 and place them in secondary containment facilities as specified by US DOT for storage of hazardous materials.
2. Secondary containment facilities must be impervious to the materials stored there for a minimum contact time of 72 hours.
3. Cover secondary containment facilities during non-working days and whenever precipitation is forecasted. Secondary containment facilities must be adequately ventilated.
4. Keep secondary containment facilities free of accumulated rainwater or spills. After precipitation, or in the event of spills or leaks, collect accumulated liquid and place it into drums within 24 hours. Handle the liquid as hazardous waste under "Waste Management" of these special provisions unless testing confirms that the liquid is nonhazardous.
5. Do not store incompatible materials, such as chlorine and ammonia, in the same secondary containment facility.
6. Store materials in their original containers with the original material labels maintained in legible condition. Immediately replace damaged or illegible labels.
7. Secondary containment facilities must have the capacity to contain precipitation from a 24-hour-long, 25-year storm, plus 10 percent of the aggregate volume of all containers or the entire volume of the largest container within the facility, whichever is greater.
8. Store bagged or boxed material on pallets. Protect bagged or boxed material from wind and rain during non-working days and whenever precipitation is forecasted.
9. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well organized, and equipped with cleanup supplies appropriate for the materials being stored.
10. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after precipitation and at least weekly during other times.

Stockpile Management

Minimize stockpiling of materials at the job site.

Implement water pollution control practices within 72 hours of stockpiling material or before a forecasted storm event, whichever occurs first. If stockpiles are being used, do not allow soil, sediment, or other debris to enter storm drains, open drainages, and watercourses.

Active and inactive soil stockpiles must be:

1. Covered with soil stabilization material or a temporary cover
2. Surrounded with a linear sediment barrier

Stockpiles of asphalt concrete and PCC rubble, HMA, aggregate base, or aggregate subbase must be:

1. Covered with a temporary cover
2. Surrounded with a linear sediment barrier

Stockpiles of pressure-treated wood must be:

1. Placed on pallets
2. Covered with impermeable material

Stockpiles of cold mix asphalt concrete must be:

1. Placed on an impervious surface
2. Covered with an impermeable material
3. Protected from stormwater run-on and runoff

Control wind erosion year round under Section 14-9.02, "Dust Control," of the Standard Specifications.

Repair or replace linear sediment barriers and covers as needed to keep them functioning properly. Whenever sediment accumulates to 1/3 of the linear sediment barrier height, remove the accumulated sediment.

Waste Management

Solid Waste

Do not allow litter, trash, or debris to accumulate anywhere on the job site, including storm drain grates, trash racks, and ditch lines. Pick up and remove litter, trash, and debris from the job site at least once a week. The WPC manager must monitor solid waste storage and disposal procedures on the job site.

If practicable, recycle nonhazardous job site waste and excess material. If recycling is not practicable, dispose of it under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way," of the Standard Specifications.

Furnish enough closed-lid dumpsters of sufficient size to contain the solid waste generated by work activities. When refuse reaches the fill line, empty the dumpsters. Dumpsters must be watertight. Do not wash out dumpsters at the job site. Furnish additional containers and pick up dumpsters more frequently during the demolition phase of construction.

Solid waste includes:

1. Brick
2. Mortar
3. Timber
4. Metal scraps
5. Sawdust
6. Pipe
7. Electrical cuttings
8. Nonhazardous equipment parts
9. Styrofoam and other packaging materials
10. Vegetative material and plant containers from highway planting
11. Litter and smoking material, including litter generated randomly by the public
12. Other trash and debris

Furnish and use trash receptacles in the job site yard, field trailers, and locations where workers gather for lunch and breaks.

Hazardous Waste and Contamination

If hazardous waste is, or will be, generated on the job site, the WPC manager must be thoroughly familiar with proper hazardous waste handling and emergency procedures under 40 CFR § 262.34(d)(5)(iii) and must have successfully completed training under 22 CA Code of Regs § 66265.16.

The WPC manager must:

1. Oversee and enforce hazardous waste management practices
2. Inspect all hazardous waste storage areas daily, including all temporary containment facilities and satellite collection locations
3. Oversee all hazardous waste transportation activities on the job site

Submit a copy of uniform hazardous waste manifest forms to the Engineer within 24 hours of transporting hazardous waste.

Submit receiving landfill documentation of proper disposal to the Engineer within 5 business days of hazardous waste transport from the project.

Unanticipated Discovery of Asbestos and Hazardous Substances

Upon discovery of asbestos or a hazardous substance, comply with Section 14-11.02 "Asbestos and Hazardous Substances," of the Standard Specifications.

Hazardous Waste Management Practices

Handle, store, and dispose of hazardous waste under 22 CA Code of Regs Div 4.5.

Use the following storage procedures:

1. Store hazardous waste and potentially hazardous waste separately from nonhazardous waste at the job site.
2. For hazardous waste storage, use metal containers approved by the United States Department of Transportation for the transportation and temporary storage of hazardous waste.
3. Store hazardous waste in sealed, covered containers labeled with the contents and accumulation start date under 22 CA Code of Regs, Div 4.5. Labels must comply with the provisions of 22 CA Code of Regs, Div 4.5. § 66262.31 and § 66262.32. Immediately replace damaged or illegible labels.
4. Handle hazardous waste containers such that no spillage occurs.
5. Store hazardous waste away from storm drains, watercourses, moving vehicles, and equipment.
6. Furnish containers with adequate storage volume at convenient satellite locations for hazardous waste collection. Immediately move these containers to secure temporary containment facilities when no longer needed at the collection location or when full.
7. Store hazardous waste and potentially hazardous waste in secure temporary containment enclosures having secondary containment facilities impervious to the materials stored there for a minimum contact-time of 72 hours. Temporary containment enclosures must be located away from public access. Acceptable secure enclosures include a locked chain link fenced area or a lockable shipping container located within the project limits.
8. Design and construct secondary containment facilities with a capacity to contain precipitation from a 24-hour-long, 25-year storm; and 10 percent of the aggregate volume of all containers, or the entire volume of the largest container within the facility, whichever is greater.
9. Cover secondary containment facilities during non-working days and if a storm event is predicted. Secondary containment facilities must be adequately ventilated.
10. Keep secondary containment facility free of accumulated rainwater or spills. After a storm event, or in the event of spills or leaks, collect accumulated liquid and place into drums within 24 hours. Handle these liquids as hazardous waste unless testing determines them to be nonhazardous.
11. Do not store incompatible wastes, such as chlorine and ammonia, in the same secondary containment facility.
12. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well organized, and equipped with cleanup supplies appropriate for the wastes being stored.
13. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after a storm event, and at least weekly during other times.

Do not:

1. Overfill hazardous waste containers
2. Spill hazardous waste or potentially hazardous waste
3. Mix hazardous wastes
4. Allow hazardous waste or potentially hazardous waste to accumulate on the ground

Dispose of hazardous waste within 90 days of the start of generation. Use a hazardous waste manifest and a transporter registered with the DTSC and in compliance with the CA Highway Patrol Biennial Inspection of Terminals Program to transport hazardous waste to an appropriately permitted hazardous waste management facility.

Dust Control for Hazardous Waste or Contamination

Excavation, transportation, and handling of material containing hazardous waste or contamination must result in no visible dust migration. Have a water truck or tank on the job site at all times while clearing and grubbing and performing earthwork operations in work areas containing hazardous waste or contamination.

Stockpiling of Hazardous Waste or Contamination

Do not stockpile material containing hazardous waste or contamination unless ordered. Stockpiles of material containing hazardous waste or contamination must not be placed where affected by surface run-on or run-off. Cover stockpiles with 13 mils minimum thickness of plastic sheeting or 1 foot of nonhazardous material. Do not place stockpiles in environmentally sensitive areas. Stockpiled material must not enter storm drains, inlets, or waters of the State.

Contractor-Generated Hazardous Waste

You are the generator of hazardous waste generated as a result of materials you bring to the job site. Use hazardous waste management practices if you generate waste on the job site from the following substances:

1. Petroleum materials
2. Asphalt materials
3. Concrete curing compound
4. Pesticides
5. Acids
6. Paints
7. Stains
8. Solvents
9. Wood preservatives
10. Roofing tar
11. Road flares
12. Lime
13. Glues and adhesives
14. Materials classified as hazardous waste under 22 CA Code of Regs, Div 4.5

If hazardous waste constituent concentrations are unknown, use a laboratory certified by the ELAP under the California Department Of Public Health to analyze a minimum of 4 discrete representative samples of the waste to determine whether it is a hazardous waste and to determine safe and lawful methods for storage and disposal. Perform sampling and analysis in compliance with US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) and under 22 CA Code of Regs, Div 4.5.

Use your US EPA Generator Identification Number and sign hazardous waste manifests for the hazardous waste you generate.

Identify contaminated soil resulting from spills or leaks by noticing discoloration, or differences in soil properties. Immediately notify the Engineer of spills or leaks. Clean up spills and leaks under the Engineer's direction and to the satisfaction of the Engineer. Soil with evidence of contamination must be sampled and analysis performed by a laboratory certified by ELAP.

If sampling and analysis of contaminated soil demonstrates that it is a hazardous waste, handle and dispose of the soil as hazardous waste. You are the generator of hazardous waste created as the result of spills or leaks for which you are responsible.

Prevent the flow of water, including ground water, from mixing with contaminated soil by using one or a combination of the following measures:

1. Berms
2. Cofferdams
3. Grout curtains
4. Freeze walls
5. Concrete seal course

If water mixes with contaminated soil and becomes contaminated, sample and analyze the water using a laboratory certified by the ELAP. If analysis results demonstrate that the water is a hazardous waste, manage and dispose of the water as hazardous waste.

Department-Generated Hazardous Waste

If the Department is the generator of hazardous waste during the work performed on this project, use hazardous waste management practices.

Labels must comply with the provisions of 22 CA Code of Regs § 66262.31 and § 66262.32. Mark labels with:

1. Date the hazardous waste is generated
2. The words "Hazardous Waste"
3. Composition and physical state of the hazardous waste (for example, asphalt grindings with thermoplastic or paint)
4. The word "Toxic"
5. Name, address, and telephone number of the Engineer
6. Contract number
7. Contractor or subcontractor name

Handle the containers such that no spillage occurs.

Hazardous Waste Transport and Disposal

Dispose of hazardous waste within California at a disposal site operating under a permit issued by the DTSC.

The Engineer will obtain the US EPA Generator Identification Number for hazardous waste disposal.

The Engineer will sign all hazardous waste manifests. Notify the Engineer 5 business days before the manifests are to be signed.

The Department will not consider you a generator of the hazardous waste and you will not be obligated for further cleanup, removal, or remedial action for such material if handled or disposed of under these specifications and the appropriate State and federal laws and regulations and county and municipal ordinances and regulations regarding hazardous waste.

Paint Waste

Clean water-based and oil-based paint from brushes or equipment within a contained area in a way that does not contaminate soil, receiving waters, or storm drain systems. Handle and dispose of the following as hazardous waste: paints, thinners, solvents, residues, and sludges that cannot be recycled or reused. When thoroughly dry, dispose of the following as solid waste: dry latex paint, paint cans, used brushes, rags, absorbent materials, and drop cloths.

Concrete Waste

Use practices to prevent the discharge of asphalt concrete, PCC, and HMA waste into storm drain systems and receiving waters.

Collect and dispose of asphalt concrete, PCC, and HMA waste generated at locations where:

1. Concrete material, including grout, is used
2. Concrete dust and debris result from demolition
3. Sawcutting, coring, grinding, grooving, or hydro-concrete demolition creates a residue or slurry
4. Concrete trucks or other concrete-coated equipment is cleaned at the job site

Sanitary and Septic Waste

Do not bury or discharge wastewater from a sanitary or septic system within the highway. A sanitary facility discharging into a sanitary sewer system must be properly connected and free from leaks. Place a portable sanitary facility at least 50 feet away from storm drains, receiving waters, and flow lines.

Comply with local health agency provisions if using an on-site disposal system.

Liquid Waste

Use practices that will prevent job-site liquid waste from entering storm drain systems and receiving waters. Liquid waste include the following:

1. Drilling slurries or fluids
2. Grease-free and oil-free wastewater and rinse water
3. Dredgings, including liquid waste from cleaning drainage systems
4. Liquid waste running off a surface, including wash or rinse water
5. Other nonstormwater liquids not covered by separate permits

Hold liquid waste in structurally sound, leak-proof containers, such as roll-off bins or portable tanks.

Liquid waste containers must be of sufficient quantity and volume to prevent overflow, spills, and leaks.

Store containers at least 50 feet from moving vehicles and equipment.

Remove and dispose of deposited solids from sediment traps unless the Engineer approves another method.

Liquid waste may require testing to determine hazardous material content before disposal.

Dispose of drilling fluids and residue.

If a location approved by the Engineer is available within the job site, fluids and residue exempt under 23 CA Code of Regs § 2511(g) may be dried by evaporation in a leak-proof container. Dispose of the remaining as solid waste.

Nonstormwater Management

Water Control and Conservation

Manage water used for work activities in a way that will prevent erosion and the discharge of pollutants into storm drain systems and receiving waters. Obtain authorization before washing anything at the job site with water that could discharge into a storm drain system or receiving waters. Report discharges immediately.

Implement water conservation practices if water is used at the job site. Inspect irrigation areas. Adjust watering schedules to prevent erosion, excess watering, or runoff. Shut off the water source to broken lines, sprinklers, or valves and repair breaks within 24 hours. Reuse water from waterline flushing for landscape irrigation if practicable. Sweep and vacuum paved areas. Do not wash paved areas with water.

Direct runoff water, including water from water line repair, from the job site to areas where it can infiltrate into the ground. Do not allow runoff water to enter storm drain systems and receiving waters. Do not allow spilled water to escape filling areas for water trucks. Direct water from off-site sources around the job site if practicable. Minimize the contact of off-site water with job site water.

Illegal Connection and Discharge Detection and Reporting

Before starting work, inspect the job site and the job site's perimeter for evidence of illicit connections, illegal discharges, and dumping. After starting work, inspect the job site and perimeter on a daily schedule for illicit connections and illegal dumping and discharges.

Whenever illegal connections, discharges, or dumping are discovered, notify the Engineer immediately. Do not take further action unless ordered. Assume that unlabeled or unidentifiable material is hazardous.

Look for the following evidence of illicit connections, illegal discharges, and dumping:

1. Debris or trash piles
2. Staining or discoloration on pavement or soils
3. Pungent odors coming from drainage systems
4. Discoloration or oily sheen on water
5. Stains and residue in ditches, channels, or drain boxes
6. Abnormal water flow during dry weather
7. Excessive sediment deposits
8. Nonstandard drainage junction structures
9. Broken concrete or other disturbances at or near junction structures

Vehicle and Equipment Cleaning

Limit vehicle and equipment cleaning or washing at the job site except what is necessary to control vehicle tracking or hazardous waste. Notify the Engineer before cleaning vehicles and equipment at the job site with soap, solvents, or steam. Contain and recycle or dispose of resulting waste under "Waste Management" of these special provisions, whichever is applicable. Do not use diesel to clean vehicles or equipment. Minimize the use of solvents.

Clean or wash vehicles and equipment in a structure equipped with disposal facilities. You may wash vehicles in an outside area if the area is:

1. Paved with asphalt concrete, HMA, or PCC
2. Surrounded by a containment berm
3. Equipped with a sump to collect and dispose of wash water

Use as little water as practicable whenever washing vehicles and equipment with water. Hoses must be equipped with a positive shutoff valve.

Discharge liquid from wash racks to a recycling system or to another system approved by the Engineer. Remove liquids and sediment as necessary.

Vehicle and Equipment Fueling and Maintenance

If practicable, perform maintenance on vehicles and equipment off-site.

If fueling or maintenance must be done at the job site, assign a site or sites, and obtain authorization before using them. Minimize mobile fueling and maintenance activities. Fueling and maintenance activities must be performed on level ground in areas protected from stormwater run-on and runoff.

Use containment berms or dikes around fueling and maintenance areas. Keep adequate quantities of absorbent spill-cleanup material and spill kits in the fueling or maintenance area and on fueling trucks. Dispose of spill-cleanup material and kits immediately after use under "Waste Management" of these special provisions. Use drip pans or absorbent pads during fueling or maintenance.

Do not leave fueling or maintenance areas unattended during fueling and maintenance activities. Fueling nozzles must be equipped with an automatic shutoff control. Nozzles must be equipped with vapor-recovery fueling nozzles where required by the Air Quality Management District. Secure nozzles in an upright position when not in use. Do not top off fuel tanks.

Recycle or properly dispose of used batteries and tires under "Waste Management" of these special provisions.

If leaks cannot be repaired immediately, remove the vehicle or equipment from the job site.

Material and Equipment Used Over Water

Place drip pans and absorbent pads under vehicles and equipment used over water. Keep an adequate supply of spill-cleanup material with vehicles and equipment. Place drip pans or plastic sheeting under vehicles and equipment on docks, barges, or other surfaces over water whenever vehicles or equipment will be idle for more than 1 hour.

Furnish watertight curbs or toe boards on barges, platforms, docks, or other surfaces over water to contain material, debris, and tools. Secure material to prevent spills or discharge into the water due to wind.

Report discharges to receiving waters immediately upon discovery. Submit a discharge notification to the Engineer.

Structure Removal Over or Adjacent to Water

Do not allow demolished material to enter storm drain systems and receiving waters. Use covers and platforms approved by the Engineer to collect debris. Use attachments on equipment to catch debris during small demolition activities. Empty debris-catching devices daily.

Paving, Sealing, Sawcutting, Grooving, and Grinding Activities

Prevent material from entering storm drain systems and receiving waters including:

1. Cementitious material
2. Asphaltic material
3. Aggregate or screenings
4. Sawcutting, grooving, and grinding residue
5. Pavement chunks
6. Shoulder backing

7. Methacrylate
8. Sandblasting residue

Cover drainage inlets and use linear sediment barriers to protect downhill receiving waters until paving, sealing, sawcutting, grooving, and grinding activities are completed and excess material has been removed. Cover drainage inlets and manholes during the application of seal coat, tack coat, slurry seal, or fog seal.

Whenever precipitation is forecasted, limit paving, sawcutting, and grinding to places where runoff can be captured.

Do not start seal coat, tack coat, slurry seal, or fog seal activities whenever precipitation is forecasted during the application and curing period. Do not excavate material from existing roadways during precipitation.

Use a vacuum to remove slurry immediately after slurry is produced. Do not allow the slurry to run onto lanes open to traffic or off the pavement.

Collect the residue from PCC grooving and grinding activities with a vacuum attachment on the grinding machine. Do not leave the residue on the pavement or allow the residue to flow across pavement.

You may stockpile material excavated from existing roadways under "Material Management" of these special provisions if approved by the Engineer.

Do not coat asphalt trucks and equipment with substances that contain soap, foaming agents, or toxic chemicals.

Park paving equipment over drip pans or plastic sheeting with absorbent material to catch drips if the paving equipment is not in use.

Thermoplastic Striping and Pavement Markers

Do not preheat, transfer, or load thermoplastic within 50 feet of drainage inlets and receiving waters.

Do not unload, transfer, or load bituminous material for pavement markers within 50 feet of drainage inlets and receiving waters.

Collect and dispose of bituminous material from the roadway after removing markers under "Waste Management" of these special provisions.

Pile Driving

Keep spill kits and cleanup materials at pile driving locations. Park pile driving equipment over drip pans, absorbent pads, or plastic sheeting with absorbent material. Protect pile driving equipment by parking on plywood and covering with plastic whenever precipitation is forecasted.

Store pile driving equipment on level ground and protect it from stormwater run-on when not in use. Use vegetable oil instead of hydraulic fluid if practicable.

Concrete Curing

Do not overspray chemical curing compounds. Minimize the drift by spraying as close to the concrete as practicable. Do not allow runoff of curing compounds. Cover drainage inlets before applying the curing compound.

Minimize the use and discharge of water by using wet blankets or similar methods to maintain moisture when concrete is curing.

Concrete Finishing

Collect and dispose of water and solid waste from high-pressure water blasting under "Waste Management" of these special provisions. Collect and dispose of sand and solid waste from sandblasting under "Waste Management" of these special provisions. Before sandblasting, cover drainage inlets within 50 feet of sandblasting. Minimize the drift of dust and blast material by keeping the nozzle close to the surface of the concrete. If the character of the blast residue is unknown, test it for hazardous materials and dispose of it properly.

Inspect containment structures for concrete finishing for damage before each day of use and before forecasted precipitation. Remove liquid and solid waste from containment structures after each work shift.

Sweeping

Sweep by hand or mechanical methods, such as vacuuming. Do not use methods that use only mechanical kick brooms.

Sweep paved roads at construction entrance and exit locations and paved areas within the job site:

1. During clearing and grubbing activities
2. During earthwork activities
3. During trenching activities
4. During roadway structural-section activities

5. When vehicles are entering and leaving the job site
6. After soil-disturbing activities
7. After observing off-site tracking of material

Monitor paved areas and roadways within the project. Sweep within:

1. 1 hour whenever sediment or debris is observed during activities that require sweeping
2. 24 hours whenever sediment or debris is observed during activities that do not require sweeping

Remove collected material, including sediment, from paved shoulders, drain inlets, curbs and dikes, and other drainage areas. You may stockpile collected material at the job site under "Material Management" of these special provisions. If stockpiled, dispose of collected material at least once per week under "Waste Management" of these special provisions.

You may dispose of sediment within the job site collected during sweeping activities. Protect the disposal areas against erosion.

Keep dust to a minimum during street sweeping activities. Use water or a vacuum whenever dust generation is excessive or sediment pickup is ineffective.

Remove and dispose of trash collected during sweeping under "Waste Management" of these special provisions.

Dewatering

Dewatering consists of discharging accumulated stormwater, groundwater, or surface water from excavations or temporary containment facilities.

Perform dewatering work as specified for the work items involved, such as temporary active treatment system or dewatering and discharge.

If dewatering and discharging activities are not specified under a work item and you perform dewatering activities:

1. Conduct dewatering activities under the Department's Field Guide for Construction Site Dewatering.
2. Ensure that any dewatering discharge does not cause erosion, scour, or sedimentary deposits that could impact natural bedding materials.
3. Discharge the water within the project limits. If the water cannot be discharged within project limits due to site constraints or contamination, dispose of the water as directed by the Engineer.
4. Do not discharge stormwater or nonstormwater that has an odor, discoloration other than sediment, an oily sheen, or foam on the surface. Notify the Engineer immediately upon discovering any such condition.

MEASUREMENT AND PAYMENT

The contract lump sum price paid for construction site management includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in spill prevention and control, material management, waste management, nonstormwater management, and dewatering activities, including identifying, sampling, testing, handling, and disposing of hazardous waste resulting from your activities, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as ordered by the Engineer.

10-1.05 TEMPORARY HYDRAULIC MULCH

GENERAL

Summary

This work includes applying, maintaining, and removing temporary hydraulic mulch. Hydraulic mulch uses a mixture of fiber, tackifier, and water to stabilize active and nonactive disturbed soil areas.

The SWPPP must describe and include the use of temporary hydraulic mulch as a water pollution control practice for soil stabilization.

Submittals

At least 5 business days before applying hydraulic mulch, submit:

1. Material Safety Data Sheet for the tackifier.
2. Product label describing the tackifier as an erosion control product.

3. List of pollutant indicators and potential pollutants for the use of temporary hydraulic mulch. Pollutant indicators are described under "Sampling and Analysis Plan for Non-Visible Pollutants" in the Preparation Manual.
4. Determination of acute and chronic toxicity for aquatic organisms conforming to EPA methods for the tackifier.
5. Composition of ingredients including chemical formulation.

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Tackifier
2. Fiber

Quality Control and Assurance

Retain and submit records of temporary hydraulic mulch applications including:

1. Compliance with specified rates
2. Application area
3. Application time
4. Quantity

MATERIALS

Tackifier

The tackifier must be:

1. Nonflammable
2. Nontoxic to aquatic organisms
3. Free from growth or germination inhibiting factors
4. Either a plant-based product or a polymeric-emulsion blend

Tackifier classified as a plant-based product must be:

1. A natural high molecular weight polysaccharide
2. A high viscosity hydrocolloid that is miscible in water
3. Functional for at least 180 days
4. Labeled as either guar, psyllium, or starch

Guar must be:

1. A guar gum based product derived from the ground endosperm of the guar plant, *Cyanopsis tetragonolobus*
2. Treated with dispersant agents for easy mixing
3. Able to be diluted at the rate of 1 to 5 pounds per 100 gallons of water

Psyllium must be:

1. Made of the finely ground muciloid coating of *Plantago ovata* or *Plantago ispaghula* seeds
2. Able to dry and form a firm but rewettable membrane

Starch must be a non-ionic, water-soluble granular material derived from corn, potato, or other plant-based source.

Tackifier classified as polymeric emulsion blend must be:

1. A liquid or dry powder formulation
2. Anionic with a residual monomer content that is at most 0.05 percent by weight
3. Functional for at least 180 days
4. A prepackaged product labeled as containing one of the following as the primary active ingredient of the polymeric emulsion blend:

- 4.1 Acrylic copolymers and polymers
- 4.2 Polymers of methacrylates and acrylates
- 4.3 Copolymers of sodium acrylates and acrylamides
- 4.4 Polyacrylamide (PAM) and copolymer of acrylamide
- 4.5 Hydrocolloid polymers

Fiber

Fiber must be wood fiber, cellulose fiber, alternate fiber, or a combination of these fibers as specified. Fiber must be:

- 1. Free from lead paint, printing ink, varnish, petroleum products, seed germination inhibitors, or chlorine bleach
- 2. Free from synthetic or plastic materials
- 3. At most 7 percent ash

If wood fiber is specified, wood fiber must be:

- 1. Long strand, whole wood fibers, thermo-mechanically processed from clean, whole wood chips
- 2. Not made from sawdust, cardboard, paper, or paper byproducts
- 3. At least 25 percent of fibers 3/8 inch long
- 4. At least 40 percent held on a No. 25 sieve

If cellulose fiber is specified, cellulose fiber must be made from natural or recycled pulp fiber, such as wood chips, sawdust, newsprint, chipboard, corrugated cardboard, or a combination of these materials.

If alternate fiber is specified, alternate fiber must be:

- 1. Long strand, whole natural fibers made from clean straw, cotton, corn, or other natural feed stock
- 2. At least 25 percent of fibers 3/8 inch long
- 3. At least 40 percent held on a No. 25 sieve

Coloring Agent

Use a biodegradable nontoxic coloring agent free from copper, mercury, and arsenic to ensure the hydraulic mulch contrasts with the application area.

CONSTRUCTION

Application

Apply temporary hydraulic mulch when an area is ready to receive temporary erosion control under "Move-in/Move-out (Temporary Erosion Control)."

Dilute hydraulic mulch with water to spread the mulch evenly.

Use hydroseeding equipment to apply hydraulic mulch.

Apply hydraulic mulch:

- 1. At the application rate shown. Successive applications or passes may be needed to achieve the required rate:

Material	Application Rate lbs/acre
Wood fiber	900
Cellulose fiber	900
Alternate fiber	900

- 2. To form a continuous mat with no gaps between the mat and the soil surface.
- 3. From 2 or more directions to achieve a continuous mat.
- 4. In layers to avoid slumping and to aid drying.
- 5. During dry weather or at least 24 hours before predicted rain.

Do not apply hydraulic mulch if:

1. Water is standing on or moving across the soil surface
2. Soil is frozen
3. Air temperature is below 40 °F during the tackifier curing period unless allowed by the tackifier manufacturer and approved by the Engineer

Do not over-spray hydraulic mulch onto the traveled way, sidewalks, lined drainage channels, or existing vegetation.

Maintenance

Reapply hydraulic mulch within 24 hours of discovering visible erosion unless the Engineer approves a longer period.

Temporary hydraulic mulch disturbed or displaced by your vehicles, equipment, or operations must be reapplied at your expense.

Cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence are not included in the cost for performing maintenance.

Removal

Remove hydraulic mulch by mechanically blending it into the soil with track laying equipment, disking, or other approved method.

MEASUREMENT AND PAYMENT

Temporary hydraulic mulch is measured by the square yard from measurements along the slope of the areas covered by the hydraulic mulch.

The contract price paid per square yard for temporary hydraulic mulch includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying temporary hydraulic mulch, complete in place, including removal of hydraulic mulch, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary hydraulic mulch. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.06 TEMPORARY HYDROSEED

GENERAL

Summary

This work includes applying, maintaining, and removing temporary hydroseed. Hydroseed uses a mixture of tackifier, fiber, seed, and water to stabilize active and nonactive disturbed soil areas.

The SWPPP must describe and include the use of temporary hydroseed as a water pollution control practice for soil stabilization.

Submittals

At least 5 business days before applying hydroseed, submit:

1. Material Safety Data Sheet for the tackifier.
2. Product label describing the tackifier as an erosion control product.
3. List of pollutant indicators and potential pollutants for the use of temporary hydroseed. Pollutant indicators are described under "Sampling and Analysis Plan for Non-Visible Pollutants" in the Preparation Manual.
4. Determination of acute and chronic toxicity for aquatic organisms conforming to EPA methods for the tackifier.
5. Composition of ingredients including chemical formulation.

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Tackifier
2. Fiber
3. Seed

Quality Control and Assurance

Retain and submit records of temporary hydroseed applications including:

1. Compliance with specified rates
2. Application area
3. Application time
4. Quantity

MATERIALS

Tackifier

The tackifier must be:

1. Nonflammable
2. Nontoxic to aquatic organisms
3. Free from growth or germination inhibiting factors
4. Either a plant-based product or a polymeric emulsion blend

Tackifier classified as plant-based product must be:

1. A natural high molecular weight polysaccharide
2. A high viscosity hydrocolloid that is miscible in water
3. Functional for at least 180 days
4. Labeled as either guar, psyllium, or starch

Guar must be:

1. A guar gum based product derived from the ground endosperm of the guar plant, *Cyamopsis tetragonolobus*
2. Treated with dispersant agents for easy mixing
3. Able to be diluted at the rate of 1 to 5 pounds per 100 gallons of water

Psyllium must be:

1. Made of the finely ground muciloid coating of *plantago ovata* or *plantago ispaghula* seeds
2. Able to dry and form a firm but rewettable membrane

Starch must be a non-ionic, water-soluble granular material derived from corn, potato, or other plant-based source.

Tackifier classified as polymeric emulsion blend must be:

1. A polymeric emulsion blend with a liquid or dry powder formulation
2. Anionic with a residual monomer content that is at most 0.05 percent by weight
3. Functional for at least 180 days
4. A prepackaged product labeled as containing one of the following as the primary active ingredient of the polymeric emulsion blend:
 - 4.1 Acrylic copolymers and polymers
 - 4.2 Polymers of methacrylates and acrylates
 - 4.3 Copolymers of sodium acrylates and acrylamides
 - 4.4 Polyacrylamide (PAM) and copolymer of acrylamide
 - 4.5 Hydrocolloid polymers

Fiber

Fiber must be wood fiber, cellulose fiber, alternate fiber, or a combination of these fibers as specified. Fiber must be:

- 1. Free from lead paint, printing ink, varnish, petroleum products, seed germination inhibitors, or chlorine bleach
- 2. Free from synthetic or plastic materials
- 3. At most 7 percent ash

If wood fiber is specified, wood fiber must be:

- 1. Long strand, whole wood fibers, thermo-mechanically processed from clean, whole wood chips
- 2. Not made from sawdust, cardboard, paper, or paper byproducts
- 3. At least 25 percent of fibers 3/8 inch long
- 4. At least 40 percent held on a No. 25 sieve

If cellulose fiber is specified, cellulose fiber must be made from natural or recycled pulp fiber, such as wood chips, sawdust, newsprint, chipboard, corrugated cardboard, or a combination of these materials.

If alternate fiber is specified, alternate fiber must be:

- 1. Long strand, whole natural fibers made from clean straw, cotton, corn, or other natural feed stock
- 2. At least 25 percent of fibers 3/8 inch long
- 3. At least 40 percent held on a No. 25 sieve

Coloring Agent

Use a biodegradable nontoxic coloring agent free from copper, mercury, and arsenic to ensure the hydroseed contrasts with the application area.

Seed

Seed must comply with Section 20-2.10, "Seed," of the Standard Specifications. Seed not required to be labeled under the California Food and Agricultural Code must be tested for purity and germination by a seed laboratory certified by the Association of Official Seed Analysts or by a seed technologist certified by the Society of Commercial Seed Technologists. Measure and mix individual seed species in the presence of the Engineer.

Seed must contain at most 1.0 percent total weed seed by weight.

Deliver seed to the job site in unopened separate containers with the seed tags attached. A container without a seed tag attached is not accepted. The Engineer takes a sample of approximately 1 ounce or 0.25 cup of seed for each seed lot greater than 2 pounds.

Seed must comply with the following:

SEED

Botanical Name (Common Name)	Percent Germination (Minimum)	Pounds Pure Live Seed Per Acre (Slope Measurement)
Lasthenia glabrata (Goldfields)	30	1.5
Lolium Multiflorum (Annual Ryegrass)	40	35.2
NassellaPulchra (Purple Needlegrass)	40	6.2
^a HordeumCalifornicum (California Barley)	40	15.0

^aSeed produced in CA only.

Seed Sampling Supplies

At the time of seed sampling, furnish a glassine lined bag and custody seal tag for each seed lot sample.

CONSTRUCTION

Application

Apply temporary hydroseed when an area is ready to receive temporary erosion control under "Move-in/Move-out (Temporary Erosion Control)."

The quantity of tackifier in the mixture must be as recommended by the manufacturer.

The ratio of water to fiber and tackifier in the mixture must be as recommended by the manufacturer. The proportions of various erosion control materials may be changed by the Engineer to meet field conditions.

Use hydroseeding equipment to apply hydroseed.

Apply hydroseed:

1. At application rate indicated. Successive applications or passes may be needed to achieve the indicated rate:

Material	Application Rate lbs/acre
Wood Fiber	900
Cellulose Fiber	900
Alternate Fiber	900
Seed	57.9

2. To form a continuous mat with no gaps between the mat and the soil surface.
3. From 2 or more directions to achieve a continuous mat.
4. In layers to avoid slumping and to aid drying.
5. During dry weather or at least 24 hours before predicted rain.

Do not apply hydroseed if:

1. Water is standing on or moving across the soil surface
2. Soil is frozen
3. Air temperature is below 40 °F during the tackifier curing period unless allowed by the tackifier manufacturer and approved by the Engineer

Do not allow over-spray onto the traveled way, sidewalks, lined drainage channels, or existing vegetation.

Maintenance

Reapply hydroseed within 24 hours of discovering visible erosion, unless the Engineer approves a longer period.

Temporary hydroseed disturbed or displaced by your vehicles, equipment, or operations must be reapplied at your expense.

Cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence are not included in the cost for performing maintenance.

Removal

Remove hydroseed by mechanically blending it into the soil with track laying equipment, disking, or other approved method.

MEASUREMENT AND PAYMENT

Temporary hydroseed is measured by the square yard from measurements along the slope of the areas covered by the hydroseed.

The contract price paid per square yard for temporary hydroseed includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying temporary hydroseed, complete in place, including removal of hydroseed, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary hydroseed. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.07 STREET SWEEPING

GENERAL

Summary

This work includes street sweeping using machine-operated sweepers.

Street sweeping must comply with the specifications for sweeping in the Section titled, "Construction Site Management," of these special provisions except a machine-operated sweeper must be used.

Street sweeping does not void specifications for main residue collection included in other work activities, such as grooving, grinding, or asphalt concrete planing.

The SWPPP must describe and include the use of street sweeping as a water pollution control practice for sediment control and tracking control.

Submittals

At least 5 business days before you start clearing and grubbing, earthwork, or other activities with the potential for tracking sediment or debris, submit:

1. Number of machine-operated sweepers described in the SWPPP
2. Type of sweeper technology

Quality Control and Assurance

Retain and submit records of street sweeping, including:

1. Quantity of disposed sweeping waste
2. Sweeping times and locations

MATERIALS

Machine-operated sweepers must use one of the following technologies:

1. Mechanical sweeper followed by a vacuum-assisted sweeper
2. Vacuum-assisted dry (waterless) sweeper
3. Regenerative-air sweeper

CONSTRUCTION

At least 1 machine-operated sweeper must be on the job site at all times when street sweeping work is required. The sweeper must be in good working order.

MEASUREMENT AND PAYMENT

The contract lump sum price paid for street sweeping includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in street sweeping, including disposal of collected material, as shown on the plans, as specified in the Standard Specifications, these special provisions, and as directed by the Engineer.

10-1.08 TEMPORARY SOIL BINDER

GENERAL

Summary

This work includes applying, maintaining, and removing temporary soil binder. Soil binder uses a mixture of soil binder, and water to stabilize active and nonactive disturbed soil areas.

The SWPPP must describe and include the use of temporary soil binder as a water pollution control practice for soil stabilization.

Submittals

At least 5 business days before applying soil binder, submit:

1. Material Safety Data Sheet for the soil binder.
2. Product label describing the soil binder as an erosion control product.

3. List of pollutant indicators and potential pollutants for the use of temporary soil binder. Pollutant indicators are described under "Sampling and Analysis Plan for Non-Visible Pollutants" in the Preparation Manual.
4. Determination of acute and chronic toxicity for aquatic organisms conforming to EPA methods for the soil binder.
5. Composition of ingredients including chemical formulation.

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for soil binder:

Quality Control and Assurance

Retain and submit records of temporary soil binder applications including:

1. Compliance with specified rates
2. Application area
3. Application time
4. Quantity

MATERIALS

Soil Binder

The soil binder must be:

1. Nonflammable
2. Nontoxic to aquatic organisms
3. Free from growth or germination inhibiting factors
4. Either a plant-based product or a polymeric emulsion blend

Soil binder classified as a plant-based product must be:

1. A natural high molecular weight polysaccharide
2. A high viscosity hydrocolloid that is miscible in water
3. Functional for at least 180 days
4. Labeled as either guar, psyllium, or starch

Guar must be:

1. A guar gum based product derived from the ground endosperm of the guar plant, *Cyanmopsis tetragonolobus*
2. Treated with dispersant agents for easy mixing
3. Able to be diluted at the rate of 1 to 5 pounds per 100 gallons of water

Psyllium must be:

1. Made of the finely ground muciloid coating of *plantago ovata* or *plantago ispaghula* seeds
2. Able to dry and form a firm but rewettable membrane

Starch must be a non-ionic, water-soluble granular material derived from corn, potato, or other plant-based source.

Soil binder classified as a polymeric emulsion blend must be:

1. A polymeric emulsion blend with a liquid or dry powder formulation
2. Anionic with a residual monomer content that is at most 0.05 percent by weight
3. Functional for at least 180 days
4. A prepackaged product labeled as containing one of the following as the primary active ingredient of the polymeric emulsion blend:
 - 4.1 Acrylic copolymers and polymers
 - 4.2 Polymers of methacrylates and acrylates

- 4.3 Copolymers of sodium acrylates and acrylamides
- 4.4 Polyacrylamide (PAM) and copolymer of acrylamide
- 4.5 Hydrocolloid polymers

Coloring Agent

Use a biodegradable, nontoxic coloring agent free from copper, mercury, and arsenic to ensure the hydraulic mulch contrasts with the application area.

CONSTRUCTION

Application

Apply temporary soil binder when an area is ready to receive temporary erosion control under "Move-in/Move-out (Temporary Erosion Control)."

Apply soil binder:

1. Per the manufacturer's recommendations for the job site soil conditions. Prewet the area if recommended by the manufacturer.
2. From 2 or more directions to achieve a continuous cover.
3. During dry weather or at least 24 hours before predicted rain.

Do not apply soil binder if:

1. Water is standing on or moving across the soil surface
2. Soil is frozen
3. Air temperature is below 40 °F during the tackifier curing period unless allowed by the manufacturer and approved by the Engineer

Do not over-spray soil binder onto the traveled way, sidewalks, lined drainage channels, or existing vegetation.

Maintenance

Reapply soil binder within 24 hours of discovering visible erosion, unless the Engineer approves a longer period.

Temporary soil binder disturbed or displaced by the Contractor's vehicles, equipment, or operations must be reapplied at the Contractor's expense.

Cleanup, repair, removal, disposal, or replacement due to improper installation or the Contractor's negligence are not included in the cost for performing maintenance.

Removal

Remove soil binder by mechanically blending it into the soil with track laying equipment, disking, or other approved method.

MEASUREMENT AND PAYMENT

Temporary soil binder is measured by the square yard from measurements along the slope of the areas covered by the soil binder.

The contract item price paid per square yard for temporary soil binder includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying temporary soil binder, complete in place, including removal of soil binder, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and the Contractor share the cost of maintaining the temporary soil binder. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays to the Contractor one-half of that cost.

10-1.09 TEMPORARY MULCH

GENERAL

Summary

This work includes spreading, maintaining, and removing temporary mulch to stabilize active and nonactive disturbed soil areas.

The SWPPP must describe and include the use of temporary mulch as a water pollution control practice for soil stabilization.

Submittals

At least 5 business days before applying mulch, submit:

1. List of pollutant indicators and potential pollutants for the use of temporary mulch. Pollutant indicators are described under "Sampling and Analysis Plan for Non-Visible Pollutants" in the Preparation Manual.
2. If compost is used:
 - 2.1. Copy of compost technical data sheet from producer including:
 - 2.1.1. Laboratory analytical test results.
 - 2.1.2. Directions for product use.
 - 2.1.3. List of product ingredients.
 - 2.2. Copy of certification under US Composting Council (USCC) Seal of Testing Assurance (STA) program.

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for the mulch material.

Quality Control and Assurance

Compost producer must:

1. Have valid permits issued by the California Integrated Waste Management Board, Local Enforcement Agency and any other State and local agencies that regulate solid waste facilities
2. Participate in US Composting Council's Seal of Testing Assurance program

If compost facility is exempt from State permit requirements, the compost producer must certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of 14 CA Code of Regs, Ch 3.1, Art 7.

Retain and submit records of temporary mulch applications including:

1. Compliance with specified rates
2. Application area
3. Application time
4. Quantity

MATERIALS

Mulch

Mulch must be compost, shredded green material, or a combination of both.

Compost may be derived from one or a combination of the following feedstock materials:

1. Green material consisting of chipped, shredded, or ground vegetation; or clean processed recycled wood products
2. Biosolids
3. Manure
4. Mixed food waste

Compost derived from feedstock materials must not contain weed seeds, pathogens, or deleterious materials as specified in 14 CA Code of Regs, Ch 3.1, Art 7, § 17868.3.

Compost must not:

1. Be derived from mixed municipal solid waste and must be free of visible contaminants
2. Contain paint, petroleum products, pesticides, or any other chemical residues harmful to animal life or plant growth
3. Possess objectionable odors

4. Exceed the maximum metal concentration listed in 14 CA Code of Regs, Ch 3.1, § 17868.2

Compost must comply with the following:

Physical and Chemical Requirements

Property	Test Method	Requirement
pH	*TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0-10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/-5 °C % Wet Weight Basis	30-60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO ₂ -C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 3 99% 3/8 25% Max. Length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the US Department of Agriculture and the US Compost Council (USCC).

Shredded green material must:

1. Be chipped, shredded, or ground vegetation; or clean processed recycled wood products. Wood chips produced from tree trimmings may contain leaves and small twigs.
2. Comply with the following particle size requirements:

Mulch Particle Size Requirements

Sieve Size	Percent Passing
3 inch	100
1 inch	90-100
3/4 inch	65-100
1/4 inch	0-75
Maximum length	6 inches

3. Not be more than 0.1 percent by volume of deleterious materials such as rocks, glass, plastics, metals, clods, weeds, weed seeds, coarse objects, salts, paint, petroleum products, pesticides, or other chemical residues that would be harmful to plant or animal life.

CONSTRUCTION

Application

Spread temporary mulch when an area is ready to receive temporary erosion control under "Move-in/Move-out (Temporary Erosion Control)."

Spread mulch:

1. To a uniform thickness of 2 inches
2. To extend to the edge of retaining walls, dikes, paving and to within 4 feet from the flow line of paved and unpaved drainage ditches
3. Using mechanical, pneumatic, or manual methods

Maintenance

Reapply mulch within 24 hours of discovering visible erosion, unless the Engineer approves a longer period.

Temporary mulch disturbed or displaced by your vehicles, equipment, or operations must be reapplied at your expense.

Cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence are not included in the cost for performing maintenance.

Removal

Remove mulch by mechanically blending it into the soil with track laying equipment, disking, or other approved method.

MEASUREMENT AND PAYMENT

Temporary mulch is measured by the square yard from measurements along the slope of the areas covered by the mulch.

The contract price paid per square yard for temporary mulch includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying temporary mulch, complete in place, including removal of mulch, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the mulch. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.10 TEMPORARY EROSION CONTROL BLANKET

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary erosion control blanket. Temporary erosion control blanket is used to cover and protect disturbed soil areas and soil from erosion by wind or water. Temporary erosion control blanket reduces channel erosion by protecting against scour created by concentrated flow.

The SWPPP must describe and include the use of temporary erosion control blanket as a water pollution control practice for soil stabilization.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for erosion control blanket.

If you substitute the steel wire staple with an alternative attachment device, submit a sample of the device for approval at least 5 business days before installation.

MATERIALS

Erosion Control Blanket

Erosion control blanket must be:

1. Described as a rolled erosion control product (RECP)
2. Classified as temporary and degradable or long-term and non-degradable
3. Machine-made mats
4. Provided in rolled strips
5. Classified by the Erosion Control Technology Council (ECTC)

Erosion control blanket classified as temporary and degradable must be one of the following:

1. Double net excelsior blanket:
 - 1.1. Classified as ECTC Type 2D
 - 1.2. Classified as an erosion control blanket
 - 1.3. Designed to last for at least one year after installation
 - 1.4. With a Universal Soil Loss Equation (USLE) C-Factor of not more than 0.20 at a 2:1 (horizontal:vertical) slope
 - 1.5. With 80 percent of the wood excelsior fibers being 6 inches or longer
 - 1.6. Capable to withstand a maximum shear stress of 1.75 pounds per square foot under ASTM D 6460
 - 1.7. With a minimum tensile strength of 75 pounds per foot under ASTM D 5035
 - 1.8. With top and bottom surfaces covered with extruded photodegradable plastic netting or lightweight non-synthetic netting
2. Double net straw and coconut blanket:
 - 2.1. Classified as ECTC Type 2D
 - 2.2. Classified as an erosion control blanket
 - 2.3. Designed to last for at least one year after installation
 - 2.4. With a USLE C-Factor of not more than 0.20 at a 2:1 (horizontal:vertical) slope
 - 2.5. Comprised of 70 percent straw and 30 percent coconut fiber
 - 2.6. Capable to withstand a maximum shear stress of 1.75 pounds per square foot under ASTM D 6460
 - 2.7. With a minimum tensile strength of 75 pounds per foot under ASTM D 5035
 - 2.8. With top and bottom surfaces covered with extruded photodegradable plastic netting or lightweight non-synthetic netting
3. Jute netting:
 - 3.1. Classified as ECTC Type 3B
 - 3.2. Classified as an open weave textile and have from 14 to 20 strands per foot in each direction
 - 3.3. Designed to last for at least one year after installation
 - 3.4. With a USLE C-Factor of not more than 0.25 at a 1.5:1 (horizontal:vertical) slope
 - 3.5. Comprised of 100 percent unbleached and undyed spun yarn made of jute fiber
 - 3.6. With an average open area from 63 to 70 percent
 - 3.7. From 48 to 72 inches in width
 - 3.8. Capable to withstand a maximum shear stress of 2.0 pounds per square foot under ASTM D6460
 - 3.9. With a minimum tensile strength of 100 pounds per foot under ASTM D 5035
 - 3.10. From 0.90 to 1.20 pounds per square yard in weight

4. Coir netting:

- 4.1. Classified as ECTC Type 4
- 4.2. Classified as an open weave textile and from 13 to 18 strands per foot in each direction
- 4.3. Designed to last for at least three years after installation
- 4.4. With a USLE C-Factor of not more than 0.25 at a 1:1 (horizontal:vertical) slope
- 4.5. Comprised of 100 percent unbleached and undyed spun coir yarn made of coconut fiber
- 4.6. With an average open area from 63 to 70 percent
- 4.7. From 72 to 158 inches in width
- 4.8. Capable to withstand a maximum shear stress of 2.25 pounds per square foot under ASTM D6460
- 4.9. With a minimum tensile strength of 125 pounds per foot under ASTM D 5035
- 4.10. From 1.20 to 1.67 pounds per square yard in weight

Erosion control blanket classified as long-term and non-degradable must:

1. Be a geosynthetic fabric
2. Comply with the specifications for rock slope protection fabric (Class 8) in Section 88-1.06, "Channel and Shore Protection," of the Standard Specifications

Staples

You may use an alternative attachment device such as a geosynthetic pins or plastic pegs to install erosion control blanket.

CONSTRUCTION

Before placing erosion control blanket, remove obstructions including rocks, clods, and debris greater than 1 inch in diameter from the ground.

If fiber rolls are to be placed in the same area as erosion control blankets, install the blankets before placing the fiber rolls.

If hydroseeding is to be done in the same area as erosion control blanket:

1. You must hydroseed before placing the double net excelsior or straw and coconut blankets
2. You may hydroseed before or after placing the jute or coir netting

If temporary erosion control blanket is installed on disturbed soil areas including embankment and excavation slopes:

1. Place the blanket loosely on the embankment or excavation slope with the longitudinal joints perpendicular to the slope contour lines
3. Place the blanket on the upper portion of the slope overlapping the blanket on the lower portion of the slope for transverse joints
4. Place the blanket on the side of the prevailing wind shall overlapping the blanket on the downwind side of the slope for longitudinal joints
5. Overlap and staple the longitudinal and transverse joints
6. Secure the ends of the blanket in key trenches

If temporary erosion control blanket is installed in area of concentrated runoff including ditches and swales:

1. Place the blanket loosely along the ditch or swale with the longitudinal edges and joints parallel to the centerline of the ditch or swale
2. Place the blanket on the upper portion of the slope overlapping the blanket on the lower portion of the slope for transverse joints
3. Secure transverse joints of blankets in intermediate joint trenches
4. Overlap and staple the longitudinal and transverse joints
5. Secure the ends of the blanket in intermediate and key trenches

MAINTENANCE

Remove sediment deposits, trash, and debris from temporary erosion control blanket as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to

erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary erosion control blanket by:

1. Removing sediment from the surface of the blanket when it is deeper than 2 inches
2. Repairing or replacing the blanket when the area treated with temporary erosion control blanket becomes exposed or exhibits visible erosion
3. Repairing or replacing the erosion control blanket when washouts occur between joints or beneath the erosion control blanket
4. Repairing or replacing the erosion control when it becomes detached, torn, or unraveled

Repair temporary erosion control blanket within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary erosion control blanket, repair erosion control blanket at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary erosion control blanket is not required, it must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary erosion control blanket must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary erosion control blanket is measured by the square yard of the actual area covered excluding overlaps.

The contract price paid per square yard for temporary erosion control blanket includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing temporary erosion control blanket, complete in place, including trench excavation and backfill, and removal of temporary erosion control blanket, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary erosion control blanket. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.11 TEMPORARY COVER

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary cover.

The SWPPP must describe and include the use of temporary cover as a water pollution control practice for soil stabilization and stockpile management.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Gravel-filled bag fabric
2. Temporary cover fabric

If you substitute a material in the following list, submit a sample of the alternative material for approval at least 5 business days before installation:

1. Alternative restrainer
2. Alternative linear sediment barrier

MATERIALS

Geosynthetic Fabrics

Geosynthetic fabrics must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.

Test under ASTM D 4759. All properties are based on Minimum Average Roll Value (MARV).

Identify, store, and handle under ASTM D 4873.

Protect geosynthetics from moisture, sunlight and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information and product identification.

Gravel-filled bag fabric must comply with:

Specification	Requirements
Grab breaking load 1-inch grip, lb, min. in each direction	205
Apparent elongation percent, min., in each direction	50
Water Flow Rate max. average roll value, gallons per minute/square foot	80-150
Permittivity 1/sec., min	1.2
Apparent opening size max. average roll value, U.S. Standard sieve size	40-80
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	70

The temporary cover fabric must be geosynthetic cover fabric, plastic sheeting, or a combination of both. Temporary cover fabric must be either:

1. Plastic sheeting consisting of a single-ply geomembrane material, 10 mils thick, that complies with ASTM D 5199
2. Geosynthetic cover fabric that complies with the following properties:

Specification	Requirements
Grab breaking load 1-inch grip, lb, min. in each direction	200
Apparent elongation percent, min., in each direction	50
Water Flow Rate max. average roll value, gallons per minute/square foot	75-120
Permittivity 1/sec., min	0.08
Apparent opening size max. average roll value, U.S. Standard sieve size	100
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	70

Gravel

Gravel for gravel-filled bags must be:

1. From 3/8 to 3/4 inch in diameter
2. Clean and free from clay balls, organic matter, and other deleterious materials

Gravel-filled Bags

Gravel-filled bags must:

1. Be made from gravel-filled bag fabric.
2. Have inside dimensions from 24 to 32 inches in length, and from 16 to 20 inches in width.
3. Have the opening bound to retain the gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.
4. Weigh from 30 to 50 pounds when filled with gravel.

Restrainers

Restrainers must be used to secure the cover fabric or plastic sheeting to the surface of the slope or stockpile.

Restrainers must be one of the following:

1. Made of gravel-filled bags that are roped together and spaced no more than a 6 feet apart
2. Made of wooden lath and anchor restrainers as shown on the plans and the following:
 - 2.1 Wooden lath must be 2" x 4" x 8', made from fir or pine, and comply with Section 88-2.12, "Lumber," of the Standard Specifications
 - 2.2 Anchor restrainers must be made from steel reinforcing bars and spaced no more than 4 feet apart along the wooden lath
3. An approved alternate method

Rope

Rope must be at least 3/8 inch in diameter.

Rope must be one of the following:

1. Biodegradable, such as sisal or manila
2. Nondegradable, such as polypropylene or nylon

Linear Sediment Barrier

Linear sediment barriers consist of one or more of the following:

1. Gravel bag berm
2. Earthen berm
3. Approved alternate method

CONSTRUCTION

Temporary Cover Fabric

Install temporary cover fabric by:

1. Placing the temporary cover fabric loosely on the slope or stockpile with the longitudinal edges perpendicular to the slope contours
2. Placing the temporary cover fabric on the upper portion of the slope to overlap cover fabric on the lower portion of the slope
3. Placing the temporary cover fabric on the side of the prevailing wind to overlap the cover fabric on the downwind side of the slope
4. Anchoring the perimeter edge of the temporary cover fabric in key trenches
5. Overlapping edges of the temporary cover fabric by at least 2 feet
6. Placing restrainers at the overlap area and along the toe of the slope. Between overlaps, the restrainers must be spaced a maximum of 8 feet on center.
7. Ensuring that, if anchor restraints are used, the leg of the steel reinforcing bar pierces the temporary cover fabric and holds the wooden lath firmly against the surface of the slope or stockpile.

Linear Sediment Barrier

Protect excavation and embankment slopes with linear sediment barrier by:

1. Preventing run-on and concentrated flows from damaging the slopes
2. Placing the barrier approximately parallel to the slope contour at the toe of the slope
3. Angling the last 6 feet of the barrier up-slope

Protect stockpiles with linear sediment barrier by:

1. Preventing run-on and concentrated flows from touching the stockpiled material
2. Surrounding the stockpile with a linear sediment barrier
3. Adding more linear sediment barrier within 24 hours of adding more material to the stockpile

If earthen berms are used as a linear sediment barrier, they must be:

1. At least 8 inches high and 36 inches wide
2. Compacted by hand or mechanical method

If gravel bag berms are used as a linear sediment barrier:

1. Place gravel bags as a single layer
2. Place gravel bags end-to-end to eliminate gaps

If you need to increase the height of the gravel bag berm:

1. Increase height by adding rows of gravel-filled bags
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row
3. Stabilize berm by adding rows at the bottom

If you remove the temporary cover to do other work, replace and secure temporary cover within one hour.

MAINTENANCE

Maintain temporary cover to minimize exposure of the slopes or stockpile and prevent movement of the material beyond the linear sediment barrier.

Maintain temporary cover by:

1. Relocating and securing restrainers to keep the erosion control blankets in place. Temporary cover fabric that breaks free must be immediately secured.
2. Repairing or replacing the temporary cover fabric when the area covered by temporary cover becomes exposed or exhibits visible erosion.
3. Repairing or replacing the linear sediment barrier when washouts occur between joints or beneath the linear sediment barrier.
4. Repairing or replacing the temporary cover fabric when it becomes detached, torn, or unraveled.

Repair temporary cover within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary cover, repair temporary cover at your expense.

REMOVAL

When the Engineer determines that temporary cover is not required, it must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary cover must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary cover is measured by the square yard of the actual area covered excluding overlaps.

The contract price paid per square yard for temporary cover includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing temporary cover, complete in place, including restrainers and removal of temporary cover, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.12 TEMPORARY CONCRETE WASHOUT (PORTABLE)

GENERAL

Summary

This work includes removal and disposal of concrete waste by furnishing, maintaining, and removing portable temporary concrete washouts.

SWPPP must describe and include the use of a portable temporary concrete washout as a water pollution control practice for waste management and materials pollution control.

Submittals

At least 5 business days before concrete activities start, submit:

1. Name and location of off-site concrete waste disposal facility to receive concrete waste
2. Copy of permit issued by RWQCB for off-site commercial disposal facility
3. Copy of license for off-site commercial disposal facility
4. Copy of permit issued by state or local agency having jurisdiction over disposal facility if disposal site is located outside of the State of California

Quality Control and Assurance

Retain and submit records of disposed concrete waste including:

1. Weight tickets
2. Delivery and removal of temporary concrete washouts

MATERIALS

Portable Temporary Concrete Washout

Portable temporary concrete washout must:

1. Be a commercially available watertight container.
2. Have sufficient capacity to contain all liquid and concrete waste generated by washout activities without seepage or spills.
3. Have at least 55-gallon capacity.
4. Be labeled for the exclusive use as a concrete waste and washout facility. Stencil "Concrete Waste material" in 3-inch high letters on white background. Top of stenciling must be 12 inches from the top of the container.

Concrete Washout Sign

Concrete washout sign must comply with the provisions in Section 12-3.06B, "Portable Signs" of the Standard Specifications and:

1. Be approved by the Engineer
2. Consist of base, framework, and sign panel
3. Be made of plywood
4. Be minimum 2' x 4' in size
5. Read "Concrete Washout" with 3 inches high black letters on white background

CONSTRUCTION

Placement

Place portable temporary concrete washouts at job site:

1. Before concrete placement activities start
2. In the immediate area of concrete work as approved by the Engineer
3. No closer than 50 feet from storm drain inlets, open drainage facilities, ESAs, or watercourses
4. Away from construction traffic or public access areas

Install a concrete washout sign adjacent to each portable temporary concrete washout location.

Operation

Use portable temporary concrete washouts for:

1. Washout from concrete delivery trucks
2. Slurries containing portland cement concrete or hot mix asphalt from sawcutting, coring, grinding, grooving, and hydro-concrete demolition
3. Concrete waste from mortar mixing stations

Relocate portable temporary concrete washouts as needed for concrete construction work.

Replace portable temporary concrete washouts when filled to capacity. Do not fill higher than 6 inches below rim.

Your WPC manager must inspect portable temporary concrete washouts:

1. Daily if concrete work occurs daily
2. Weekly if concrete work does not occur daily

Maintenance

When relocating or transporting a portable temporary concrete washout within the job site, secure it to prevent spilling of concrete waste material. If any spilled material is observed, remove spilled material and place it into portable temporary concrete washout.

Removal

Dispose of concrete waste material at a facility specifically licensed to receive solid concrete waste, liquid concrete waste, or both. When portable temporary concrete washout is full, remove and dispose of concrete waste within 2 days.

PAYMENT

The contract lump sum price paid for temporary concrete washout (portable) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing, maintaining, and removing the portable temporary concrete washout, including removal and disposal of concrete waste, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.13 TEMPORARY FIBER ROLL

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary fiber roll.

The SWPPP must describe and include the use of temporary fiber roll as a water pollution control practice for sediment control.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for fiber roll.

MATERIALS

Fiber Roll

Fiber roll must:

1. Last for at least one year after installation
2. Be Type 1 or Type 2

If specified, Type 1 fiber roll must be:

1. Made from an erosion control blanket:
 - 1.1. Classified by the Erosion Control Technology Council (ECTC) as ECTC 2D
 - 1.2. With a Universal Soil Loss Equation (USLE) C-Factor of not more than 0.20 at a 2:1 (horizontal:vertical) slope
 - 1.3. Capable to withstand a maximum shear stress of 1.75 pounds per square foot under ASTM D 6460
 - 1.4. With a minimum tensile strength of 75 pounds per foot under ASTM D 5035
 - 1.5. With top and bottom surfaces covered with extruded photodegradable plastic netting or lightweight non-synthetic netting
 - 1.6. That complies with one of the following:
 - 1.6.1. Double net straw and coconut blanket with 70 percent straw and 30 percent coconut fiber
 - 1.6.2. Double net excelsior blanket with 80 percent of the wood excelsior fibers being 6 inches or longer
2. Rolled along the width
3. Secured with natural fiber twine every 6 feet and 6 inches from each end
4. Finished to be either:
 - 4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 0.5 pounds per linear foot
 - 4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 2 pounds per linear foot

If specified, Type 2 fiber roll must:

1. Be filled with rice or wheat straw, wood excelsior, or coconut fiber
2. Be covered with a photodegradable plastic netting or a biodegradable jute, sisal, or coir fiber netting
3. Have the netting secured tightly at each end
4. Be finished to be either:
 - 4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 1.1 pounds per linear foot
 - 4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 3 pounds per linear foot

Wood Stakes

Wood stakes must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects which would render the stakes unfit for use
3. Pointed on the end to be driven into the ground

For fiber roll, wood stakes must be at least:

1. 1" x 1" x 24" in size for Type 1 installation
2. 1" x 2" x 24" in size for Type 2 installation

Rope

For Type 2 installation, rope must:

1. Be biodegradable, such as sisal or manila
2. Have a minimum diameter of 1/4 inch

CONSTRUCTION

Before placing fiber roll, remove obstructions including rocks, clods, and debris greater than one inch in diameter from the ground.

If fiber roll is to be placed in the same area as erosion control blanket, install the blanket before placing the fiber roll. For other soil stabilization practices such as hydraulic mulch or compost, place the fiber roll and then apply the soil stabilization practice.

Place fiber roll on slopes at the following spacing unless the plans show a different spacing:

1. 10 feet apart for slopes steeper than 2:1 (horizontal:vertical)
2. 15 feet apart for slopes from 2:1 to 4:1 (horizontal:vertical)
3. 20 feet apart for slopes from 4:1 to 10:1 (horizontal:vertical)
4. 50 feet apart for slopes flatter than 10:1 (horizontal:vertical)

Place fiber roll approximately parallel to the slope contour. For any 20 foot section of fiber roll, do not allow the fiber roll to vary more than 5 percent from level.

Type 1 and Type 2 fiber roll may be installed using installation method Type 1, Type 2, or a combination:

For installation method Type 1, install fiber roll by:

1. Placing in a furrow that is from 2 to 4 inches deep
2. Securing with wood stakes every 4 feet along the length of the fiber roll
3. Securing the ends of the fiber roll by placing a stake 6 inches from the end of the roll
4. Driving the stakes into the soil so that the top of the stake is less than 2 inches above the top of the fiber roll

For installation method Type 2, install fiber roll by:

1. Securing with rope and notched wood stakes.
2. Driving stakes into the soil until the notch is even with the top of the fiber roll.
3. Lacing the rope between stakes and over the fiber roll. Knot the rope at each stake.
4. Tightening the fiber roll to the surface of the slope by driving the stakes further into the soil.

MAINTENANCE

Maintain temporary fiber roll to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary fiber roll as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary fiber roll by:

1. Removing sediment from behind the fiber roll when sediment is 1/3 the height of the fiber roll above ground
2. Repairing or adjusting the fiber roll when rills and other evidence of concentrated runoff occur beneath the fiber roll.
3. Repairing or replacing the fiber roll when they become split, torn, or unraveled
4. Adding stakes when the fiber roll slump or sag
5. Replacing broken or split wood stakes

Repair temporary fiber roll within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary fiber roll, repair temporary fiber roll at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary fiber roll is not required, they must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary fiber roll must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary fiber roll is measured by the linear foot along the centerline of the installed roll. Where temporary fiber roll is joined and overlapped, the overlap is measured as a single installed roll.

The contract price paid per linear foot for temporary fiber roll includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary fiber roll, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer

The State and you share the cost of maintaining the temporary fiber roll. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.14 TEMPORARY SILT FENCE

GENERAL

Summary

This work includes installing, maintaining, and removing temporary silt fence.

The SWPPP must describe and include the use of temporary silt fence as a water pollution control practice for sediment control.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for silt fence fabric.

MATERIALS

Silt Fence Fabric

Geosynthetic fabric for temporary silt fence must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.

Test under ASTM D 4759. All properties must be based on Minimum Average Roll Value (MARV).

Identify, store, and handle under ASTM D 4873.

Protect geosynthetics from moisture, sunlight, and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information, and product identification.

Silt fence fabric must comply with:

Property	ASTM Designation	Specification	
		Woven	Non-woven
Grab breaking load 1-inch grip, lb, min. in each direction	D 4632	120	120
Apparent elongation percent, min., in each direction	D 4632	15	50
Water Flow Rate max. average roll value, gallons per minute/square foot	D 4491	10-50	100-150
Permittivity 1/sec., min.	D 4491	0.05	0.05
Apparent opening size max. average roll value, U.S. Standard sieve size	D 4751	30	30
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	D 4595	70	

Posts

Posts must be wood or metal.

Wood posts must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects that would render the stakes unfit for use
3. Pointed on the end to be driven into the ground
4. At least 2" x 2" in size, and 4 feet long

Metal posts must:

1. Be made of steel.
2. Have a "U," "T," "L," or other cross sectional shape that can resist failure from lateral loads.
3. Be pointed on the end to be driven into the ground.
4. Weigh at least 0.75-pound per foot.
5. Be at least 4 feet long.
6. Have a safety cap attached to the exposed end. The safety cap must be orange or red plastic and fit snugly to the metal post.

CONSTRUCTION

Silt fence must be:

1. Constructed with silt fence fabric, posts, and fasteners
2. Prefabricated or assembled at the job site

Silt fence fabric must be attached to posts using these methods:

1. If prefabricated silt fence is used, posts must be inserted into sewn pockets
2. If assembled on the job site:
 - 2.1. If wood posts are used, fasteners must be staples or nails
 - 2.2. If steel posts are used, fasteners must be tie wires or locking plastic fasteners
 - 2.3. Spacing of the fasteners must be no more than 8 inches apart

Place silt fence approximately parallel to the slope contour. For any 50 foot section of silt fence, do not allow the elevation at the base of the fence to vary more than 1/3 of the fence height.

Install silt fence by:

1. Placing the bottom of the fabric in a trench that is 6 inches deep
2. Securing with posts placed on the downhill side of the fabric

3. Backfilling the trench with soil and hand or mechanically tamping to secure the fabric in the trench

If you reinforce the silt fence fabric with wire or plastic mesh, you may increase the post spacing to a maximum of 10 feet. The field-assembled reinforced silt fence must be able to retain saturated sediment without collapsing.

Connect silt fence sections by:

1. Joining separate sections of silt fence to form reaches that are no more than 500 feet long
2. Securing the end posts of each section by wrapping the tops of the posts with at least two wraps of 16-gage diameter tie wire
3. Ensuring that each reach is a continuous run of silt fence from end to end or from an end to an opening, including joined panels

If you mechanically push the silt fence fabric vertically through the soil, you must demonstrate that the silt fence fabric will not be damaged and will not slip out of the soil, resulting in sediment passing under the silt fence fabric.

MAINTENANCE

Maintain temporary silt fence to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary silt fence as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary silt fence by:

1. Removing sediment from behind the silt fence when sediment is 1/3 the height of the silt fence above ground
2. Repairing or adjusting the silt fence when rills and other evidence of concentrated runoff occur beneath the silt fence fabric
3. Repairing or replacing the silt fence fabric when it become split, torn, or unraveled

Repair temporary silt fence within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary silt fence, repair temporary silt fence at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary silt fence is not required, remove and dispose of fence under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary silt fence must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary silt fence is measured by the linear foot along the centerline of the installed fence.

The contract price paid per linear foot for temporary silt fence includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary silt fence, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary silt fence. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.15 TEMPORARY FENCE

Temporary fence shall be furnished, constructed, maintained, and later removed as shown on the plans, as specified in these special provisions and as directed by the Engineer.

Except as otherwise specified in this section, temporary fence shall conform to the plan details and the specifications for permanent fence of similar character as provided in Section 80, "Fences," of the Standard Specifications.

Used materials may be installed provided the used materials are good, sound and are suitable for the purpose intended, as determined by the Engineer.

Materials may be commercial quality provided the dimensions and sizes of the materials are equal to, or greater than, the dimensions and sizes shown on the plans or specified herein.

Posts shall be either metal or wood at the Contractor's option.

Galvanizing and painting of steel items will not be required.

Treating wood with a wood preservative will not be required.

Concrete footings for metal posts will not be required.

Temporary fence that is damaged during the progress of the work shall be repaired or replaced by the Contractor at the Contractor's expense.

When no longer required for the work, as determined by the Engineer, temporary fence shall be removed. Removed facilities shall become the property of the Contractor and shall be removed from the site of the work, except as otherwise provided in this section.

Removed temporary fence materials that are not damaged may be constructed in the permanent work provided the materials conform to the requirements specified for the permanent work and such materials are new when used for the temporary fence.

Holes caused by the removal of temporary fence shall be backfilled in conformance with the provisions in the second paragraph of Section 15-1.02, "Preservation of Property," of the Standard Specifications.

The various types and kinds of temporary fence will be measured and paid for in the same manner specified for permanent fence of similar character as provided in Section 80, "Fences," of the Standard Specifications.

Full compensation for maintaining, removing, and disposing of temporary fence shall be considered as included in the contract prices paid per linear foot for the various types of temporary fence and no additional compensation will be allowed therefor.

10-1.16 TEMPORARY GRAVEL BAG BERM

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary gravel bag berm.

The SWPPP must describe and include the use of temporary gravel bag berm as a water pollution control practice for sediment control.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for gravel-filled bag fabric.

MATERIALS

Gravel-filled Bag Fabric

Geosynthetic fabric for temporary gravel bag berm must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.

Test under ASTM D 4759. All properties must be based on Minimum Average Roll Value (MARV).

Identify, store, and handle under ASTM D 4873.

Protect geosynthetics from moisture, sunlight, and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information, and product identification.

Gravel-filled bag fabric must comply with:

Specification	Requirements
Grab breaking load 1-inch grip, lb, min. in each direction	205
Apparent elongation percent, min., in each direction	50
Water Flow Rate max. average roll value, gallons per minute/square foot	80-150
Permittivity 1/sec., min	1.2
Apparent opening size max. average roll value, U.S. Standard sieve size	40-80
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	70

Gravel

Gravel for gravel-filled bags must be:

1. From 3/8 to 3/4 inch in diameter
2. Clean and free from clay balls, organic matter, and other deleterious materials

Gravel-filled Bags

Gravel-filled bags must:

1. Be made from gravel-filled bag fabric.
2. Have inside dimensions from 24 to 32 inches in length, and from 16 to 20 inches in width.
3. Have the opening bound to retain the gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.
4. Weigh from 30 to 50 pounds when filled with gravel.

CONSTRUCTION

Before constructing temporary gravel bag berm, remove obstructions including rocks, clods, and debris greater than 1 inch in diameter from the ground.

Temporary gravel bag berm must:

1. Be placed as a single layer of gravel bags to create a linear sediment barrier
2. Be placed end-to-end to eliminate gaps
3. Be placed approximately parallel to the slope contour
4. Have the last 6 feet of the gravel bag berm angled up-slope

If you need to increase the height of the temporary gravel bag berm:

1. Increase height by adding rows of gravel-filled bags
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row
3. Stabilize berm by adding rows at the bottom

If used within shoulder area, gravel-filled bags must be placed behind temporary railing (Type K).

MAINTENANCE

Maintain temporary gravel bag berm to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary gravel bag berm as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary gravel bag berm by:

1. Removing sediment from behind the gravel bag berm when sediment is 1/3 the height of the gravel bag berm above ground

2. Repairing or adjusting the gravel-filled bags when rills and other evidence of concentrated runoff occur beneath the gravel-filled bags
3. Repairing or replacing the gravel-filled bags when they become split, torn, or unraveled

Repair temporary gravel bag berm within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary gravel bag berm, repair temporary gravel bag berm at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary gravel bag berm is not required, they must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary gravel bag berm must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary gravel bag berm is measured by the linear foot along the centerline of the installed berm.

The contract price paid per linear foot for temporary gravel bag berm includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary gravel bag berm, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary gravel bag berm. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.17 TEMPORARY CONSTRUCTION ENTRANCE

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary construction entrance to provide temporary access.

The SWPPP must describe and include the use of temporary construction entrance as a water pollution control practice for tracking control.

Temporary construction entrance must be Type 1, Type 2, or a combination.

Submittals

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for:

1. Temporary entrance fabric
2. Rock

Submit details for alternatives at least 5 business days before installation. You may propose alternatives for the following items:

1. Alternative sump
2. Alternative corrugated steel panels

If the Engineer approves, you may eliminate the sump.

MATERIALS

Temporary Entrance Fabric

Temporary entrance fabric must comply with the specifications for rock slope protection fabric (Class 8) in Section 88-1.06, "Channel and Shore Protection," of the Standard Specifications.

Rock

Rock must be Type A or Type B.

Rock (Type A) must comply with:

1. Requirements under Section 72-2.02, "Materials," of the Standard Specifications
2. Following sizes:

Square Screen Size (inch)	Percentage Passing	Percentage Retained
6	100	0
3	0	100

Rock (Type B) must be Railway Ballast Number 25. Do not use blast furnace slag. Railway Ballast Number 25 must comply with:

1. Description in AREMA Manual for Railway Engineering.
2. Following sizes:

Nominal Size Square Opening	Percentage Passing								
	3"	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4
2-1/2"-3/8"	100	80-100	60-85	50-70	25-50	-	5-20	0-10	0-3

3. Following properties:

Specification	Requirements
Percent material passing No. 200 sieve, max. ASTM: C 117	1.0
Bulk specific gravity, min. ASTM: C 127	2.60
Absorption, percent min. ASTM: C 127	1.0
Clay lumps and friable particles, percent max. ASTM: C 142	0.5
Degradation, percent max. ASTM: C 535	30
Soundness (Sodium Sulfate), percent max. ASTM: C 88	5.0
Flat, elongated particles, or both, percent max. ASTM: D 4791	5.0

Corrugated Steel Panels

Corrugated steel panels must:

1. Be made of steel.
2. Be pressed or shop welded
3. Have a slot or hook for connecting panels together

CONSTRUCTION

Prepare location for temporary construction entrance by:

1. Removing vegetation to ground level and clear away debris
2. Grading ground to uniform plane
3. Grading ground surface to drain
4. Removing sharp objects that may damage fabric
5. Compacting the top 1.5 feet of soil to at least 90 percent relative compaction

If temporary entrance (Type 1) is specified, use rock (Type A).

If temporary construction entrance (Type 2) is specified, use Rock (Type B) under corrugated steel panels. Use at least 6 corrugated steel panels for each entrance. Couple panels together.

Install temporary construction entrance by:

1. Positioning fabric along the length of the entrance
2. Overlapping sides and ends of fabric by at least 12 inches
3. Spreading rock over fabric in the direction of traffic
4. Covering fabric with rock within 24 hours
5. Keeping a 6 inch layer of rock over fabric to prevent damage to fabric by spreading equipment

Do not drive on fabric until rock is spread.

Unless the Engineer eliminates the sump, install a sump within 20 feet of each temporary construction entrance.

Repair fabric damaged during rock spreading by placing a new fabric over the damaged area. New fabric must be large enough to cover damaged area and provide at least 18-inch overlap on all edges.

Maintenance

Maintain temporary construction entrance to minimize generation of dust and tracking of soil and sediment onto public roads. If dust or sediment tracking increases, place additional rock unless the Engineer approves another method.

Repair temporary construction entrance if:

1. Fabric is exposed
2. Depressions in the entrance surface develop
3. Rock is displaced

Repair temporary construction entrance within 24 hours of discovering damage unless the Engineer approves a longer period.

During use of temporary construction entrance, do not allow soil, sediment, or other debris tracked onto pavement to enter storm drains, open drainage facilities, or watercourses. When material is tracked onto pavement, remove it within 24 hours unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace the temporary construction entrance, repair it at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

Removal

When the Engineer determines that temporary construction entrance is not required, remove and dispose of it under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Backfill and repair ground disturbance, including holes and depressions, caused by installation and removal of temporary construction entrance under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary construction entrance is determined from actual count in place. Temporary construction entrance is measured one time only and no additional measurement will be recognized.

The contract price paid for temporary construction entrance includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing temporary construction entrance, complete in place, including removal of temporary construction entrance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

No additional compensation will be made if the temporary construction entrance is relocated during the course of construction.

The State and you share the cost of maintaining temporary construction entrance. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.18 MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)

GENERAL

Summary

This work includes moving onto the project when an area is ready to receive temporary erosion control, setting up required personnel and equipment for the application of erosion control materials, and moving out all personnel and equipment when temporary erosion control in that area is completed.

Temporary erosion control consists of any water pollution control practice for soil stabilization.

When notified by the Engineer that an area is ready for temporary erosion control, start erosion control work within 5 business days.

MEASUREMENT AND PAYMENT

Move-in/move-out (temporary erosion control) is measured as units from actual count. A move-in followed by a move-out is considered one unit.

The contract unit price paid for move-in/move-out (temporary erosion control) includes full compensation for furnishing all labor, materials (excluding temporary erosion control materials), tools, equipment, and incidentals and for doing all the work involved in moving in and removing from the project all personnel and equipment necessary for application of temporary erosion control, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.19 TEMPORARY DRAINAGE INLET PROTECTION

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary drainage inlet protection. Drainage inlet protection settles and filters sediment before stormwater runoff discharges into storm drainage systems.

The SWPPP must describe and include the use of temporary drainage inlet protection as a water pollution control practice for sediment control.

Provide temporary drainage inlet protection to meet the changing conditions around the drainage inlet. Temporary drainage inlet protection must be appropriate type to meet the conditions around the drainage inlet.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Erosion control blanket
2. Fiber rolls
3. Safety cap for metal posts
4. Silt fence fabric
5. Sediment filter bag
6. Foam barrier
7. Rigid plastic barrier
8. Gravel-filled bag fabric

If you substitute the steel wire staple with an alternative attachment device, submit a sample of the device for approval at least 5 business days before installation.

MATERIALS

Geosynthetic Fabrics

Geosynthetic fabrics for temporary drainage inlet protection must consist of one of the following:

1. Polyester

2. Polypropylene
3. Combined polyester and polypropylene

Geosynthetic fabrics for temporary drainage inlet must comply with the specifications for water pollution control in Section 88-1.05, "Water Pollution Control," of the Standard Specifications.

Foam barrier must comply with:

Foam Barrier

Property	ASTM Designation	Specification
Grab breaking load 1-inch grip, lb, min. in each direction	D 4632	200
Apparent elongation percent, min., in each direction	D 4632	15
Water Flow Rate max. average roll value, gallons per minute/square foot	D 4491	100-150
Permittivity 1/sec., min.	D 4491	0.05
Apparent opening size max. average roll value, U.S. Standard sieve size	D 4751	40
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	D 4595	70

Sample under ASTM D 4354, Procedure C.

Test under ASTM D 4759. All properties are based on Minimum Average Roll Value (MARV).

Identify, store, and handle under ASTM D 4873.

Erosion Control Blanket

Erosion control blanket must be:

1. Described as a rolled erosion control product (RECP)
2. Classified as temporary and degradable or long-term and non-degradable
3. Machine-made mats
4. Provided in rolled strips
5. Classified by the Erosion Control Technology Council (ECTC)

Erosion control blanket classified as temporary and degradable must be one of the following:

1. Double net excelsior blanket:
 - 1.1. Classified as ECTC Type 2D
 - 1.2. Classified as an erosion control blanket
 - 1.3. Designed to last for at least one year after installation
 - 1.4. With a Universal Soil Loss Equation (USLE) C-Factor of not more than 0.20 at a 2:1 (horizontal:vertical) slope
 - 1.5. With 80 percent of the wood excelsior fibers being 6 inches or longer
 - 1.6. Capable to withstand a maximum shear stress of 1.75 pounds per square foot under ASTM D 6460
 - 1.7. With a minimum tensile strength of 75 pounds per foot under ASTM D 5035
 - 1.8. With top and bottom surfaces covered with extruded photodegradable plastic netting or lightweight non-synthetic netting

2. Double net straw and coconut blanket:
 - 2.1. Classified as ECTC Type 2D
 - 2.2. Classified as an erosion control blanket
 - 2.3. Designed to last for at least one year after installation
 - 2.4. With a USLE C-Factor of not more than 0.20 at a 2:1 (horizontal:vertical) slope
 - 2.5. Comprised of 70 percent straw and 30 percent coconut fiber
 - 2.6. Capable to withstand a maximum shear stress of 1.75 pounds per square foot under ASTM D 6460
 - 2.7. With a minimum tensile strength of 75 pounds per foot under ASTM D 5035
 - 2.8. With top and bottom surfaces covered with extruded photodegradable plastic netting or lightweight non-synthetic netting

3. Jute netting:
 - 3.1. Classified as ECTC Type 3B
 - 3.2. Classified as an open weave textile and have from 14 to 20 strands per foot in each direction
 - 3.3. Designed to last for at least one year after installation
 - 3.4. With a USLE C-Factor of not more than 0.25 at a 1.5:1 (horizontal:vertical) slope
 - 3.5. Comprised of 100 percent unbleached and undyed spun yarn made of jute fiber
 - 3.6. With an average open area from 63 to 70 percent
 - 3.7. From 48 to 72 inches in width
 - 3.8. Capable to withstand a maximum shear stress of 2.0 pounds per square foot under ASTM D 6460
 - 3.9. With a minimum tensile strength of 100 pounds per foot under ASTM D 5035
 - 3.10. From 0.90 to 1.20 pounds per square yard in weight

4. Coir netting:
 - 4.1. Classified as ECTC Type 4
 - 4.2. Classified as an open weave textile and from 13 to 18 strands per foot in each direction
 - 4.3. Designed to last for at least three years after installation
 - 4.4. With a USLE C-Factor of not more than 0.25 at a 1:1 (horizontal:vertical) slope
 - 4.5. Comprised of 100 percent unbleached and undyed spun coir yarn made of coconut fiber
 - 4.6. With an average open area from 63 to 70 percent
 - 4.7. From 72 to 158 inches in width
 - 4.8. Capable to withstand a maximum shear stress of 2.25 pounds per square foot under ASTM D6460
 - 4.9. With a minimum tensile strength of 125 pounds per foot under ASTM D 5035
 - 4.10. From 1.20 to 1.67 pounds per square yard in weight

Erosion control blanket classified as long-term and non-degradable must:

1. Be a geosynthetic fabric
2. Comply with the specifications for rock slope protection fabric (Class 8) in Section 88-1.06, "Channel and Shore Protection," of the Standard Specifications

Staples

You may use an alternative attachment device such as a geosynthetic pins or plastic pegs to install erosion control blanket.

Rock

Rock must comply with:

1. Requirements under Section 72-2.02, "Materials," of the Standard Specifications
2. Following sizes:

Square Screen Size (inch)	Percentage Passing	Percentage Retained
6	100	0
3	0	100

Rope

Rope for fiber rolls must be:

1. Biodegradable, such as sisal or manila
2. At least 1/4 inch in diameter

Fiber Rolls

Fiber rolls must:

1. Last for at least one year after installation
2. Be Type 1 or Type 2

For Type 1, fiber rolls must be:

1. Made from an erosion control blanket classified as temporary and degradable
2. Rolled along the width
3. Secured with natural fiber twine every 6'-6" from each end
4. Finished to be either:
 - 4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 0.5 pounds per linear foot
 - 4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 2 pounds per linear foot

For Type 2, fiber rolls must:

1. Be filled with rice or wheat straw, wood excelsior, or coconut fiber
2. Be covered with photodegradable plastic netting, biodegradable jute, sisal, or coir fiber netting
3. Have netting secured tightly at each end
4. Be finished to be either:
 - 4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 1.1 pounds per linear foot
 - 4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 3 pounds per linear foot

Wood Stakes

Wood stakes must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects which would render the stakes unfit for use
3. Pointed on the end to be driven into the ground

For fiber rolls, wood stakes must be at least:

1. 1" x 1" x 24" in size for Type 1 installation
2. 1" x 2" x 24" in size for Type 2 installation

Posts

Posts must be wood or metal.

Wood posts must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects that would render the stakes unfit for use
3. Pointed on the end to be driven into the ground
4. At least 2" x 2" in size, and 4 feet long

Metal posts must:

1. Be made of steel.
2. Have a "U," "T," "L," or other cross sectional shape that can resist failure from lateral loads.
3. Be pointed on the end to be driven into the ground.
4. Weigh at least 0.75-pound per foot.
5. Be at least 4 feet long.
6. Have a safety cap attached to the exposed end. The safety cap must be orange or red plastic and fit snugly to the metal post.

Silt Fence

Silt fence must be:

1. Constructed with silt fence fabric, posts, and fasteners
2. Prefabricated or assembled at the job site

Silt fence fabric must be attached to posts using these methods:

1. If prefabricated silt fence is used, posts must be inserted into sewn pockets
2. If assembled on the job site:
 - 2.1. If wood posts are used, fasteners must be staples or nails
 - 2.2. If steel posts are used, fasteners must be tie wires or locking plastic fasteners
 - 2.3. Spacing of the fasteners must be at least 8 inches

Gravel-filled Bags

Gravel-filled bags must:

1. Be made from fabric.
2. Have inside dimensions from 24 to 32 inches in length, and from 16 to 20 inches in width.
3. Have the opening bound to retain the gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.
4. Weigh from 30 to 50 pounds when filled with gravel.

Gravel for gravel-filled bags must be:

1. From 3/8 to 3/4 inch in diameter
2. Clean and free from clay balls, organic matter, and other deleterious materials

Sediment Filter Bag

Sediment filter bag must:

1. Be made of fabric
2. Be sized to fit the catch basin or drainage inlet
3. Include a high-flow bypass

Sediment filter bag may include a metal frame. Sediment filter bags that do not have a metal frame and are deeper than 18 inches must:

1. Include lifting loops and dump straps
2. Include a restraint cord to keep the sides of the bag away from the walls of the catch basin

Foam Barriers

Foam barriers must:

1. Be filled with a urethane foam core
2. Have a geosynthetic fabric cover and flap
3. Have a triangular, circular, or square shaped cross section

4. Have a vertical height of at least 5 inches after installation
5. Have a horizontal flap of at least 8 inches in width
6. Have a length of at least 4 feet per unit
7. Have the ability to interlock separate units into a longer barrier so that water does not flow between the units
8. Be secured to:
 - 8.1. Pavement with 1-inch concrete nails with 1-inch washers and solvent-free adhesive
 - 8.2. Soil with 6-inch nails with 1-inch washers

Rigid Plastic Barriers

Rigid plastic barriers must:

1. Have an integrated filter
2. Have a formed outer jacket of perforated high density polyethylene (HDPE) or polyethylene terephthalate (PET)
3. Have a flattened tubular shaped cross section
4. Be made from virgin or recycled materials
5. Be free from biodegradable filler materials that degrade the physical or chemical characteristics of the finished filter core or outer jacket
6. Have a length of at least 4 feet per unit
7. Have the ability to interlock separate units into a longer barrier so that water does not flow between the units
8. Be secured to:
 - 8.1. Pavement with 1-inch concrete nails with 1-inch washers and solvent-free adhesive, with gravel-filled bags, or a combination
 - 8.2. Soil with 6-inch nails with 1-inch washers and wood stakes

9. Comply with the following properties:

Specification	Requirements
Grab tensile strength of outer jacket material, pounds/square inch, min. in each direction ASTM D 4632*	4000
Break strength of outer jacket, pounds/square inch ASTM D 4632*	1300
Permittivity of filter core, 1/sec., min. ASTM D 4491	0.38
Flow rate of filter core, gallons per minute per square foot, ASTM D 4491	100 min. 200 max.
Filter core aperture size, max., Average Opening Size (AOS), microns	425
Ultraviolet stability (outer jacket & filter core), percent tensile strength retained after 500 hours, min. ASTM D 4355 (xenon-arc lamp and water spray weathering method)	90

* or appropriate test method for specific polymer

If used at a curb inlet without a grate, rigid plastic barriers must:

1. Have a horizontal flap of at least 6 inches with an under-seal gasket to prevent underflows
2. Include a high-flow bypass
3. Have a vertical height of at least 7 inches after installation
4. Be sized to fit the catch basin or drainage inlet

If used at a grated catch basin without a curb inlet, rigid plastic barriers must:

1. Cover the grate by at least 2 inches on each side and have an under-seal gasket to prevent underflows
2. Include a high-flow bypass

3. Have a vertical height of at least 1.5 inches after installation
4. Be sized to fit the catch basin or drainage inlet

If used at a curb inlet with a grate, rigid plastic barriers must:

1. Have a horizontal flap that covers the grate by at least 2 inches on the 3 sides away from the curb opening and have an under-seal gasket to prevent underflows
2. Include a high-flow bypass
3. Have a vertical section that covers the curb opening by at least 5 inches after installation
4. Be sized to fit the catch basin or drainage inlet

If used as a linear sediment barrier, rigid plastic barriers:

1. Must have an installed height of at least 6 inches
2. May have a horizontal flap of at least 4 inches

Linear Sediment Barrier

Linear sediment barriers must consist of one or more of the following:

1. Silt fence
2. Gravel-filled bags
3. Fiber roll
4. Rigid plastic barrier
5. Foam barrier

Flexible Sediment Barrier

Flexible sediment barriers consist of one or more of the following:

1. Rigid plastic barrier
2. Foam barrier

CONSTRUCTION

For drainage inlet protection at drainage inlets in paved and unpaved areas:

1. Prevent ponded runoff from encroaching on the traveled way or overtopping the curb or dike. Use linear sediment barriers to redirect runoff and control ponding.
2. Clear the area around each drainage inlet of obstructions including rocks, clods, and debris greater than one inch in diameter before installing the drainage inlet protection.
3. Install a linear sediment barrier up-slope of the existing drainage inlet and parallel with the curb, dike, or flow line to prevent sediment from entering the drainage inlet.

Erosion Control Blanket

To install erosion control blanket and geosynthetic fabric:

1. Secure blanket or fabric to the surface of the excavated sediment trap with staples and embed in a trench adjacent to the drainage inlet
2. Anchor the perimeter edge of the erosion control blanket in a trench

Silt Fence

If silt fence is used as a linear sediment barrier:

1. Place fence along the perimeter of the erosion control blanket, with the posts facing the drainage inlet
2. Install fence with the bottom edge of the silt fence fabric in a trench. Backfill the trench with soil and compact manually

Gravel Bag Berm

If gravel bag berm is used as a linear sediment barrier:

1. Place gravel-filled bags end-to-end to eliminate gaps
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row

If gravel bag berms are used for Type 3A and Type 3B:

1. Place gravel-filled bags end-to-end to eliminate gaps
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row
3. Arrange bags to create a spillway by removing one or more gravel-filled bags from the upper layer

If used within shoulder area, place gravel-filled bags behind temporary railing (Type K).

Fiber Rolls

If fiber rolls are used as a linear sediment barrier:

1. Place fiber rolls in a furrow.
2. Secure fiber rolls with stakes installed along the length of the fiber rolls. Stakes must be installed from 6 to 12 inches from the end of the rolls.

If fiber rolls are used as a linear sediment barrier for Type 4A, place them over the erosion control blanket.

Foam Barriers

If foam barriers are used as a linear sediment barrier:

1. Install barriers with the horizontal flap in a 3 inch deep trench and secured with nails and washers placed no more than 4 feet apart
2. Secure barriers with 2 nails at the connection points where separate units overlap
3. Place barriers without nails or stakes piercing the core

Flexible Sediment Barriers

If flexible sediment barriers are used:

1. Secure barriers to the pavement with nails and adhesive, gravel-filled bags, or a combination
2. Install barriers flush against the sides of concrete, asphalt concrete, or hot mix asphalt curbs or dikes
3. Place barriers to provide a tight joint with the curb or dike and anchored in a way that runoff cannot flow behind the barrier

If flexible sediment barriers are used for Type 4B:

1. Secure barriers to the pavement according to the angle and spacing shown on the plans
2. Place barriers to provide a tight joint with the curb or dike. Cut the cover fabric or jacket to ensure a tight fit

Rigid Sediment Barriers

If rigid sediment barriers are used at a grated catch basin without a curb inlet:

1. Place barriers using the gasket to prevent runoff from flowing under the barrier
2. Secure barriers to the pavement with nails and adhesive, gravel-filled bags, or a combination

If rigid sediment barriers are used for linear sediment barriers:

1. Install barriers in a trench. Backfill the trench with soil and compact manually
2. Place barrier with separate units overlapping at least 4 inches
3. Reinforce barriers with a wood stake at each overlap
4. Fasten barriers to the wood stakes with steel screws, 16 gauge galvanized steel wire, or with UV stabilized cable ties that are from 5 to 7 inches in length

Sediment Filter Bags

Install sediment filter bags for Type 5 by:

1. Removing the drainage inlet grate
2. Placing the sediment bag in the opening
3. Replacing the grate to secure the sediment filter bag in place

MAINTENANCE

Maintain temporary drainage inlet protection to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary drainage inlet protection as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary drainage inlet protection by removing sediment from:

1. Behind flexible sediment barriers when sediment exceeds 1 inch in depth
2. Surface of the erosion control blanket when sediment exceeds 1 inch in depth
3. Sediment trap for Type 2 when the volume has been reduced by approximately one-half
4. Behind silt fence when the sediment is 1/3 the height of the silt fence fabric above ground
5. Sediment filter bags when filled or when the restraint cords are no longer visible

If rills and other evidence of concentrated runoff occur beneath the linear sediment barrier, repair or adjust the barrier.

If silt fence fabric becomes split, torn, or unraveled, repair or replace silt fence.

If geosynthetic fabric becomes split, torn, or unraveled, repair or replace foam barriers.

Repair or replace sagging or slumping linear sediment barriers with additional stakes. Replace broken or split wood stakes.

Reattach foam barriers and rigid plastic barriers that become detached or dislodged from the pavement.

Repair split or torn rigid plastic barriers with 16 gauge galvanized steel wire or UV stabilized cable ties that are from 5 to 7 inches in length.

For sediment filter bags without metal frames, empty by placing one inch steel reinforcing bars through the lifting loops and then lift the filled bag from the drainage inlet. For sediment filter bags with metal frames, empty by lifting the metal frame from the drainage inlet. Rinse before replacing in the drainage inlet. When rinsing the sediment filter bags, do not allow the rinse water to enter a drain inlet or waterway.

Repair temporary drainage inlet protection within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary drainage inlet protection, repair temporary drainage inlet protection at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that the temporary drainage inlet protection is not required, it must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary drainage inlet protection must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Quantities of temporary drainage inlet protection will be determined from actual count in place. The protection will be measured one time only and no additional measurement will be recognized.

The contract unit price paid for temporary drainage inlet protection includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary drainage inlet protection, complete in place, including removal of materials, cleanup and disposal of retained

sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

No additional compensation will be made if the temporary drainage inlet protection is relocated during the course of construction.

The State and you share the cost of maintaining the temporary drainage inlet protection. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.20 TEMPORARY DRAINAGE SAN FERNANDO BOULEVARD EXCAVATION

GENERAL

Summary

This work includes constructing concrete slurry backfill for the storm drain inlets and pipes during the stage construction of the San Fernando Boulevard excavation.

The SWPPP must describe and include the use of temporary drainage inlet protection as a water pollution control practice for sediment control. Temporary drainage inlet protection must conform to Section 10-1 of these special provisions for a full description of submittals, materials, construction and maintenance. Full compliance with this special provision is required.

MATERIAL

Concrete backfill for culverts shall be constructed in conformance with the provisions in Section 66-1.045, "Concrete Backfill," of the Standard Specifications.

PAYMENT

The lump sum price paid for temporary drainage San Fernando Avenue excavation includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the concrete slurry backfill and temporary drainage inlet protection, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.21 TEMPORARY UTILITIES

TEMPORARY ELECTRICAL FACILITIES

Provide and maintain electrical power and wiring requirements specified in provision of "Contractor-Furnished Resident Engineer's (RE) Office" of these special provisions. Electrical power must be provided at your expense. You must request the utility company to install temporary power poles in locations required by the Engineer. You must furnish temporary wiring, feeders, and connections.

TEMPORARY WATER

Provide temporary water service specified in provision "Contractor-Furnished RE Office" of these special provisions at your expense. Work must conform to the California Plumbing Code, California Code of Regulations, Title 24, Part 5. You must determine the closest availability of water and obtain approval by authorities having jurisdiction before making the connection.

Provide temporary piping or hose to carry water to every point where needed. Water must be potable, unless otherwise approved by the Engineer.

TEMPORARY HEATING AND COOLING

Provide temporary heating and cooling, to meet all requirements specified in provision "Contractor-Furnished RE Office" of these special provisions.

Fuel, equipment, and methods of heating will be approved by the Engineer before use.

MEASUREMENT AND PAYMENT

Full compensation for providing temporary utilities to operate RE office is included in the contract lump sum price paid for contractor-furnished RE office and no additional compensation will be allowed therefor.

10-1.22 COOPERATION

It is anticipated that work by another contractor may be in progress adjacent to or within the limits of this project during progress of the work on this contract. The following table lists contracts anticipated to be in progress during this contract.

Contract No.	Co-Rte-PM	Location	Type of Work
07-1218V4	LA-5-31.6/36.0	Los Angeles County in Burbank 0.3 km south of Cohasset Street undercrossing to 0.1 km north of Sheldon Street overcrossing	Construct HOV Lanes
07-1219U4	LA-5-36.0/39/4	Los Angeles County in Los Angeles on Route 5 from 0.1 km north of Sheldon Street overcrossing and Various Locations	Consturct HOV Lanes
07-A2926	LA-5-29.4/31.6	Los Angeles County in Burbank from west Magnolia Boulevard overcrossing to 0.4 mile north of Buena Vista Street / Winona Avenue undercrossing	Demolition of improvements within the Right of Way
07-A3044	LA-5-29.4/31.6	Los Angeles County in Burbank from west Magnolia Boulevard overcrossing to 0.4 mile north of Buena Vista Street / Winona Avenue undercrossing	Asbestos and lead of improvements within the Right of Way

Comply with Section 7-1.14, "Cooperation," of the Standard Specifications.

10-1.23 PROGRESS SCHEDULE (CRITICAL PATH METHOD)

SUMMARY

Comply with Section 8-1.04, "Progress Schedule," of the Standard Specifications except you must use computer software to prepare the schedule.

You are responsible for assuring that all activity sequences are logical and that each schedule shows a coordinated plan for complete performance of the work.

DEFINITIONS

contract completion date: Current extended date for completion of the contract shown on the Weekly Statement of Working Days furnished by the Engineer as specified in Section 8-1.06, "Time of Completion," of the Standard Specifications.

data date: Day after the date through which a schedule is current. Everything occurring earlier than the data date is as-built and everything on or after the data date is planned.

early completion time: Difference in time between an early scheduled completion date and the contract completion date.

float: Difference between the earliest and latest allowable start or finish times for an activity.

milestone: Event activity that has zero duration and is typically used to represent the beginning or end of a certain stage of the project.

narrative report: Document submitted with each schedule that discusses topics related to project progress and scheduling.

near critical path: Chain of activities with total float exceeding that of the critical path but having no more than 10 working days of total float.

State-owned float activity: Activity documenting time saved on the critical path by actions of the State. It is the last activity prior to the scheduled completion date.

time impact analysis: Schedule and narrative report developed specifically to demonstrate what effect a proposed change or delay has on the current scheduled completion date.

time-scaled network diagram: Graphic depiction of a CPM schedule comprised of activity bars with relationships for each activity represented by arrows. The tail of each arrow connects to the activity bar for the predecessor and points to the successor.

total float: Amount of time that an activity or chain of activities can be delayed before extending the scheduled completion date.

GENERAL REQUIREMENTS

Submit baseline, monthly updated, and final updated schedules, each consistent in all respects with the time and order of work requirements of the contract. Perform work in the sequence indicated on the current accepted schedule.

Each schedule must show:

1. Calculations using the critical path method to determine controlling activities.
2. Duration activities less than 20 working days.
3. At least 50 but not more than 500 activities, unless authorized. The number of activities must be sufficient to assure adequate planning of the project, to permit monitoring and evaluation of progress, and to do an analysis of time impacts.
4. Each required constraint. Constraints other than those required by the special provisions may be included only if authorized.
5. State-owned float as the predecessor activity to the scheduled completion date.
6. Activities with identification codes for responsibility, stage, work shifts, location, and contract pay item numbers.

You may show early completion time on any schedule provided that the requirements of the contract are met. Early completion time is considered a resource for your exclusive use. You may increase early completion time by improving production, reallocating resources to be more efficient, performing sequential activities concurrently, or by completing activities earlier than planned. You may also submit for approval a VECP as specified in Section 4-1.035B, "Value Engineering Change Proposal." of the Standard Specifications that will reduce time of construction.

You may show a scheduled completion date that is later than the contract completion date on an update schedule, after the baseline schedule is accepted. Provide an explanation for a late scheduled completion date in the narrative report that is included with the schedule.

State-owned float is considered a resource for the exclusive use of the State. The Engineer may accrue State-owned float by the early completion of review of any type of required submittal when it saves time on the critical path. Prepare a time impact analysis, when requested by the Engineer, to determine the effect of the action as specified in "Time Impact Analysis." The Engineer documents State-owned float by directing you to update the State-owned float activity on the next updated schedule. Include a log of the action on the State-owned float activity and include a discussion of the action in the narrative report. The Engineer may use State-owned float to mitigate past, present, or future State delays by offsetting potential time extensions for contract change orders.

The Engineer may adjust contract working days for ordered changes that affect the scheduled completion date as specified in Section 4-1.03, "Changes," of the Standard Specifications. Prepare a time impact analysis to determine the effect of the change as specified in "Time Impact Analysis" and include the impacts acceptable to the Engineer in the next updated schedule. Changes that do not affect the controlling operation on the critical path will not be considered as the basis for a time adjustment. Changes that do affect the controlling operation on the critical path will be considered by the Engineer in decreasing time or granting an extension of time for completion of the contract. Time extensions will only be granted if the total float is absorbed and the scheduled completion date is delayed 1 or more working days because of the ordered change.

The Engineer's review and acceptance of schedules does not waive any contract requirements and does not relieve you of any obligation or responsibility for submitting complete and accurate information. Correct rejected schedules and resubmit them within 7 days of notification by the Engineer, at which time a new review period of 7 days will begin.

Errors or omissions on schedules do not relieve you from finishing all work within the time limit specified for completion of the contract. If, after a schedule has been accepted by the Engineer, either you or the Engineer discover that any aspect of the schedule has an error or omission, you must correct it on the next updated schedule.

COMPUTER SOFTWARE

Submit a description of your proposed schedule software for authorization. All software must be compatible with the current version of the Windows operating system in use by the Engineer. The schedule software must include the latest version of Oracle Primavera P6 Professional Project Management for Windows, or equivalent.

If schedule software equivalent to P6 is proposed, it must be capable of:

1. Generating files that can be imported into P6
2. Comparing 2 schedules and providing reports of changes in activity ID, activity description, constraints, calendar assignments, durations, and logic ties

NETWORK DIAGRAMS, REPORTS, AND DATA

Include the following with each schedule submittal:

1. 2 sets of originally plotted, time-scaled network diagrams
2. 2 copies of a narrative report
3. 1 read-only compact disk or floppy diskette containing the schedule data

The time-scaled network diagrams must conform to the following:

1. Show a continuous flow of information from left to right
2. Be based on early start and early finish dates of activities
3. Clearly show the primary paths of criticality using graphical presentation
4. Be prepared on 34" x 44"
5. Include a title block and a timeline on each page

The narrative report must be organized in the following sequence with all applicable documents included:

1. Transmittal letter
2. Work completed during the period
3. Identification of unusual conditions or restrictions regarding labor, equipment or material; including multiple shifts, 6-day work weeks, specified overtime or work at times other than regular days or hours
4. Description of the current critical path
5. Changes to the critical path and scheduled completion date since the last schedule submittal
6. Description of problem areas
7. Current and anticipated delays:
 - 7.1. Cause of delay
 - 7.2. Impact of delay on other activities, milestones, and completion dates
 - 7.3. Corrective action and schedule adjustments to correct the delay
8. Pending items and status thereof:
 - 8.1. Permits
 - 8.2. Change orders
 - 8.3. Time adjustments
 - 8.4. Noncompliance notices
9. Reasons for an early or late scheduled completion date in comparison to the contract completion date

Schedule submittals will only be considered complete when all documents and data have been submitted as described above.

PRECONSTRUCTION SCHEDULING CONFERENCE

Schedule a preconstruction scheduling conference with your project manager and the Engineer within 15 days after contract approval. The Engineer will conduct the meeting and review the requirements of this section with you.

Submit a general time-scaled logic diagram displaying the major activities and sequence of planned operations and be prepared to discuss the proposed work plan and schedule methodology that comply with the requirements of

this section. If you propose deviations to the construction staging, then the general time-scaled logic diagram must also display the deviations and resulting time impacts. Be prepared to discuss the proposal.

At this meeting, also submit the alphanumeric coding structure and activity identification system for labeling work activities. To easily identify relationships, each activity description must indicate its associated scope or location of work by including such terms as quantity of material, type of work, bridge number, station to station location, side of highway (such as left, right, northbound, southbound), lane number, shoulder, ramp name, ramp line descriptor, or mainline.

The Engineer reviews the logic diagram, coding structure, and activity identification system, and provide any required baseline schedule changes to you for implementation.

BASELINE SCHEDULE

Beginning the week following the preconstruction scheduling conference, meet with the Engineer weekly to discuss schedule development and resolve schedule issues until the baseline schedule is accepted.

Submit a baseline schedule within 20 days of contract approval. Allow 20 days for the Engineer's review after the baseline schedule and all support data are submitted.

The baseline schedule must include the entire scope of work and how you plan to complete all work contemplated. The baseline schedule must show the activities that define the critical path. Multiple critical paths and near-critical paths must be kept to a minimum. A total of not more than 50 percent of the baseline schedule activities must be critical or near critical, unless otherwise authorized.

The baseline schedule must not extend beyond the number of contract working days. The baseline schedule must have a data date of contract approval. If you start work before contract approval, the baseline schedule must have a data date of the 1st day you performed work at the job site.

If you submit an early completion baseline schedule that shows contract completion in less than 85 percent of the contract working days, the baseline schedule must be supplemented with resource allocations for every task activity and include time-scaled resource histograms. The resource allocations must be shown to a level of detail that facilitates report generation based on labor crafts and equipment classes for you and your subcontractors. Use average composite crews to display the labor loading of on-site construction activities. Optimize and level labor to reflect a reasonable plan for accomplishing the work of the contract and to assure that resources are not duplicated in concurrent activities. The time-scaled resource histograms must show labor crafts and equipment classes to be used. The Engineer may review the baseline schedule activity resource allocations using Means Productivity Standards or equivalent to determine if the schedule is practicable.

UPDATED SCHEDULE

Submit an updated schedule and meet with the Engineer to review contract progress, on or before the 1st day of each month, beginning 1 month after the baseline schedule is accepted. Allow 15 days for the Engineer's review after the updated schedule and all support data are submitted, except that the review period will not start until the previous month's required schedule is accepted. Updated schedules that are not accepted or rejected within the review period are considered accepted by the Engineer.

The updated schedule must have a data date of the 21st day of the month or other date established by the Engineer. The updated schedule must show the status of work actually completed to date and the work yet to be performed as planned. Actual activity start dates, percent complete, and finish dates must be shown as applicable. Durations for work that has been completed must be shown on the updated schedule as the work actually occurred, including Engineer submittal review and your resubmittal times.

You may include modifications such as adding or deleting activities or changing activity constraints, durations, or logic that do not (1) alter the critical path(s) or near critical path(s) or (2) extend the scheduled completion date compared to that shown on the current accepted schedule. Justify in writing the reasons for any changes to planned work. If any proposed changes in planned work will result in (1) or (2) above, then submit a time impact analysis as specified in this section.

TIME IMPACT ANALYSIS

Submit a written time impact analysis (TIA) with each request for adjustment of contract time, or when you or the Engineer consider that an approved or anticipated change may impact the critical path or contract progress.

The TIA must illustrate the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate. The analysis must use the accepted schedule that has a data date closest to and before the event. If the Engineer determines that the accepted schedule used does not appropriately represent the conditions before the event, the accepted schedule must be updated to the day before the event being analyzed. The TIA must include an impact schedule developed from incorporating the event into the accepted schedule by adding or deleting activities, or by changing durations or logic of existing activities. If the impact schedule shows that

incorporating the event modifies the critical path and scheduled completion date of the accepted schedule, the difference between scheduled completion dates of the two schedules must be equal to the adjustment of contract time. The Engineer may construct and use an appropriate project schedule or other recognized method to determine adjustments in contract time until you provide the TIA.

Submit 2 copies of your TIA within 20 days of receiving a written request for a TIA from the Engineer. Allow the Engineer 15 days after receipt to review the submitted TIA. All approved TIA schedule changes must be shown on the next updated schedule.

If a TIA you submit is rejected, meet with the Engineer to discuss and resolve issues related to the TIA. If clarification is still needed, you are allowed 15 days to submit a protest as specified in Section 5-1.011, "Protests," of the Standard Specifications. If agreement is not reached, you are allowed 5 days from the date you receive the Engineer's response to your protest to submit an Initial Potential Claim Record as specified in Section 5-1.146B, "Initial Potential Claim Record," of the Standard Specifications. Only show actual as-built work, not unapproved changes related to the TIA, in subsequent updated schedules. If agreement is reached at a later date, approved TIA schedule changes must be shown on the next updated schedule. The Engineer withholds remaining payment on the schedule bid item if a TIA is requested and not submitted within 20 days. The schedule item payment resumes on the next estimate after the requested TIA is submitted. No other contract payment is withheld regarding TIA submittals.

FINAL UPDATED SCHEDULE

Submit a final update, as-built schedule with actual start and finish dates for the activities, within 30 days after completion of contract work. Provide a written certificate with this submittal signed by your project manager or an officer of the company stating, "To my knowledge and belief, the enclosed final update schedule reflects the actual start and finish dates of the actual activities for the project contained herein." An officer of the company may delegate in writing the authority to sign the certificate to a responsible manager.

PAYMENT

Progress schedule (critical path method) will be paid for at a lump sum price. The contract lump sum price paid for progress schedule (critical path method) includes full compensation for furnishing all labor, material, tools, equipment, and incidentals, and for doing all the work involved in preparing, furnishing, and updating schedules, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Payments for the progress schedule (critical path method) bid item will be made progressively as follows:

1. A total of 25 percent of the item amount will be paid upon achieving all of the following:
 - 1.1. Completion of 5 percent of all contract item work.
 - 1.2. Acceptance of all schedules and approval of all TIAs required to the time when 5 percent of all contract item work is complete.
2. A total of 50 percent of the item amount will be paid upon completion of 25 percent of all contract item work and acceptance of all schedules and approval of all TIAs required to the time when 25 percent of all contract item work is complete.
3. A total of 75 percent of the item amount will be paid upon completion of 50 percent of all contract item work and acceptance of all schedules and approval of all TIAs required to the time when 50 percent of all contract item work is complete.
4. A total of 100 percent of the item amount will be paid upon completion of all contract item work, acceptance of all schedules and approval of all TIAs required to the time when all contract item work is complete, and submittal of the certified final update schedule.

If you fail to complete any of the work or provide any of the schedules required by this section, the Engineer makes an adjustment in compensation as specified in Section 4-1.03C, "Changes in Character of Work," of the Standard Specifications for the work not performed. Adjustments in compensation for schedules will not be made for any increased or decreased work ordered by the Engineer in submitting schedules.

10-1.24 TIME-RELATED OVERHEAD

The Contractor will be compensated for time-related overhead as described below and in conformance with "Force Account Payment" of these special provisions. The Contractor will not be compensated for time-related overhead for delays to the controlling operations caused by the Engineer that occur prior to the first working day,

but will be compensated for actual overhead costs incurred, as determined by an independent Certified Public Accountant audit examination and report.

Attention is directed to "Beginning of Work, Time of Completion and Liquidated Damages," "Force Account Payment," and "Progress Schedule (Critical Path Method)" of these special provisions.

The provisions in Section 9-1.08D(2)(b), "Overhead Claims," of the Standard Specifications shall not apply.

Time-related overhead shall consist of those overhead costs, including field and home office overhead, that are in proportion to the time required to complete the work. Time-related overhead shall not include costs that are not related to time, including but not limited to, mobilization, licenses, permits, and other charges incurred only once during the contract. Time-related overhead shall not apply to subcontractors of any tier, suppliers, fabricators, manufacturers, or other parties associated with the Contractor.

Field office overhead expenses include time-related costs associated with the normal and recurring operations of the construction project, and shall not include costs directly attributable to the work of the contract. Time-related costs of field office overhead include, but are not limited to, salaries, benefits, and equipment costs of project managers, general superintendents, field office managers and other field office staff assigned to the project, and rent, utilities, maintenance, security, supplies, and equipment costs of the project field office.

Home office overhead or general and administrative expenses refer to the fixed costs of operating the Contractor's business. These costs include, but are not limited to, general administration, insurance, personnel and subcontract administration, purchasing, accounting, and project engineering and estimating. Home office overhead costs shall exclude expenses specifically related to other contracts or other businesses of the Contractor, equipment coordination, material deliveries, and consultant and legal fees.

The quantity of time-related overhead associated with a reduction in contract time for an accepted VECP under Section 4-1.035B, "Value Engineering Change Proposal," of the Standard Specifications shall be considered a construction cost attributable to the resultant estimated net savings due to the cost reduction incentive.

If the final increased quantity of time-related overhead exceeds 149 percent of the number of working days specified in the verified Bid Item List, the Contractor shall, within 60 days of the Engineer's written request, submit to the Engineer an audit examination and report performed by an independent Certified Public Accountant of the Contractor's actual overhead costs. The audit examination and report shall depict the Contractor's project and company-wide financial records and shall specify the actual overall average daily rates for both field and home office overhead for the entire duration of the project, and whether the costs have been properly allocated. The rates of field and home office overhead shall exclude unallowable costs as determined in the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31.

Independent Certified Public Accountant's audit examinations shall be performed in conformance with the requirements of the American Institute of Certified Public Accountants Attestation Standards. Audit examinations and reports shall determine if the rates of field office overhead and home office overhead are:

- A. Allowable in conformance with the requirements of the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31.
- B. Adequately supported by reliable documentation.
- C. Related solely to the project under examination.

Within 20 days of receipt of the Engineer's written request, the Contractor shall make its financial records available for audit by the State for the purpose of verifying the actual rate of time-related overhead specified in the audit submitted by the Contractor. The actual rate of time-related overhead specified in the audit, submitted by the Contractor, will be subject to approval by the Engineer.

If the Engineer requests the independent Certified Public Accountant audit, or if it is requested in writing by the Contractor, the contract item payment rate for time-related overhead, in excess of 149 percent of the number of working days specified in the verified Bid Item List, will be adjusted to reflect the actual rate.

The cost of performing an independent Certified Public Accountant audit examination and submitting the report, requested by the Engineer, will be borne equally by the State and the Contractor. The division of the cost will be made by determining the cost of providing an audit examination and report in conformance with the provisions of Section 9-1.04, "Extra Work Performed by Specialists," of the Standard Specifications, and paying to the Contractor one-half of that cost. The cost of performing an audit examination and submitting the independent Certified Public Accountant audit report for overhead claims other than for the purpose of verifying the actual rate of time-related overhead shall be entirely borne by the Contractor. The cost of performing an audit examination and submitting the independent Certified Public Accountant audit report to verify actual overhead costs incurred prior to the first working day shall be entirely borne by the Contractor.

The quantity of time-related overhead to be paid will be measured by the working day, designated in the verified Bid Item List as WDAY. The estimated number of working days is the number of working days, excluding days for plant establishment, as specified in "Beginning of Work, Time of Completion and Liquidated Damages" of

these special provisions. The quantity of time-related overhead will be increased or decreased only as a result of suspensions or adjustments of contract time which revise the current contract completion date, and which satisfy any of the following criteria:

- A. Suspensions of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications, except:
 - 1. Suspensions ordered due to weather conditions being unfavorable for the suitable prosecution of the controlling operation or operations.
 - 2. Suspensions ordered due to the failure on the part of the Contractor to carry out orders given, or to perform the provisions of the contract.
 - 3. Suspensions ordered due to factors beyond the control of and not caused by the State or the Contractor, for which the Contractor is granted non-working days.
 - 4. Other suspensions that mutually benefit the State and the Contractor.
- B. Adjustments of contract time granted by the State set forth in approved contract change orders, in conformance with the provisions in Section 4-1.03, "Changes," of the Standard Specifications.

A delay to the controlling operation may be concurrent and any of the following:

- 1. Nonexcusable: A nonexcusable delay is caused by the fault, nonperformance, or deficiency of the Contractor, subcontractors of any tier, or suppliers. The days during a nonexcusable delay are working days. No time or payment adjustment for a nonexcusable delay is allowed.
- 2. Excusable: An excusable delay is caused by factors beyond the control and without the fault of the State or the Contractor. The days during an excusable delay are non-working days.
- 3. Compensable: A compensable delay is caused solely by the fault, deficiency, error, omission, or change made by the State. A time adjustment and a payment adjustment for the actual cost without markup or profit are allowed.

A concurrent delay occurs when 2 or more separate delays overlap partially or entirely. A nonexcusable delay concurrent with either an excusable or a compensable delay is a nonexcusable delay. An excusable delay concurrent with a compensable delay is an excusable delay.

The quantity of time-related overhead is only adjusted as a result of a compensable delay and is not adjusted as a result of either a nonexcusable or an excusable delay.

An approved time impact analysis submitted as specified in "Progress Schedule (Critical Path Method)" of these special provisions is used to determine the type and duration of a delay.

In the event an early completion progress schedule, as defined in "Progress Schedule (Critical Path Method)" of these special provisions, is submitted by the Contractor and approved by the Engineer, the amount of time-related overhead eligible for payment will be based on the total number of working days for the project, in conformance with the provisions in "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions, rather than the Contractor's early completion progress schedule.

The contract price paid per working day for time-related overhead shall include full compensation for time-related overhead, including the Contractor's share of costs of the independent Certified Public Accountant audit of overhead costs requested by the Engineer, as specified in these special provisions, and as directed by the Engineer.

The provisions in Sections 4-1.03B, "Increased or Decreased Quantities," and 4-1.03C, "Changes in Character of the Work," of the Standard Specifications shall not apply to the contract item of time-related overhead.

Full compensation for additional overhead costs involved in incentive and disincentive provisions to satisfy internal milestone or multiple calendar requirements shall be considered as included in the contract items of work involved and no additional compensation will be allowed therefor.

Full compensation for additional overhead costs incurred during days of inclement weather when the contract work is extended into additional construction seasons due to delays caused by the State shall be considered as included in the time-related overhead paid during the contract working days, and no additional compensation will be allowed therefor.

Full compensation for additional overhead costs involved in performing additional contract item work that is not a controlling operation shall be considered as included in the contract items of work involved and no additional compensation will be allowed therefor.

Full compensation for overhead, other than time-related overhead measured and paid for as specified above, and other than overhead costs included in the markups specified in "Force Account Payment" of these special provisions,

shall be considered as included in the various items of work and no additional compensation will be allowed therefor.

Overhead costs incurred by subcontractors of any tier, suppliers, fabricators, manufacturers, and other parties associated with the Contractor shall be considered as included in the various items of work and as specified in Section 9-1.03, "Force Account Payment," of the Standard Specifications.

For the purpose of making progress payments pursuant to the provisions in Section 9-1.07, "Progress Payments," of the Standard Specifications, the number of working days to be paid for time-related overhead in each monthly partial payment will be the number of working days, specified above to be measured for payment that occurred during that monthly estimate period, including compensable suspensions and right of way delays. Working days granted by contract change order due to extra work or changes in character of the work, will be paid for upon completion of the contract. The amount earned per working day for time-related overhead shall be the lesser of the following amounts:

- A. The contract item price.
- B. Twenty percent of the original total contract amount divided by the number of working days specified in "Beginning of Work, Time of Completion and Liquidated Damages," of these special provisions.

After the work has been completed, except plant establishment work, as provided in Section 20-4.08, "Plant Establishment Work," of the Standard Specifications, the amount of the total contract item price for time-related overhead not yet paid will be included for payment in the first estimate made after completion of roadway construction work, in conformance with the provisions in Section 9-1.07, "Progress Payments," of the Standard Specifications.

10-1.25 RIGHT OF WAY OBSTRUCTIONS

Attention is directed to the occupied improvements located within the right of way at:

Parcel No.	Description	Date Available
79660	Work Around Parcel	06/19/2013

It is anticipated that these improvements will be vacated and removed by 06/19/2013.

The Contractor shall take no action that will result in unnecessary inconvenience, disproportionate injury or any action coercive in nature to the occupants of these improvements who have not yet moved from the improvements.

In the event that the improvements mentioned above are not removed by the date specified and, if in the opinion of the Engineer, the Contractor's operations are delayed or interfered with by reason of the improvements not being removed by the date specified, the State will compensate the Contractor for the delays to the extent provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

10-1.26 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES

Flagging, signs, and temporary traffic control devices furnished, installed, maintained, and removed when no longer required shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Category 1 temporary traffic control devices are defined as small and lightweight (less than 100 pounds) devices. These devices shall be certified as crashworthy by crash testing, crash testing of similar devices, or years of demonstrable safe performance. Category 1 temporary traffic control devices include traffic cones, plastic drums, portable delineators, and channelizers.

If requested by the Engineer, the Contractor shall provide written self-certification for crashworthiness of Category 1 temporary traffic control devices at least 5 business days before beginning any work using the devices or within 2 business days after the request if the devices are already in use. Self-certification shall be provided by the manufacturer or Contractor and shall include the following:

- A. Date,
- B. Federal Aid number (if applicable),
- C. Contract number, district, county, route and post mile of project limits,
- D. Company name of certifying vendor, street address, city, state and zip code,
- E. Printed name, signature and title of certifying person; and
- F. Category 1 temporary traffic control devices that will be used on the project.

The Contractor may obtain a standard form for self-certification from the Engineer.

Category 2 temporary traffic control devices are defined as small and lightweight (less than 100 pounds) devices that are not expected to produce significant vehicular velocity change, but may cause potential harm to impacting vehicles. Category 2 temporary traffic control devices include barricades and portable sign supports.

Category 2 temporary traffic control devices shall be on the Federal Highway Administration's (FHWA) list of Acceptable Crashworthy Category 2 Hardware for Work Zones. This list is maintained by FHWA and can be located at:

http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/listing.cfm?code=workzone

The Department also maintains this list at:

<http://www.dot.ca.gov/hq/traffops/signtech/signdel/pdf/Category2.pdf>

Category 2 temporary traffic control devices that have not received FHWA acceptance shall not be used. Category 2 temporary traffic control devices in use that have received FHWA acceptance shall be labeled with the FHWA acceptance letter number and the name of the manufacturer. The label shall be readable and permanently affixed by the manufacturer. Category 2 temporary traffic control devices without a label shall not be used.

If requested by the Engineer, the Contractor shall provide a written list of Category 2 temporary traffic control devices to be used on the project at least 5 business days before beginning any work using the devices or within 2 business days after the request if the devices are already in use.

Category 3 temporary traffic control devices consist of temporary traffic-handling equipment and devices that weigh 100 pounds or more and are expected to produce significant vehicular velocity change to impacting vehicles. Temporary traffic-handling equipment and devices include crash cushions, truck-mounted attenuators, temporary railing, temporary barrier, and end treatments for temporary railing and barrier.

Type III barricades may be used as sign supports if the barricades have been successfully crash tested, meeting the NCHRP Report 350 criteria, as one unit with a construction area sign attached.

Category 3 temporary traffic control devices shall be shown on the plans or on the Department's Highway Safety Features list. This list is maintained by the Division of Engineering Services and can be found at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

Category 3 temporary traffic control devices that are not shown on the plans or not listed on the Department's Highway Safety Features list shall not be used.

Full compensation for providing self-certification for crashworthiness of Category 1 temporary traffic control devices and for providing a list of Category 2 temporary traffic control devices used on the project shall be considered as included in the prices paid for the various items of work requiring the use of the Category 1 or Category 2 temporary traffic control devices and no additional compensation will be allowed therefor.

10-1.27 CONSTRUCTION AREA SIGNS

Construction area signs for temporary traffic control shall be furnished, installed, maintained, and removed when no longer required in conformance with the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Attention is directed to "Furnish Sign" of these special provisions.

Attention is directed to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. Type II retroreflective sheeting shall not be used on construction area sign panels. Type III, IV, VIII, or IX retroreflective sheeting shall be used for stationary mounted construction area sign panels.

The Contractor shall furnish and install 2 2006 State Transportation Bond Funding Identification signs at locations designated by the Engineer before starting major construction activities visible to highway users. Upon completion of the project, the Contractor shall remove and dispose of 2006 State Transportation Bond Funding Identification signs.

Unless otherwise shown on the plans or specified in these special provisions, the color of construction area warning and guide signs shall have black legend and border on orange background, except W10-1 or W47(CA) (Highway-Rail Grade Crossing Advance Warning) sign shall have black legend and border on yellow background.

Orange background on construction area signs shall be fluorescent orange.

Repair to construction area sign panels will not be allowed, except when approved by the Engineer. At nighttime under vehicular headlight illumination, sign panels that exhibit irregular luminance, shadowing or dark blotches shall be immediately replaced at the Contractor's expense.

The Contractor shall notify the appropriate regional notification center for operators of subsurface installations at least 2 business days, but not more than 14 days, prior to commencing excavation for construction area sign posts. The regional notification centers include, but are not limited to, the following:

Notification Center	Telephone Number
Underground Service Alert	811

Excavations required to install construction area signs shall be performed by hand methods without the use of power equipment, except that power equipment may be used if it is determined there are no utility facilities in the area of the proposed post holes. The post hole diameter, if backfilled with portland cement concrete, shall be at least 4 inches greater than the longer dimension of the post cross section.

Construction area signs placed within 15 feet from the edge of the travel way shall be mounted on stationary mounted sign supports as specified in "Construction Area Traffic Control Devices" of these special provisions.

The Contractor shall maintain accurate information on construction area signs. Signs that are no longer required shall be immediately covered or removed. Signs that convey inaccurate information shall be immediately replaced or the information shall be corrected. Covers shall be replaced when they no longer cover the signs properly. The Contractor shall immediately restore to the original position and location any sign that is displaced or overturned, from any cause, during the progress of work.

PAYMENT

Full compensation for furnishing and installing 2006 State Transportation Bond Funding Identification signs, including removal and disposal upon project completion, is included in the contract lump sum price paid for Construction Area Signs, and no separate payment will be allowed therefor.

10-1.28 MAINTAINING TRAFFIC

Maintaining traffic shall conform to the provisions in Sections 7-1.08, "Public Convenience," Section 7-1.09, "Public Safety," and Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Closure is defined as the closure of a traffic lane or lanes, including shoulder or ramp, within a single traffic control system.

Closures shall conform to the provisions in "Traffic Control System for Lane Closure" of these special provisions.

In addition to the provisions set forth in Section 7-1.09, "Public Safety," of the Standard Specifications, whenever work, including the work of installing, maintaining, and removing temporary railing (Type K) is to be performed on the freeway within 6 feet of the adjacent traffic lane, the adjacent traffic lane shall be closed.

Except as listed above, closure of adjacent traffic lane will not be required for grinding and grooving operations, for sawcutting concrete slabs or installing loop detectors with an Impact Attenuator Vehicle (IAV) as a shadow vehicle, and for installing, maintaining and removing traffic control devices.

At locations where falsework pavement lighting or pedestrian openings through falsework are designated, falsework lighting shall be installed in conformance with the provisions in Section 86-6.11, "Falsework Lighting," of the Standard Specifications.

Openings shall be provided through bridge falsework for the use of public traffic at each location where falsework is constructed over the streets or routes listed in the following table. The type, minimum width, height, and number of openings at each location, and the location and maximum spacing of falsework lighting, if required for each opening, shall conform to the requirements in the table. The width of vehicular openings shall be the clear width between temporary railings or other protective work. The spacing shown for falsework pavement lighting is the maximum distance center to center in feet between fixtures.

Buena Vista -Winona Ave UC - Bridge No. 53-1110

	Number	Width	Height
Vehicle Openings			
Buena Vista St.	1	36	15
Winona Ave.	1	24	15
Pedestrian Openings			
Buena Vista St.	1	4	8
Winona Ave.	1	4	8
	Location	Spacing	
Falsework Pavement			
Lighting			
Buena Vista St.	R/L	22.5	
Winona Ave.	R/L	30 staggered 1/2 space	

(Width and Height in feet)

(R = Right side of traffic. L = Left side of traffic)

(C = Centered overhead)

Burbank Blvd OC - Bridge No. 53-3057

	Number	Width	Height
Vehicle Openings			
Northbound	1	62	15
Southbound	1	62	15
	Location	Spacing	
Falsework Pavement			
Lighting			
Northbound and Southbound	R/L	40 with C 40 staggered 1/2 space	

(Width and Height in feet)

(R = Right side of traffic. L = Left side of traffic)

(C = Centered overhead)

The exact location of openings will be determined by the Engineer.

Work that interferes with public traffic shall be limited to the hours when closures are allowed, except for work required under Sections 7-1.08, "Public Convenience," and Section 7-1.09, "Public Safety" or as shown on the Stage Construction Plans.

The full width of the ramp traveled way shall be open for use by public traffic on designated legal holidays.

Designated legal holidays are: January 1st, the third Monday in February, the last Monday in May, July 4th, the first Monday in September, November 11th, Thanksgiving Day, and December 25th. When a designated legal holiday falls on a Sunday, the following Monday shall be a designated legal holiday. When November 11th falls on a Saturday, the preceding Friday shall be a designated legal holiday.

Special days are: Martin Luther King Jr Day and Columbus Day.

Not more than one separate stationary lane closure will be allowed in each direction of travel at one time. Upon the engineer's approval, concurrent stationary closures shall be spaced no closer than 1.5 miles apart.

At the Contractor's option, work may be performed during the hours designated as "No work permitted" shown on Charts 1 and 2, provided temporary traffic screen is installed on top of temporary railing (Type K), as shown on the plans. No traffic screens will be permitted on the right side of traffic within the limits of a right horizontal curve with a radius less than 2000 feet as viewed in the direction of travel and on the left side of traffic within the limits of a left horizontal curve with a radius less than 2000 feet as viewed in the direction of travel. Temporary traffic screen shall be furnished, installed, maintained, and removed at the Contractor's expense.

In addition to the requirements in "Impact Attenuator Vehicle" of these special provisions, when performing traffic control for stationary lane closures where median shoulders are less than 8 feet, the Contractor shall conform to the requirements as shown on the Traffic Handling Details Plan titled "Traffic Control System For Median Shoulders Less Than 8 Feet."

When removing and replacing concrete pavement and approach slabs along the mainline, the Contractor shall schedule operations in conformance with the hours and requirements as shown on Table A and Table B in place of Charts 1 and 2. The Contractor shall place a C43(CA) sign every 500 feet throughout the length of the closure during the entire curing period.

Route 5 may be closed to public traffic at one location in each direction of travel at one time for falsework erection and removal, bridge demolition, striping, and loop detector installation in conformance with the hours and requirements as shown on Charts 3 through 10.

Except as otherwise provided in these special provisions, the Contractor will be permitted to close the ramps listed below for the purpose of "roadway structural section reconstruction, structure widening, and construction of ramp termini" for an extended period of time beginning at 2200 Friday through 0500 the following Monday in place of Charts 11, 19, 21, 22, 23, and 24 and as shown in the Stage Construction Plans:

Ramp Name	Direction	Maximum Number of 55-Hour Closure	Stage/Phase
Burbank Blvd off-ramp	North	1	Stage 6 Phase 3
San Fernando Blvd on-ramp	North	1	Stage 3 Phase 2
Buena Vista St on and off-ramps	North	3 (both ramps closed)	Stage 3 Phase 2
Buena Vista St on and off-ramps	South	3 (both ramps closed)	Stage 2 Phase 3

A portable changeable message sign shall be placed at a location on the ramp, as determined by the Engineer, 7 continuous days in advance of the date of the planned closure, with the weekend message: "RAMP / WILL BE / CLOSED – NEXT / WEEKEND," and with a weekday message: "RAMP / WILL BE / CLOSED – THIS / WEEKEND." When the off-ramp is closed, the Contractor shall place a portable changeable message sign for the entire closure duration a minimum of 1500 feet in advance of the off-ramp upstream to the ramp being closed or as determined by the Engineer with the message: "NAME OF RAMP / EXIT / CLOSED." When the on-ramp is closed, detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Except as otherwise specified on Charts 11 through 25 in these special provisions, other ramps may be closed when the adjacent freeway lane is permitted to be closed as shown on Charts 1 and 2. When an on-ramp is closed and a ramp closure chart has not been included in this section "Maintaining Traffic," public traffic shall be detoured to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special portable freeway detour signs (SP-2), as shown on the plans, shall be posted along the detour route and shall be removed at the end of each closure.

Except as otherwise specified in these special provisions, closure of on-ramps or off-ramps servicing 2 consecutive local street interchanges in the same direction of travel will not be allowed. Deviations from ramp closure requirements shall be requested in writing by the Contractor and submitted to the Engineer for approval. The Engineer may permit the deviations if public traffic will be better served and the work expedited. If 2 or more consecutive on-ramps are permitted or as specified in these special provisions to be closed, special signs for entrance ramp closures (SP-4) as shown on the plans shall be furnished and installed at the Contractor's expense. When an off-ramp is closed, the Contractor shall furnish and erect special signs for exit ramp closures (SP-3 or SP-5), as shown on the plans. This sign shall be placed on the right shoulder of freeway upstream of the preceding off-ramp.

Special advance notice publicity signs (SP-1), as shown on the plans, shall be posted at locations as determined by the Engineer, a minimum of 7 days prior to ramp closures. Accurate information shall be maintained on the signs (SP-1). When work is not actively in progress, SP-1 signs shall be removed or covered.

Full compensation for furnishing, erecting, maintaining, and removing special advance notice publicity signs (SP-1), special portable freeway detour signs (SP-2, SP-6 and SP-7), special signs for exit ramp closures (SP-3 or SP-5), and C43(CA) signs as shown on the plans shall be considered as included in the contract lump sum price paid for traffic control system and no separate payment will be made therefor.

Detour route signs shall be furnished, installed, maintained, and removed when no longer required at the locations shown on the Motorist Information Plans (MI-Sheets) or where designated by the Engineer and in

conformance with the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Full compensation for furnishing, erecting, maintaining, and removing detour route signs as shown on the Motorist Information Plans (MI-Sheets) shall be considered as included in the contract lump sum price for traffic control system and no separate payment will be made therefor.

Special signs shall be disposed of as provided in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way" of the Standard Specifications at the conclusion of the project.

City streets may be closed during the hours shown on Charts 26 through 29 included in this section "Maintaining Traffic." The Contractor may close Buena Vista Street and Winona Avenue completely for bridge demolition. Full closure of Buena Vista Street is allowed between 2200 through 0500 hours for a period of one week only. When a city street is completely closed, traffic shall be detoured as shown on the Motorist Information Plans. Only one complete city street closure at a time shall be permitted. Special advance notice publicity signs (SP-1), as shown on the plans, shall be mounted on the right shoulder of the city street, in each direction of travel, a minimum of 10 days prior to the planned full street closure. Accurate information shall be maintained on the (SP-1) signs. When the city street is not completely closed, the (SP-1) signs shall be removed or covered.

The Contractor may close Burbank Boulevard completely for an extended period of time for the purpose of bridge removal and replacement. A portable changeable message sign shall be placed 7 continuous days in advance of the planned street closure at a location, as shown on plans, or as determined by the Engineer, with the message: "BURBANK / BLVD WILL / BE CLOSED – XXX / TO / XXX." When Burbank Blvd is completely closed, the Contractor shall place a portable changeable message sign for the entire closure duration, as shown on plans, or as determined by the Engineer with the message: "BURBANK / BLVD / CLOSED – TO THRU / TRAFFIC."

The Contractor shall notify the City of Burbank 14 calendar days in advance of any full street closures. The Contractor shall also notify the Metropolitan Transportation Authority at (213) 922-4632, at least 5 business days in advance of any planned street closure. No long-term ramp closures and long-term street closure on Burbank Blvd will be allowed until the Empire Ave interchange has been completed and is in full operation.

No work on city streets that interferes with public traffic shall be performed between 0500 and 0900, or between 1500 and 2100, except the streets shown on Charts 26 through 29. Work within City's right-of-way performed on weekends, Saturday and Sunday, must be coordinated with the City.

Local authorities shall be notified at least 5 business days before work begins. The Contractor shall cooperate with local authorities to handle traffic through the work area and shall make arrangements to keep the work area clear of parked vehicles.

Personal vehicles of the Contractor's employees shall not be parked within the right of way.

When work vehicles or equipment are parked within 6 feet of a traffic lane to perform active construction, the shoulder area shall be closed as shown on the plans.

If minor deviations from the requirements of this section concerning hours of work are required, a written request shall be submitted to the Engineer at least 15 days before the proposed date of the closure. The Engineer may approve the deviations if there is no significant increase in the cost to the State and if the work can be expedited and better serve the public traffic.

Freeway Lane Closure Restriction for Designated Legal Holidays and Special Days										
Thu	Fri	Sat	Sun	Mon	Tues	Wed	Thu	Fri	Sat	Sun
x	H xx	xx	xx							
x	xx	H xx	xx							
	x	xx	xx	H xx						
	x			SD xx						
				x	H xx					
					x	H xx				
						x	H xx	xx		xx
Legends:										
	Refer to Charts 1-10									
x	The full width of the traveled way shall be open for use by public traffic by 0400.									
xx	The full width of the traveled way shall be open for use by public traffic.									
H	Designated Legal Holiday									
SD	Special Day									

**Chart No. 1
Freeway Lane Requirements and Hours of Work**

County: LA	Route/Direction: 5/North																								
Closure Limits: Olive Ave off-ramp to Hollywood Way off-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	1	1	1	1	2	3	N	N	N	S	S	S	S	S	N	N	N	N	N	S	S	3	3	2	
Fridays	2	1	1	1	2	3	N	N	N	S	S	S	S	S	N	N	N	N	N	S	S	3	3		
Saturdays	2	2	1	1	1	2	3	3	S	S	S	S	N	N	N	N	N	N	N	S	S	3	3		
Sundays	2	2	1	1	1	1	2	2	3	3	S	S	N	N	N	N	N	N	N	S	S	3	3	2	

Legend:

- | |
|---|
| 1 |
|---|

 Provide at least one through freeway lane open in direction of travel
- | |
|---|
| 2 |
|---|

 Provide at least two adjacent through freeway lanes open in direction of travel
- | |
|---|
| 3 |
|---|

 Provide at least three adjacent through freeway lanes open in direction of travel
- | |
|---|
| S |
|---|

 Shoulder closure permitted
- | |
|---|
| N |
|---|

 No work permitted

REMARKS: Number of Through Traffic Lanes – 4*
 * - Traffic lanes outside of the through traffic lanes delineated with a double line of pavement markers as shown on "Pavement Markers and Traffic Lines Typical Details (Detail 37 series)," may be closed at the same time as adjacent through traffic lane, or ramp is allowed to be closed.

**Chart No. 2
Freeway Lane Requirements and Hours of Work**

County: LA	Route/Direction: 5/South																								
Closure Limits: Hollywood Way on-ramp to Verdugo Ave off-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	1	1	1	1	2	3	N	N	N	N	N	N	N	N	N	N	N	N	N	S	S	3	2	2	
Fridays	1	1	1	1	2	3	N	N	N	N	N	N	N	N	N	N	N	N	N	S	S	3	3	3	
Saturdays	2	1	1	1	1	2	3	3	N	N	N	N	N	N	N	N	N	N	N	S	S	3	3	2	
Sundays	2	1	1	1	1	1	2	2	3	3	N	N	N	N	N	N	N	N	N	S	S	3	2	2	

Legend:

- | |
|---|
| 1 |
|---|

 Provide at least one through freeway lane open in direction of travel
- | |
|---|
| 2 |
|---|

 Provide at least two adjacent through freeway lanes open in direction of travel
- | |
|---|
| 3 |
|---|

 Provide at least three adjacent through freeway lanes open in direction of travel
- | |
|---|
| S |
|---|

 Shoulder closure permitted
- | |
|---|
| N |
|---|

 No work permitted

REMARKS: Number of Through Traffic Lanes – 4

**Chart No. 3
Complete Freeway Closure Hours**

County: LA	Route/Direction: 5/North	
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Closure Limits: Olive Ave off-ramp to Scott Rd off-ramp

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Monday through Thursdays	C	C	C	C																					
Fridays	C	C	C	C																					
Saturdays																									
Sundays			C	C	C	C	C																		

Legend:

C	Freeway may be closed completely
	No complete freeway or closure is permitted

REMARKS:
DETOUR:
 Detour traffic to exit at Olive Ave off-ramp and detour to the next available on-ramp downstream of the Olive Ave off-ramp. Place a portable changeable message sign on the right shoulder of northbound Route 5 at the westbound Western Ave on-ramp gore with the message: "FREEWAY / CLOSED – OLIVE / TO / SCOTT RD." Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message : "NORTH 5 / CLOSED / AT OLIVE – ALT USE / W 134 TO / N 170." A minimum of 14 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Alameda Ave on-ramps and detour traffic to the next available on-ramp. A minimum of 18 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Olive Ave on-ramp and detour traffic to the next available on-ramp. A minimum of 14 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Scott Rd/Burbank Blvd on-ramp and detour traffic to the next available on-ramp. A minimum of 10 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

**Chart No. 4
Complete Freeway Closure Hours**

County: LA	Route/Direction: 5/North	
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Closure Limits: Burbank Blvd off-ramp to Buena Vista St on-ramp

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Monday through Thursdays	C	C	C	C																					
Fridays	C	C	C	C																					
Saturdays																									
Sundays			C	C	C	C	C																		

Legend:

- C Freeway may be closed completely
- No complete freeway or closure is permitted

REMARKS:
DETOUR:
 Detour traffic to exit at eastbound Burbank Blvd off-ramp; east on Burbank Blvd; north on San Fernando Blvd; east on Amherst Dr; north on Glenoaks Blvd; south on Buena Vista St to the on-ramp to northbound Route 5. Place a portable changeable message sign on the right shoulder of northbound Route 5 at the westbound Western Ave on-ramp gore with the message: "FREEWAY / CLOSED – BURBANK / TO BUENA / VISTA."
 Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message : "NORTH 5 / CLOSED AT / BURBANK – ALT USE / W 134 TO / N 170." A minimum of 24 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Olive Ave on-ramp and detour traffic to the next available on-ramp. A minimum of 14 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Scott Rd/Burbank Blvd on-ramp and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the San Fernando Blvd on-ramp and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

**Chart No. 5
Complete Freeway Closure Hours**

County: LA	Route/Direction: 5/North																								
Closure Limits: Burbank Blvd off-ramp to Hollywood Way on-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C																					
Fridays		C	C	C																					
Saturdays																									
Sundays			C	C	C	C	C																		

Legend:

- C Freeway may be closed completely
- No complete freeway or closure is permitted

REMARKS:

DETOUR:

Detour traffic to exit at eastbound Burbank Blvd off-ramp; east on Burbank Blvd; north on San Fernando Blvd; east on Amherst Dr; north on Glenoaks Blvd; south on Hollywood Way to the on-ramp to northbound Route 5. Place a portable changeable message sign on the right shoulder of northbound Route 5 at the westbound Western Ave on-ramp gore with the message: "FREEWAY / CLOSED – BURBANK / TO / HOLLYWOOD." Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message : "NORTH 5 / CLOSED AT / BURBANK – ALT USE / W 134 TO / N 170." A minimum of 24 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Olive Ave on-ramp to northbound Route 5 and detour traffic to the next available on-ramp. A minimum of 16 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Scott Rd/Burbank Blvd on-ramp to northbound Route 5 and detour traffic to the next available on-ramp. A minimum of 14 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the San Fernando Blvd on-ramp to northbound Route 5 and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Buena Vista St on-ramp to northbound Route 5 and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

**Chart No. 6
Complete Freeway Closure Hours**

County: LA	Route/Direction: 5/South	
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Closure Limits: Hollywood Way off-ramp to Buena Vista St on-ramp

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C																					
Fridays	C	C	C	C																					
Saturdays		C	C	C	C																				
Sundays		C	C	C	C	C																			

Legend:

C	Freeway may be closed completely
	No complete freeway or closure is permitted

REMARKS:
DETOUR:
 Detour traffic to exit at Hollywood Way off-ramp; south on Hollywood Way; east on Victory Blvd; east on Burbank Blvd to the on-ramp to southbound Route 5. Place a portable changeable message sign on the right shoulder of southbound Route 5 at the Penrose St on-ramp gore with the message: "FREEWAY / CLOSED – HOLLYWOOD / TO BUENA / VISTA." Place a second portable changeable message sign on the right shoulder of southbound Route 5 at the Terra Bella St on-ramp gore with the message : "SOUTH 5 / CLOSED AT / HOLLYWOOD – ALT USE / S 170 TO / E 134." A minimum of 21 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Hollywood Way on-ramp to southbound Route 5 and detour traffic as shown in Chart No. 25.

**Chart No. 7
Complete Freeway Closure Hours**

County: LA	Route/Direction: 5/South																									
Closure Limits: Hollywood Way off-ramp to Burbank Blvd on-ramp																										
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Mondays through Thursdays	C	C	C	C																						
Fridays	C	C	C	C																						
Saturdays		C	C	C	C																					
Sundays		C	C	C	C	C																				

Legend:

- C Freeway may be closed completely
- No complete freeway or closure is permitted

REMARKS:

DETOUR:
 Detour traffic to exit at Hollywood Way off-ramp; south on Hollywood Way; east on Victory Blvd; east on Burbank Blvd to the on-ramp to southbound Route 5. Place a portable changeable message sign on the right shoulder of southbound Route 5 at the Penrose St on-ramp gore with the message: "FREEWAY / CLOSED – HOLLYWOOD / TO / BURBANK." Place a second portable changeable message sign on the right shoulder of southbound Route 5 at the Terra Bella St on-ramp gore with the message : "SOUTH 5 / CLOSED AT / HOLLYWOOD – ALT USE / S 170 TO / E 134." A minimum of 24 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Hollywood Way on-ramp to southbound Route 5 and detour traffic as shown in Chart No. 25.
 Close the Buena Vista St on-ramp to southbound Route 5 and detour traffic as shown in Chart No. 24.
 Close the Empire Ave (Lincoln St) on-ramp to southbound Route 5 and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

**Chart No. 8
Complete Freeway Closure Hours**

County: LA	Route/Direction: 5/South	
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Closure Limits: Buena Vista St off-ramp to Burbank Blvd on-ramp

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C																					
Fridays	C	C	C	C																					
Saturdays		C	C	C	C																				
Sundays		C	C	C	C	C																			

Legend:

C Freeway may be closed completely

No complete freeway or closure is permitted

REMARKS:

DETOUR:

Detour traffic to exit at Buena Vista St off-ramp; south on San Fernando Rd; east on Winona Ave; south on Buena Vista St; south on San Fernando Blvd; continue south on Victory Place; east on Burbank Blvd to the on-ramp to southbound Route 5. Place a portable changeable message sign on the right shoulder of southbound Route 5 at the Penrose St on-ramp gore with the message: "FREEWAY / CLOSED – BUENA / VISTA TO / BURBANK." Place a second portable changeable message sign on the right shoulder of southbound Route 5 at the Terra Bella St on-ramp gore with the message : "S5 CLOSED /AT BUENA / VISTA – ALT USE / S 170 TO / E 134." A minimum of 21 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Hollywood Way on-ramp to southbound Route 5 and detour traffic as shown in Chart No. 25.
 Close the Buena Vista St on-ramp to southbound Route 5 and detour traffic as shown in Chart No. 24.
 Close the Empire Ave (Lincoln St) on-ramp to southbound Route 5 and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

**Chart No. 9
Complete Freeway Closure Hours**

County: LA	Route/Direction: 5/South																									
Closure Limits: Buena Vista St off-ramp to Verdugo Ave off-ramp																										
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Mondays through Thursdays	C	C	C	C																						
Fridays	C	C	C	C																						
Saturdays																										
Sundays		C	C	C	C	C																				

Legend:

- C Freeway may be closed completely
- No complete freeway or closure is permitted

REMARKS:

DETOUR:
 Detour traffic to exit at Buena Vista St off-ramp; south on San Fernando Rd; south on Buena Vista St; east on Victory Blvd; east on Burbank Blvd; south on Front St to the on-ramp to southbound Route 5. Place a portable changeable message sign on the right shoulder of southbound Route 5 at the Penrose St on-ramp gore with the message: "FREEWAY / CLOSED – BUENA / VISTA TO / VERDUGO." Place a second portable changeable message sign on the right shoulder of southbound Route 5 at the Terra Bella on-ramp gore with the message : "S5 CLOSED / AT BUENA / VISTA – ALT USE / S 170 TO / E 134." A minimum of 26 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.

Close the Buena Vista St on-ramp to southbound Route 5 and detour traffic as shown in Chart No. 25.
 Close the Lincoln St (Empire Ave) on-ramp to southbound Route 5 and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.
 Close the Burbank Blvd on-ramps to southbound Route 5 and detour traffic as shown in Chart Nos. 16 & 17.

Chart No. 10 Complete Freeway Closure Hours																									
County: LA										Route/Direction: 5/South															
Closure Limits: Burbank Blvd off-ramp to Verdugo Ave off-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C																					
Fridays	C	C	C	C																					
Saturdays																									
Sundays		C	C	C	C	C																			
Legend:																									
<input type="checkbox"/> C Freeway may be closed completely <input type="checkbox"/> No complete freeway or closure is permitted																									
REMARKS: Detour traffic to exit at Burbank Blvd off-ramp; west on Burbank Blvd; south on Victory Blvd; east on Alameda Ave to the on-ramp to southbound Route 5. Place a portable changeable message sign on the right shoulder of southbound Route 5 at the Roscoe Blvd on-ramp gore with the message: "FREEWAY / CLOSED – BURBANK / TO / VERDUGO." Place a second portable changeable message sign on the right shoulder of southbound Route 5 at the Terra Bella on-ramp gore with the message : "SOUTH 5 / CLOSED AT / BURBANK – ALT USE / S 170 TO / E 134." A minimum of 21 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Close the Lincoln St(Empire Ave) on-ramp to southbound Route 5 and detour traffic to the next available on-ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Close the Burbank Blvd on-ramps to southbound Route 5 and detour traffic as shown in Chart Nos. 16 & 17.																									

Chart No. 11 Complete Ramp Closure Hours																									
County: LA										Route/Direction: 5/North															
Closure Limits: Burbank Blvd off-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C
Fridays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C
Saturdays	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C
Sundays	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C
Legend:																									
<input type="checkbox"/> C Ramp may be closed completely <input type="checkbox"/> N No work permitted																									
REMARKS:																									

**Chart No. 12
Complete Ramp Closure Hours**

County: LA	Route/Direction: 5/North																								
Closure Limits: EB Burbank Blvd off-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Fridays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Legend:																									
<input type="checkbox"/> C	Ramp may be closed completely																								
<input type="checkbox"/> N	No work permitted																								
REMARKS:																									

**Chart No. 13
Complete Ramp Closure Hours**

County: LA	Route/Direction: 5/North																								
Closure Limits: WB Burbank Blvd off-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Fridays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Legend:																									
<input type="checkbox"/> C	Ramp may be closed completely																								
<input type="checkbox"/> N	No work permitted																								
REMARKS:																									

Chart No. 14 Complete Ramp Closure Hours																										
County: LA										Route/Direction: 5/North																
Closure Limits: Scott Rd/Burbank Blvd on-ramp																										
FROM HOUR TO HOUR		24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays		C	C	C	C	C	C	N	N	N	C	C	C	C	N	N	N	N	N	N	N	C	C	C	C	
Fridays		C	C	C	C	C	C	N	N	N	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	
Saturdays		C	C	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	
Sundays		C	C	C	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	C	C	C	
Legend:																										
C		Ramp may be closed completely																								
N		No work permitted																								
REMARKS:																										
Detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.																										

Chart No. 15 Complete Ramp Closure Hours																										
County: LA										Route/Direction: 5/South																
Closure Limits: Burbank Blvd off-ramp																										
FROM HOUR TO HOUR		24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays		C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	
Fridays		C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	
Saturdays		C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	
Sundays		C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	
Legend:																										
C		Ramp may be closed completely																								
N		No work permitted																								
REMARKS:																										

**Chart No. 16
Complete Ramp Closure Hours**

County: LA	Route/Direction: 5/South																								
Closure Limits: WB Burbank Blvd on-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Fridays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C
Saturdays	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C
Legend:																									
<input type="checkbox"/> C	Ramp may be closed completely																								
<input type="checkbox"/> N	No work permitted																								
REMARKS:																									
Detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.																									

**Chart No. 17
Complete Ramp Closure Hours**

County: LA	Route/Direction: 5/South																								
Closure Limits: EB Burbank Blvd on-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Fridays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Legend:																									
<input type="checkbox"/> C	Ramp may be closed completely																								
<input type="checkbox"/> N	No work permitted																								
REMARKS:																									
Detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.																									

Chart No. 18 Complete Ramp Closure Hours																											
County: LA					Route/Direction: 5/North																						
Closure Limits: Scott Road off-ramp (Empire Ave off-ramp)																											
FROM HOUR TO HOUR 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24																											
Mondays through Thursdays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Fridays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Saturdays					C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Sundays					C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	C	C	C	C
Legend:																											
C Ramp may be closed completely																											
N No work permitted																											
REMARKS: : The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.																											

Chart No. 19 Complete Ramp Closure Hours																												
County: LA					Route/Direction: 5/North																							
Closure Limits: San Fernando Blvd on-ramp (Empire Ave on-ramp)																												
FROM HOUR TO HOUR 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24																												
Mondays through Thursdays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Fridays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Saturdays					C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Sundays					C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	C	C	C	C	
Legend:																												
C Ramp may be closed completely																												
N No work permitted																												
REMARKS: Detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.																												

Chart No. 20 Complete Ramp Closure Hours																										
County: LA					Route/Direction: 5/South																					
Closure Limits: Scott Road/San Fernando Rd off-ramp (Empire Ave off-ramp)																										
FROM HOUR TO HOUR		24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays		C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Fridays		C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Saturdays		C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Sundays		C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Legend:																										
C		Ramp may be closed completely																								
N		No work permitted																								
REMARKS: : The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.																										

Chart No. 21 Complete Ramp Closure Hours																										
County: LA					Route/Direction: 5/North																					
Closure Limits: Buena Vista St off-ramp																										
FROM HOUR TO HOUR		24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays		C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Fridays		C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Saturdays		C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Sundays		C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Legend:																										
C		Ramp may be closed completely																								
N		No work permitted																								
REMARKS: : The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.																										

Chart No. 22 Complete Ramp Closure Hours																											
County: LA					Route/Direction: 5/North																						
Closure Limits: Buena Vista St on-ramp																											
FROM HOUR TO HOUR 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24																											
Mondays through Thursdays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	
Fridays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C
Saturdays					C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C
Sundays					C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C
Legend:																											
<input type="checkbox"/> C Ramp may be closed completely <input type="checkbox"/> N No work permitted																											
REMARKS: Detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on the plans, shall be posted along the detour route and shall be removed at the end of each closure.																											

Chart No. 23 Complete Ramp Closure Hours																												
County: LA					Route/Direction: 5/South																							
Closure Limits: Buena Vista St off-ramp																												
FROM HOUR TO HOUR 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24																												
Mondays through Thursdays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	
Fridays					C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Saturdays					C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Sundays					C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C	C
Legend:																												
<input type="checkbox"/> C Ramp may be closed completely <input type="checkbox"/> N No work permitted																												
REMARKS: : The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.																												

**Chart No. 24
Complete Ramp Closure Hours**

County: LA	Route/Direction: 5/South																								
Closure Limits: Buena Vista St on-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C
Fridays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C

Legend:

- C Ramp may be closed completely
- N No work permitted

REMARKS:

Detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.
The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.

**Chart No. 25
Complete Ramp Closure Hours**

County: LA	Route/Direction: 5/South																								
Closure Limits: Hollywood Way on-ramp																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C
Fridays	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	C	C	C	C	C

Legend:

- C Ramp may be closed completely
- N No work permitted

REMARKS:

Detour traffic to the next available on-ramp downstream of the closed ramp. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure.
The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.

Chart No. 26 Complete City Street Closure																																		
Location: Burbank Blvd OC										Direction: East-West																								
Closure Limits: Between Front St & San Fernando Blvd																																		
FROM HOUR TO HOUR 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24																																		
Mondays through Thursdays										C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C		
Fridays										C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C	C	C
Saturdays										C	C	C	C	C	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sundays										N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Legend:																																		
C Street may be closed																																		
N No work permitted																																		
REMARKS: Number of Through Traffic Lanes – 2 in Each Direction When the street is closed, detour eastbound Burbank Blvd traffic and southbound Victory Blvd traffic south on Victory Blvd; east on Magnolia Blvd north on 1st St; north on San Fernando Blvd to Burbank Blvd. Detour westbound Burbank Blvd traffic and northbound San Fernando Blvd traffic north on San Fernando Rd; east on Amherst Dr; north on Glenoaks Blvd; south on Buena Vista St; south on San Fernando Blvd; continue south to Victory Pl to Burbank Blvd. A minimum of 32 detour signs, SC3 (CA), shall be posted along the detour route and shall be removed at the end of each closure. For long-term closure of Burbank Blvd, detour traffic as shown on the Motorist Information Plans. The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.																																		

Chart No. 27 Complete City Street Closure																																			
Location: Empire Ave UC										Direction: East-West																									
Closure Limits: Between Victory Pl & NB Scott Rd off-ramp																																			
FROM HOUR TO HOUR 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24																																			
Mondays through Thursdays										1	1	1	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	1	1	1	
Fridays										1	1	1	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	1	1	1
Saturdays										1	1	1	1	1	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Sundays										N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Legend:																																			
1 Provide at least one city street lane open in direction of travel																																			
N No work permitted																																			
REMARKS: Number of Through Traffic Lanes – 2 in Each Direction When the street is closed, detour eastbound Empire Ave traffic south on Victory Place; continue straight to Victory Blvd; east on Magnolia Blvd; north on 3rd St; west on Burbank Blvd; north on San Fernando Blvd to Empire Ave. Detour the northbound San Fernando Blvd to westbound Empire Ave traffic east on Amherst Dr; north on Glenoaks Blvd; south on Buena Vista St; south on Victory Place to Empire Ave. A minimum of 18 detour signs, SC3 (CA), shall be posted along the detour route and shall be removed at the end of each closure. The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.																																			

**Chart No. 28
Complete City Street Closure**

Location: Buena Vista St UC	Direction: North-South																								
Closure Limits: Between San Fernando Rd & Winona Ave																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	1	1	1	1	1	N	N	N	N	1	1	1	1	1	N	N	N	N	N	N	N	1	1	1	
Fridays	1	1	1	1	1	N	N	N	N	1	1	1	1	1	N	N	N	N	N	N	N	1	1	1	
Saturdays	N	N	N	N	N	N	N	N	N	1	1	1	1	1	N	N	N	N	N	N	N	N	N	N	
Sundays	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	

Legend:

- 1 Provide at least one city street lane open in direction of travel
- N No work permitted

REMARKS: Number of Through Traffic Lanes – 2 in Each Direction
 Full closure of Buena Vista St will be allowed between 2300 and 0500 hours for one week only for the purpose of demolition, falsework installation and removal. A 14-day notice to the City of Burbank Public Works Department Traffic Engineer and Permit Section is required for any nighttime closure.

When the street is closed, detour traffic as follows:
 Detour northbound Buena Vista St traffic and northbound San Fernando Blvd traffic to north on San Fernando Blvd; north on Hollywood Way; east on Cohasset St; south on Glenoaks Blvd to Buena Vista St. Detour southbound Buena Vista St traffic to east on Winona Ave; south on Glenoaks Blvd; west on Amherst Dr; south on San Fernando Blvd; west on Burbank Blvd to Buena Vista St. A minimum of 16 detour signs, SC3(CA), shall be posted along the detour route and shall be removed at the end of each closure.
 The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.

**Chart No. 29
Complete City Street Closure**

Location: Winona Ave UC	Direction: East-West																								
Closure Limits: Between San Fernando Rd & Buena Vista St																									
FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	N	N	N	N	R	R	R	R	R	R	N	N	N	N	N	N	R	C	C	
Fridays	C	C	C	C	C	N	N	N	N	R	R	R	R	R	R	N	N	N	N	N	N	R	C	C	
Saturdays	C	C	C	C	C	N	N	N	N	R	R	R	R	R	R	N	N	N	N	N	N	R	C	C	
Sundays	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	

Legend:

R	Provide at least one through traffic lane, not less than 12 feet in width, for use by both directions of travel (Reversing Control)
C	Street may be closed
N	No work permitted

REMARKS: Number of Through Traffic Lanes – 1 in Each Direction
 When the street is closed, detour traffic as follows:
 Detour southbound San Fernando Rd traffic to north on Ontario St; east on Cohasset St; south on Glenoaks Blvd to Buena Vista St. Detour westbound Winona Ave traffic to north on Buena Vista St; north on Glenoaks Blvd; west on Cohasset St; south on California St to San Fernando Rd. A minimum of 10 detour signs, SC3(CA), shall be posted along the detour route and shall be removed at the end of each closure.

The full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress.

TABLE A

Permissible Hours of Lane Closures for
Concrete Slab and Approach Slab Replacement/Pavement Removal and Reconstruction

Location: NB Route 5 from Magnolia Blvd to Cohasset St

Slab/Lane No. Being Replaced	Lane No. Closed	Remove, Replace, and Cure Slabs
		Closure Hours
No. 1	No. 1 & 2	2200 to 0600 Sun-Mon; Mon-Tue; Tue-Wed; Wed-Thu; Thu-Fri 2300 Saturday to 0800 Saturday 0001 Sunday to 1000 Sunday
No. 2 or No 1 & 2	No. 1, 2 & 3	0100 Saturday to 0800 Saturday 0200 Sunday to 0900 Sunday
No. 3 or No 3 & 4	No. 2, 3 & 4	
No. 4	No. 3 & 4	2200 to 0600 Sun-Mon; Mon-Tue; Tue-Wed; Wed-Thu; Thu-Fri 2300 Saturday to 0800 Saturday 0001 Sunday to 1000 Sunday
Slab/Lane No. Being Replaced	Other Closure Requirements	
No. 1	<p>Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 2 by 0500 on Monday, Tuesday, Wednesday, Thursday, and Friday. Open lane number 2 by 0600 on Saturday and by 0800 on Sunday.</p>	
No. 2 or 1 & 2	<p>Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 3 by 0500 on Saturday and by 0600 on Sunday.</p>	
No. 3 or 3 & 4	<p>Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 2 by 0500 on Saturday and by 0600 on Sunday.</p>	
No. 4	<p>Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 3 by 0500 on Monday, Tuesday, Wednesday, Thursday, and Friday.</p>	

	Open lane number 3 by 0600 on Saturday and by 0800 on Sunday.
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TABLE B		
Permissible Hours of Lane Closures for Concrete Slab and Approach Slab Replacement/Pavement Removal and Reconstruction		
Location: SB Route 5 from Cohasset St to Magnolia Blvd		
Slab/Lane No. Being Replaced	Lane No. Closed	Remove, Replace, and Cure Slabs
		Closure Hours
No. 1	No. 1 & 2	2200 to 0600 Sun-Mon; Mon-Tue; Tue-Wed; Wed-Thu; Thu-Fri 2300 Saturday to 0800 Saturday 2300 Sunday to 0900 Sunday
No. 2 or No 1 & 2	No. 1, 2 & 3	0100 Saturday to 0800 Saturday 0100 Sunday to 0900 Sunday
No. 3 or No 3 & 4	No. 2, 3 & 4	
No. 4	No. 3 & 4	2200 to 0600 Sun-Mon; Mon-Tue; Tue-Wed; Wed-Thu; Thu-Fri 2300 Saturday to 0800 Saturday 2300 Sunday to 0900 Sunday
Slab/Lane No. Being Replaced	Other Closure Requirements	
No. 1	Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of southbound Route 5 in advance of the Route 170 off-connector with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 2 by 0500 on Monday, Tuesday, Wednesday, Thursday, and Friday. Open lane number 2 by 0600 on Saturday and by 0800 on Sunday.	
No. 2 or 1 & 2	Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 3 by 0500 on Saturday and by 0600 on Sunday.	

No. 3 or 3 & 4	Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 2 by 0500 on Saturday and by 0600 on Sunday.
No. 4	Place a portable changeable message sign as shown on the Traffic Handling Plans. Place a second portable changeable message sign on the right shoulder of northbound Route 5 upstream of Colorado Blvd off-ramp with the message as shown on plans. Close on-ramps within the closure as needed and detour traffic to the next available on-ramp downstream of the closed ramp in the direction of travel. A minimum of 12 special freeway detour signs (SP-2), as shown on plans, shall be posted along the detour route and shall be removed at the end of each closure. Open lane number 3 by 0500 on Monday, Tuesday, Wednesday, Thursday, and Friday. Open lane number 3 by 0600 on Saturday and by 0800 on Sunday.

Precast concrete members shall not be cast within the right of way of Route 5.

Erection of steel girders over local streets shall be undertaken one span at a time. During girder erection, public traffic in the lanes over which girders are being placed shall be detoured or stopped as specified in this section, "Maintaining Traffic."

Erection and removal of falsework at locations where falsework openings are required shall be undertaken one location at a time. During falsework erection and removal, public traffic in the lanes over which falsework is being erected or removed shall be detoured or stopped as specified in this section, "Maintaining Traffic." Falsework erection shall include adjustments or removal of components that contribute to the horizontal stability of the falsework system. Falsework removal shall include lowering falsework, blowing sand from sand jacks, turning screws on screw jacks, and removing wedges.

The Contractor shall have necessary materials and equipment on the site to erect the girders and falsework in any one span or over any one opening before detouring or stopping public traffic.

10-1.29 CLOSURE REQUIREMENTS AND CONDITIONS

Closures shall conform to the provisions in "Maintaining Traffic" of these special provisions and these special provisions.

CLOSURE SCHEDULE

A schedule of planned closures (except for shoulders) for the next week period, defined as Friday noon through the following Friday noon, shall be submitted by noon each Monday. A written schedule shall be submitted not less than 25 days and not more than 125 days before the anticipated start of any operation that will:

1. Reduce horizontal clearances, traveled way, including shoulders, to two lanes or less due to such operations as temporary barrier placement and paving
2. Reduce the vertical clearances available to the public due to such operations as pavement overlay, overhead sign installation, or falsework or girder erection

The Closure Schedule shall show the locations and times of the proposed closures. The online Lane Closure System (LCS) at <http://lcs.dot.ca.gov> shall be used. Closure Schedules submitted to the Engineer with incomplete or inaccurate information will be rejected and returned for correction and resubmittal online. The Contractor will be notified of disapproved closures or closures that require coordination with other parties as a condition of approval. The Contractor shall contact the Engineer to schedule required LCS training 2 weeks before submitting the first lane closure request.

Closure Schedule amendments, including adding additional closures, shall be submitted online by noon to the Engineer, at least 3 business days in advance of a planned closure. Approval of Closure Schedule amendments will be at the discretion of the Engineer.

The Contractor shall cancel lane closure requests that are not needed at least 2 business days via the online system before the date of closure.

Closures that are cancelled due to unsuitable weather may be rescheduled at the discretion of the Engineer.

CONTINGENCY PLAN

A detailed contingency plan shall be prepared for reopening closures to public traffic. If required by "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions, the contingency plan shall be submitted to the Engineer before work at the job site begins. Otherwise, the contingency plan shall be submitted to the Engineer within one business day of the Engineer's request.

LATE REOPENING OF CLOSURES

If a closure is not reopened to public traffic by the specified time, work shall be suspended in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications. No further closures are to be made until the Engineer has accepted a work plan, submitted by the Contractor, that will insure that future closures will be reopened to public traffic at the specified time. The Engineer will have 2 business days to accept or reject the Contractor's proposed work plan. The Contractor will not be entitled to compensation for the suspension of work resulting from the late reopening of closures.

For each 10-minute interval, or fraction thereof past the time specified to reopen the closure, the Department will deduct the amount per interval shown below from moneys due or that may become due the Contractor under the contract. Damages are limited to 5 percent of project cost per occurrence and will not be assessed when the Engineer requests that the closure remain in place beyond the scheduled pickup time.

Type of Facility	Route or Segment	Period	Damages/interval (\$)
Mainline	Route 5	1st half hour	\$2,000 / 10 minutes
		2nd half hour	\$3,100 / 10 minutes
		2nd hour and beyond	\$4,100 / 10 minutes
Each Ramp	Route 5	1st half hour and beyond	\$ 500 / 10 minutes

COMPENSATION

The Engineer shall be notified of delays in the Contractor's operations due to the following conditions, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of those conditions, and the Contractor's loss due to that delay could not have been avoided by rescheduling the affected closure or by judicious handling of forces, equipment and plant, the delay will be considered a right of way delay and will be compensated in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications:

1. The Contractor's proposed Closure Schedule is denied and his planned closures are within the time frame allowed for closures in "Maintaining Traffic" of these special provisions, except that the Contractor will not be entitled to compensation for amendments to the Closure Schedule that are not approved.
2. The Contractor is denied a confirmed closure.

Should the Engineer direct the Contractor to remove a closure before the time designated in the approved Closure Schedule, delay to the Contractor's schedule due to removal of the closure will be considered a right of way delay and compensation for the delay will be determined in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

10-1.30 IMPACT ATTENUATOR VEHICLE

GENERAL

Summary

Work includes protecting traffic and workers by using impact attenuator vehicle as a shadow vehicle when placing and removing components of a traffic control system, and when performing a moving lane closure.

Comply with Section 12-3.03, "Flashing Arrow Signs," of the Standard Specifications.

Impact attenuator vehicle must comply with the following test levels under National Cooperative Highway Research Program 350:

1. Test level 3 for pre-construction posted speed limit of 50 mph or more
2. Test levels 2 or 3 for pre-construction posted speed limit of 45 mph or less

Comply with the attenuator manufacturer's recommendations for:

1. Support truck
2. Trailer-mounted operation
3. Truck-mounted operation

Definitions

impact attenuator vehicle: Support truck towing a deployed attenuator mounted to a trailer or support truck with a deployed attenuator mounted to the support truck.

Submittals

Upon request, submit a Certificate of Compliance for attenuator to the Engineer under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Quality Control and Assurance

Attenuator must be a brand listed on the Department's pre-approved list under Highway Safety Features at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

MATERIALS

The combined weight of the support truck and the attenuator must be at least 19,800 pounds, except the weight of the support truck must not be less than 16,100 pounds or greater than 26,400 pounds.

If using the Trinity MPS-350 truck-mounted attenuator, the support truck must not have any underneath fuel tank mounted within 10'-6" of the rear of the support truck.

Each impact attenuator vehicle must:

1. Have standard brake lights, taillights, sidelights, and turn signals
2. Have an inverted "V" chevron pattern placed across the entire rear of the attenuator composed of alternating 4 inch wide non-reflective black stripes and 4 inch wide yellow retroreflective stripes sloping at 45 degrees
3. Have a Type II flashing arrow sign
4. Have a flashing or rotating amber light
5. Have an operable 2-way communication system for maintaining contact with workers

CONSTRUCTION

Use impact attenuator vehicle to follow behind equipment and workers who are placing and removing components of a traffic control system for a lane closure or a ramp closure. Flashing arrow sign must be operating in arrow mode during this activity. Follow at a distance to prevent intrusion into the workspace from passing traffic.

After placing components of a traffic control system for a lane closure or a ramp closure you may use impact attenuator vehicle in a closed lane and in advance of a work area to protect traffic and workers.

Use impact attenuator vehicle as a shadow vehicle under traffic control for a moving lane closure.

Secure objects including equipment, tools and ballast on impact attenuator vehicle to prevent loosening upon impact by an errant vehicle.

Do not use a damaged attenuator in the work. Replace, at your expense, an attenuator damaged from an impact during work.

MEASUREMENT AND PAYMENT

Full compensation for furnishing and operating impact attenuator vehicle is included in the contract lump sum price paid for traffic control system, and no additional compensation will be allowed therefor.

10-1.31 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE

A traffic control system shall consist of closing traffic lanes and ramps in conformance with the details shown on the plans, the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications, the provisions under "Maintaining Traffic" and "Construction Area Signs" of these special provisions, and these special provisions.

The provisions in this section will not relieve the Contractor of responsibility for providing additional devices or taking measures as may be necessary to comply with the provisions in Section 7-1.09, "Public Safety," of the Standard Specifications.

During traffic stripe operations and pavement marker placement operations using bituminous adhesive, traffic shall be controlled, at the option of the Contractor, with either stationary or moving lane closures. During other operations, traffic shall be controlled with stationary lane closures. Attention is directed to the provisions in Section 84-1.04, "Protection From Damage," and Section 85-1.06, "Placement," of the Standard Specifications.

If components in the traffic control system are displaced or cease to operate or function as specified, from any cause, during the progress of the work, the Contractor shall immediately repair the components to the original condition or replace the components and shall restore the components to the original location.

STATIONARY LANE CLOSURE

When lane and ramp closures are made for work periods only, at the end of each work period, components of the traffic control system, except portable delineators placed along open trenches or excavation adjacent to the traveled way, shall be removed from the traveled way and shoulder. If the Contractor so elects, the components may be stored at selected central locations, designated by the Engineer within the limits of the highway right of way.

Each vehicle used to place, maintain and remove components of a traffic control system on multilane highways shall be equipped with a Type II flashing arrow sign which shall be in operation when the vehicle is being used for placing, maintaining or removing the components. Vehicles equipped with Type II flashing arrow sign not involved in placing, maintaining or removing the components when operated within a stationary type lane closure shall only display the caution display mode. The sign shall be controllable by the operator of the vehicle while the vehicle is in motion. The flashing arrow sign shown on the plans shall not be used on the vehicles which are doing the placing, maintaining and removing of components of a traffic control system and shall be in place before a lane closure requiring the sign's use is completed.

The 1,700-foot section of a lane closure, shown along lane lines between the 1,000-foot lane closure tapers on the plans entitled "Traffic Control System for Lane Closures on Freeways and Expressways" and "Traffic Control System for Lane and Complete Closures on Freeways and Expressways" shall not be used.

The traffic cones shown to be placed transversely across closed traffic lanes and shoulders on the plans entitled "Traffic Control System for Lane Closures on Freeways and Expressways" and "Traffic Control System for Lane and Complete Closures on Freeways and Expressways" shall not be placed.

MOVING LANE CLOSURE

Flashing arrow signs used in moving lane closures shall be truck-mounted. Changeable message signs used in moving lane closure operations shall conform to the provisions in Section 12-3.12, "Portable Changeable Message Signs," of the Standard Specifications, except the signs shall be truck-mounted and the full operation height of the bottom of the sign may be less than 7 feet above the ground, but should be as high as practicable.

Flashing arrow signs shall be in the caution display mode when used on 2-lane, 2-way highways.

Truck-mounted attenuators (TMA) for use in moving lane closures shall be any of the following approved models, or equal:

1. Hexfoam TMA Series 3000, Alpha 1000 TMA Series 1000, and Alpha 2001 TMA Series 2001, manufactured by Energy Absorption Systems, Inc., 35 East Wacker Drive, Suite 1100, Chicago, IL 60601:
 - 1.1. Northern California: Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828, telephone (800) 884-8274, FAX (916) 387-9734
 - 1.2. Southern California: Traffic Control Service, Inc., 1818 E. Orangethorpe, Fullerton, CA 92831-5324, telephone (800) 222-8274, FAX (714) 526-9501
2. Cal T-001 Model 2 or Model 3, manufacturer and distributor: Hexcel Corporation, 11711 Dublin Boulevard, P.O. Box 2312, Dublin, CA 94568, telephone (925) 551-4900
3. Renco Rengard Model Nos. CAM 8-815 and RAM 8-815, manufacturer and distributor: Renco Inc., 1582 Pflugerville Loop Road, P.O. Box 730, Pflugerville, TX 78660-0730, telephone (800) 654-8182

Each TMA shall be individually identified with the manufacturer's name, address, TMA model number, and a specific serial number. The names and numbers shall each be a minimum 1/2 inch high and located on the left (street) side at the lower front corner. The TMA shall have a message next to the name and model number in 1/2 inch high letters which states, "The bottom of this TMA shall be _____ inches \pm _____ inch above the ground at all points for proper impact performance." Any TMA which is damaged or appears to be in poor condition shall not be

used unless recertified by the manufacturer. The Engineer shall be the sole judge as to whether used TMAs supplied under this contract need recertification. Each unit shall be certified by the manufacturer to meet the requirements for TMA in conformance with the standards established by the Transportation Laboratory.

Approvals for new TMA designs proposed as equal to the above approved models shall be in conformance with the procedures (including crash testing) established by the Transportation Laboratory. For information regarding submittal of new designs for evaluation contact: Transportation Laboratory, 5900 Folsom Boulevard, Sacramento, California 95819.

New TMAs proposed as equal to approved TMAs or approved TMAs determined by the Engineer to need recertification shall not be used until approved or recertified by the Transportation Laboratory.

PAYMENT

The contract lump sum price paid for traffic control system shall include full compensation for furnishing all labor, materials (including signs), tools, equipment, and incidentals, and for doing all the work involved in placing, removing, storing, maintaining, moving to new locations, replacing and disposing of the components of the traffic control system shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications shall not apply to the item of traffic control system. Adjustments in compensation for traffic control system will be made only for increased or decreased traffic control system required by changes ordered by the Engineer and will be made on the basis of the cost of the increased or decreased traffic control necessary. The adjustment will be made on a force account basis as provided in Section 9-1.03, "Force Account Payment," of the Standard Specifications for increased work and estimated on the same basis in the case of decreased work.

Traffic control system required by work which is classed as extra work, as provided in Section 4-1.03D of the Standard Specifications, will be paid for as a part of the extra work.

10-1.32 TEMPORARY PAVEMENT DELINEATION

Temporary pavement delineation shall be furnished, placed, maintained, and removed in conformance with the provisions in Section 12-3.01, "General," of the Standard Specifications and these special provisions. Nothing in these special provisions shall be construed as reducing the minimum standards specified in the California MUTCD or as relieving the Contractor from the responsibilities specified in Section 7-1.09, "Public Safety," of the Standard Specifications.

GENERAL

When the work causes obliteration of pavement delineation, temporary or permanent pavement delineation shall be in place before opening the traveled way to public traffic. Laneline or centerline pavement delineation shall be provided for traveled ways open to public traffic. On multilane roadways (freeways and expressways) edgeline delineation shall be provided for traveled ways open to public traffic.

The Contractor shall perform the work necessary to establish the alignment of temporary pavement delineation, including required lines or markers. Surfaces to receive application of paint or removable traffic tape temporary pavement delineation shall be dry and free of dirt and loose material. Temporary pavement delineation shall not be applied over existing pavement delineation or other temporary pavement delineation. Temporary pavement delineation shall be maintained until superseded or replaced with a new pattern of temporary pavement delineation or permanent pavement delineation, or as determined by the Engineer.

Temporary pavement markers, including underlying adhesive, and removable traffic tape that are applied to the final layer of surfacing or existing pavement to remain in place or that conflicts with a subsequent or new traffic pattern for the area shall be removed when no longer required for the direction of public traffic, as determined by the Engineer.

TEMPORARY LANELINE AND CENTERLINE DELINEATION

When lanelines or centerlines are obliterated and temporary pavement delineation to replace the lines is not shown on the plans, the minimum laneline and centerline delineation to be provided for that area shall be temporary pavement markers placed at longitudinal intervals of not more than 24 feet. The temporary pavement markers shall be the same color as the laneline or centerline the pavement markers replace. Temporary pavement markers shall be, at the option of the Contractor, one of the temporary pavement markers listed for short term day/night use (14 days or less) or long term day/night use (180 days or less) in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. The temporary pavement markers shall be placed in conformance with the manufacturer's instructions. Temporary pavement markers for long term day/night use (180 days or less) shall be cemented to the surfacing with the adhesive recommended by the manufacturer, except epoxy adhesive shall not be

used to place the temporary pavement markers in areas where removal of the temporary pavement markers will be required.

Temporary laneline or centerline delineation consisting entirely of temporary pavement markers listed for short term day/night use (14 days or less), shall be placed on longitudinal intervals of not more than 24 feet and shall be used for a maximum of 14 days on lanes opened to public traffic. Before the end of the 14 days the permanent pavement delineation shall be placed. If the permanent pavement delineation is not placed within the 14 days, the Contractor shall replace the temporary pavement markers and provide additional temporary pavement delineation and shall bear the cost thereof. The additional temporary pavement delineation to be provided shall be equivalent to the pattern specified for the permanent pavement delineation for the area, as determined by the Engineer.

Where "no passing" centerline pavement delineation is obliterated, the following "no passing" zone signing shall be installed before opening the lanes to public traffic. W20-1 (ROAD WORK AHEAD) signs shall be installed from 1,000 feet to 2,000 feet in advance of "no passing" zones. R4-1 (DO NOT PASS) signs shall be installed at the beginning and at every 2,000-foot interval within "no passing" zones. For continuous zones longer than 2 miles, W7-3a or W71(CA) (NEXT _____ MILES) signs shall be installed beneath the W20-1 signs installed in advance of "no passing" zones. R4-2 (PASS WITH CARE) signs shall be installed at the end of "no passing" zones. The exact location of "no passing" zone signing will be as determined by the Engineer and shall be maintained in place until permanent "no passing" centerline pavement delineation has been applied. The signing for "no passing" zones, shall be removed when no longer required for the direction of public traffic. The signing for "no passing" zones shall conform to the provisions in "Construction Area Signs" of these special provisions, except for payment.

TEMPORARY EDGELINE DELINEATION

On multilane roadways (freeways and expressways), when edgelines are obliterated and temporary pavement delineation to replace those edgelines is not shown on the plans, the edgeline delineation to be provided for those areas adjacent to lanes open to public traffic shall be as follows:

1. Temporary pavement delineation for right edgelines shall, at the option of the Contractor, consist of either a solid 4-inch wide traffic stripe tape of the same color as the stripe it replaces, traffic cones, portable delineators or channelizers placed at longitudinal intervals not to exceed 100 feet.
2. Temporary pavement delineation for left edgelines shall, at the option of the Contractor, consist of either solid 4-inch wide traffic stripe tape of the same color as the stripe it replaces, traffic cones, portable delineators or channelizers placed at longitudinal intervals not to exceed 100 feet or temporary pavement markers placed at longitudinal intervals of not more than 6 feet.

Where removal of the 4-inch wide traffic stripe will not be required, painted traffic stripe conforming to the provisions of "Temporary Traffic Stripe (Paint)" of these special provisions may be used.

The lateral offset for traffic cones, portable delineators or channelizers used for temporary edgeline delineation shall be as determined by the Engineer. If traffic cones or portable delineators are used as temporary pavement delineation for edgelines, the Contractor shall provide personnel to remain at the project site to maintain the cones or delineators during the hours of the day that the portable delineators are in use.

Channelizers used for temporary edgeline delineation shall be the surface mounted type and shall be orange in color. Channelizer bases shall be cemented to the pavement in the same manner provided for cementing pavement markers to pavement in "Pavement Markers" of these special provisions, except epoxy adhesive shall not be used to place channelizers on the top layer of pavement. Channelizers shall be, at the Contractor's option, one of the surface mount types (36 inch) listed in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Temporary edgeline delineation shall be removed when no longer required for the direction of public traffic as determined by the Engineer.

TEMPORARY TRAFFIC STRIPE (PAINT)

The painted temporary traffic stripe shall be complete in place at the location shown before opening the traveled way to public traffic. Removal of painted temporary traffic stripe will not be required.

Temporary painted traffic stripe shall conform to the provisions in "Paint Traffic Stripe and Pavement Marking" of these special provisions, except for payment.

TEMPORARY PAVEMENT MARKERS

Retroreflective pavement markers conforming to the provisions in "Pavement Markers" of these special provisions may be used in place of temporary pavement markers for long term day/night use (180 days or less) except to simulate patterns of broken traffic stripe. Placement of the retroreflective pavement markers used for

temporary pavement markers shall conform to the provisions in "Pavement Markers" of these special provisions except the waiting period provisions before placing the pavement markers on new hot mix asphalt surfacing as specified in Section 85-1.06, "Placement," of the Standard Specifications shall not apply and epoxy adhesive shall not be used to place pavement markers in areas where removal of the pavement markers will be required.

MEASUREMENT AND PAYMENT

Temporary traffic stripe shown on the plans will be measured and paid for in the same manner specified for paint traffic stripe in Section 84-3.06, "Measurement," and Section 84-3.07, "Payment," of the Standard Specifications.

Full compensation for furnishing, placing, maintaining, and removing the temporary pavement markers (including underlying adhesive, layout (dribble) lines to establish alignment of temporary pavement markers or used for temporary laneline and centerline delineation and signing specified for "no passing" zones) for those areas where temporary laneline and centerline delineation is not shown on the plans and for providing equivalent patterns of permanent traffic lines for those areas when required, shall be considered as included in the contract prices paid for the items of work that obliterated the laneline and centerline pavement delineation and no separate payment will be made therefor.

Full compensation for furnishing, placing, maintaining, and removing temporary edgeline delineation not shown on the plans shall be considered as included in the contract prices paid for the items of work that obliterated the edgeline pavement delineation and no separate payment will be made therefor. The quantity of channelizers used as temporary edgeline delineation will not be included in the quantity of channelizer (surface mounted) to be paid for.

10-1.33 BARRICADE

Barricades shall be furnished, placed and maintained at the locations shown on the plans, specified in the Standard Specifications or in these special provisions or where designated by the Engineer. Barricades shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Attention is directed to "Prequalified and Tested Signing and Delineation Materials" of these special provisions regarding retroreflective sheeting for barricades.

Construction area sign and marker panels conforming to the provisions in Section 12-3.06, "Construction Area Signs," of the Standard Specifications shall be installed on barricades in a manner determined by the Engineer at the locations shown on the plans.

Sign panels for construction area signs and marker panels installed on barricades shall conform to the provisions in Section 12-3.06A, "Stationary Mounted Signs," of the Standard Specifications.

Full compensation for furnishing, installing, maintaining, and removing construction area signs and marker panels on barricades shall be considered as included in the contract unit price paid for the type of barricade involved and no separate payment will be made therefor.

Barricades shown on the plans as part of a traffic control system will be paid for as provided in "Traffic Control System for Lane Closure" of these special provisions and will not be included in the count for payment of barricades.

10-1.34 PORTABLE CHANGEABLE MESSAGE SIGNS

GENERAL

Summary

Work includes furnishing, placing, operating, maintaining, and removing portable changeable message signs. Comply with Section 12-3.12 "Portable Changeable Message Signs," of the Standard Specifications.

Definitions

useable shoulder area: Paved or unpaved contiguous surface adjacent to the traveled way with:

1. Sufficient weight bearing capacity to support portable changeable message sign
2. Slope not greater than 6:1 (horizontal:vertical)

Submittals

Upon request, submit a Certificate of Compliance for each portable changeable message sign under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Quality Control and Assurance

Comply with the manufacturer's operating instructions for portable changeable message sign.

Approaching drivers must be able to read the entire message for all phases at least twice at the posted speed limit before passing portable changeable message sign. You may use more than 1 portable changeable message sign to meet this requirement.

Only display the message shown on the plans or ordered by the Engineer or specified in these special provisions.

MATERIALS

Portable changeable message sign must have 24-hour timer control or remote control capability.

The text of the message displayed on portable changeable message sign must not scroll, or travel horizontally or vertically across the face of the message panel.

CONSTRUCTION

Continuously repeat the entire message in no more than 2 phases of at least 3 seconds per phase.

If useable shoulder area is at least 15 feet wide, the displayed message on portable changeable message sign must be minimum 18-inch character height. If useable shoulder area is less than 15 feet wide, you may use a smaller message panel with minimum 12-inch character height to prevent encroachment in the traveled way.

You or your representative must be available by cell phone for operations that require portable changeable message signs. Give the Engineer your cell phone number. When the Engineer contacts you, immediately comply with the Engineer's request to modify the displayed message.

Start displaying the message on portable changeable message sign 5 minutes before closing the lane.

Place portable changeable message sign as far from the traveled way as practicable where it is legible to traffic and does not encroach on the traveled way. Place portable changeable sign before or at the crest of vertical roadway curvature where it is visible to approaching traffic. Avoid placing portable changeable message sign within or immediately after horizontal roadway curvature. Where possible, place portable changeable message sign behind guardrail or temporary railing (Type K).

Except where placed behind guardrail or temporary railing (Type K) use traffic control for shoulder closure to delineate portable changeable message sign.

Remove portable changeable message sign when not in use.

MEASUREMENT AND PAYMENT

Full compensation for portable changeable message signs, including furnishing, placing, operating, modifying messages, maintaining, transporting from location to location, removing, and repairing or replacing defective or damaged portable changeable message signs is included in the contract lump sum price paid for traffic control system and no separate payment will be made therefor.

10-1.35 CHANNELIZER

Channelizers shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Channelizers shall conform to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

When no longer required for the work as determined by the Engineer, channelizers and underlying adhesive used to cement the channelizer bases to the pavement shall be removed. Removed channelizers and adhesive shall become the property of the Contractor and shall be removed from the site of work.

10-1.36 TEMPORARY TRAFFIC SCREEN

Temporary traffic screen shall be furnished, installed, and maintained on top of temporary railing (Type K) at the locations designated on the plans, specified in the special provisions or directed by the Engineer and shall conform to the provisions specified for traffic handling equipment and devices in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Temporary traffic screen panels shall be new or used CDX Grade, or better, plywood or weather resistant strandboard mounted and anchored on temporary railing (Type K). Wale boards shall be new or used Douglas fir, rough sawn, Construction Grade, or better. Pipe screen supports shall be new or used galvanized steel pipe, Schedule 40. Nuts, bolts, and washers shall be cadmium plated. Screws shall be black or cadmium plated flat head, cross slotted screws with full thread length.

When no longer required, as determined by the Engineer, temporary traffic screen shall be removed from the site of the work and shall become the property of the Contractor.

10-1.37 TEMPORARY CRASH CUSHION MODULE

This work shall consist of furnishing, installing, and maintaining sand filled temporary crash cushion modules in groupings or arrays at each location shown on the plans, as specified in these special provisions or where designated by the Engineer. The grouping or array of sand filled modules shall form a complete sand filled temporary crash cushion in conformance with the details shown on the plans and these special provisions.

Temporary crash cushions shall be secured in place prior to commencing work for which the temporary crash cushions are required.

Whenever the work or the Contractor's operations establishes a fixed obstacle, the exposed fixed obstacle shall be protected with a sand filled temporary crash cushion. The sand filled temporary crash cushion shall be in place prior to opening the lanes adjacent to the fixed obstacle to public traffic.

Sand filled temporary crash cushions shall be maintained in place at each location, including times when work is not actively in progress. Sand filled temporary crash cushions may be removed during a work period for access to the work provided that the exposed fixed obstacle is 15 feet or more from a lane carrying public traffic and the temporary crash cushion is reset to protect the obstacle prior to the end of the work period in which the fixed obstacle was exposed. When no longer required, as determined by the Engineer, sand filled temporary crash cushions shall be removed from the site of the work.

Sand filled temporary crash cushion modules shall be one of the following, or equal, and be manufactured after March 31, 1997:

1. Energite III and Fitch Inertial Modules, manufactured by Energy Absorption Systems, Inc., 35 East Wacker Drive, Suite 1100, Chicago, IL 60601:
 - 1.1. Northern California: Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828, telephone (800) 884-8274, FAX (916) 387-9734
 - 1.2. Southern California: Traffic Control Service, Inc., 1818 E. Orangethorpe, Fullerton, CA 92831-5324, telephone (800) 222-8274, FAX (714) 526-9501
2. Traffix Sand Barrels, manufactured by Traffix Devices, Inc., 220 Calle Pintesresco, San Clemente, CA 92672, telephone (949) 361-5663, FAX (949) 361-9205
 - 2.1. Northern California: United Rentals, Inc., 1533 Berger Drive, San Jose, CA 95112, telephone (408) 287-4303, FAX (408) 287-1929
 - 2.2. Southern California: Statewide Safety & Sign, Inc., P.O. Box 1440, Pismo Beach, CA 93448, telephone (800) 559-7080, FAX (805) 929-5786
3. CrashGard Model CC-48 Sand Barrels, manufactured by Plastic Safety Systems, Inc., 2444 Baldwin Road, Cleveland, OH 44104:
 - 3.1. Northern California:
 - 3.1.1. Capitol Barricade Safety & Sign, 6329 Elvas Ave, Sacramento, CA 95819, telephone (888) 868-5021, FAX (916) 451-5388
 - 3.1.2. Sierra Safety, Inc., 9093 Old State Highway, New Castle, CA 95658, telephone (916) 663-2026, FAX (916) 663-1858
 - 3.2. Southern California: Hi Way Safety Inc., 13310 5th Street, Chino, CA 91710, telephone (909) 591-1781, FAX (909) 627-0999

Modules contained in each temporary crash cushion shall be of the same type at each location. The color of the modules shall be the standard yellow color, as furnished by the vendor, with black lids. The modules shall exhibit good workmanship free from structural flaws and objectionable surface defects. The modules need not be new. Good used undamaged modules conforming to color and quality of the types specified herein may be utilized. If used Fitch modules requiring a seal are furnished, the top edge of the seal shall be securely fastened to the wall of the module by a continuous strip of heavy duty tape.

Modules shall be filled with sand in conformance with the manufacturer's directions, and to the sand capacity in pounds for each module shown on the plans. Sand for filling the modules shall be clean washed concrete sand of

commercial quality. At the time of placing in the modules, the sand shall contain not more than 7 percent water as determined by California Test 226.

Modules damaged due to the Contractor's operations shall be repaired immediately by the Contractor at the Contractor's expense. Modules damaged beyond repair, as determined by the Engineer, due to the Contractor's operations shall be removed and replaced by the Contractor at the Contractor's expense.

Temporary crash cushion modules may be placed on movable pallets or frames. Comply with dimensions shown on the plans. The pallets or frames shall provide a full bearing base beneath the modules. The modules and supporting pallets or frames shall not be moved by sliding or skidding along the pavement or bridge deck.

A Type R or P marker panel shall be attached to the front of the crash cushion as shown on the plans, when the closest point of the crash cushion array is within 12 feet of the traveled way. The marker panel, when required, shall be firmly fastened to the crash cushion with commercial quality hardware or by other methods determined by the Engineer.

At the completion of the project, temporary crash cushion modules, sand filling, pallets or frames, and marker panels shall become the property of the Contractor and shall be removed from the site of the work. Temporary crash cushion modules shall not be installed in the permanent work.

Temporary crash cushion modules will be measured by the unit as determined from the actual count of modules used in the work or ordered by the Engineer at each location. Temporary crash cushion modules placed in conformance with Section 7-1.09, "Public Safety," of the Standard Specifications and modules placed in excess of the number specified or shown will not be measured nor paid for.

Repairing modules damaged by public traffic will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications. Modules damaged beyond repair by public traffic, when ordered by the Engineer, shall be removed and replaced immediately by the Contractor. Modules replaced due to damage by public traffic will be measured and paid for as temporary crash cushion module.

If the Engineer orders a lateral move of the sand filled temporary crash cushions and the repositioning is not shown on the plans, moving the sand filled temporary crash cushion will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications and these temporary crash cushion modules will not be counted for payment in the new position.

The contract unit price paid for temporary crash cushion module shall include full compensation for furnishing all labor, materials (including sand, pallets or frames and marker panels), tools, equipment, and incidentals, and for doing all the work involved in furnishing, installing, maintaining, moving, and resetting during a work period for access to the work, and removing from the site of the work when no longer required (including those damaged by public traffic) sand filled temporary crash cushion modules, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.38 REMOVE YELLOW TRAFFIC STRIPE AND PAVEMENT MARKING (HAZARDOUS WASTE)

GENERAL

Summary

This work includes removing existing yellow thermoplastic and yellow painted traffic stripe and pavement marking at the locations shown on the plans. The residue from the removal of this material is a hazardous waste.

Residue from removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking contains lead chromate. The average lead concentration is greater than or equal to 1000 mg/kg total lead or 5 mg/l soluble lead. When applied to the roadway, the yellow thermoplastic and yellow painted traffic stripe and pavement marking contained as much as 2.6 percent lead. Residue produced from the removal of this yellow thermoplastic and yellow painted traffic stripe and pavement marking contains heavy metals in concentrations that exceed thresholds established by the Health and Safety Code and 22 CA Code of Regs. For bidding purposes, assume that the residue is not regulated under the Federal Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 et seq. Yellow thermoplastic and yellow paint may produce toxic fumes when heated.

Submittals

Lead Compliance Plan: Submit a lead compliance plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

Work Plan: Submit a work plan for the removal, containment, storage, and disposal of yellow thermoplastic and yellow painted traffic stripe and pavement marking for acceptance not less than 15 days prior to the start of the removal operations. The work plan must include:

1. Objective of the operation
2. Removal equipment

3. Type of hazardous waste storage containers
4. Container storage location and how it will be secured
5. Hazardous waste sampling protocol and QA/QC requirements and procedures
6. Qualifications of sampling personnel
7. Analytical lab that will perform the analyses
8. CA Department of Toxic Substances Control (DTSC) registration certificate and California Highway Patrol (CHP) Biennial Inspection of Terminals (BIT) Program compliance documentation of the hazardous waste hauler that will transport the hazardous waste
9. Disposal site that will accept the hazardous waste residue

The Engineer will review the work plan within 5 business days of receipt.

Do not perform work that generates hazardous waste residue until the work plan has been accepted by the Engineer. The Engineer's review and acceptance does not waive any contract requirements and does not relieve the Contractor from complying with Federal, State, and local laws, regulations, and requirements.

Correct any rejected work plan and resubmit a corrected work plan within 5 business days of notification by the Engineer; at which time a new review period of 5 business days will begin.

Analytical Test Results: Submit analytical test results of the residue from removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking, including chain of custody documentation, for review and acceptance before:

1. Requesting the Engineer's signature on the waste profile requested by the disposal facility
2. Requesting the Engineer obtain an EPA ID no. for disposal
3. Removing the residue from the site

United States Environmental Protection Agency Identification Number Request: Submit a request for the U.S. EPA ID no. when the Engineer accepts analytical test results documenting that residue from removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking is a hazardous waste.

Disposal Documentation: Submit receiving landfill documentation of proper disposal within 5 business days of residue transport from the project.

CONSTRUCTION

Where grinding or other approved methods are used to remove yellow thermoplastic and yellow painted traffic stripe and pavement marking that will produce a hazardous waste residue, the removed residue, including dust, must be contained and collected immediately. Use a HEPA filter-equipped vacuum attachment operated concurrently with the removal operations or other equally effective approved methods for collection of the residue.

Store hazardous waste residue in labeled and covered containers. Labels must comply with the provisions of 22 CA Code of Regs §§66262.31 and 66262.32. Mark labels with:

1. Date the hazardous waste is generated
2. The words "Hazardous Waste"
3. Composition and physical state of the hazardous waste (for example, asphalt grindings with thermoplastic or paint)
4. The word "Toxic"
5. Name, address, and telephone no. of the Engineer
6. Contract no.
7. Contractor or subcontractor name

Use metal containers approved by the U.S. Department of Transportation for the transportation and temporary storage of the removed residue. Handle the containers such that no spillage occurs. Store containers in a secured enclosure. Acceptable secure enclosures include a locked chain link fenced area or a lockable shipping container located within the project limits until disposal as approved.

Make necessary arrangements to test the yellow thermoplastic and yellow paint hazardous waste residue as required by the disposal facility and these special provisions. Testing must include, at a minimum:

1. Total lead by EPA Method 6010B
2. Total chromium by US EPA Method 6010B series
3. Soluble lead by California Waste Extraction Test

4. Soluble chromium by California Waste Extraction Test
5. Soluble lead by Toxicity Characteristic Leaching Procedure
6. Soluble chromium by Toxicity Characteristic Leaching Procedure

From the 1st 220 gallons of hazardous waste or portion thereof if less than 220 gallons of hazardous waste are produced, a minimum of 4 randomly selected samples must be taken and analyzed individually. Samples must not be composited. From each additional 880 gallons of hazardous waste or portion thereof if less than 880 gallons are produced, a minimum of 1 additional random sample must be taken and analyzed. Use chain of custody procedures consistent with Chapter 9 of U.S. EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) while transporting samples from the project to the laboratory. Each sample must be homogenized before analysis by the laboratory performing the analyses. A sample aliquot sufficient to cover the amount necessary for the total and the soluble analyses must then be taken. This aliquot must be homogenized a 2nd time and the total and soluble analyses run on this aliquot. The homogenization process must not include grinding of the samples. Submit the name and location of the disposal facility that will be accepting the hazardous waste and the analytical laboratory along with the testing requirements not less than 5 business days before the start of removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking. The analytical laboratory must be certified by the CA Department of Public Health Environmental Laboratory Accreditation Program for all analyses to be performed.

After the Engineer accepts the analytical test results, dispose of yellow thermoplastic and yellow paint hazardous waste residue at a California Department of Toxic Substance Control permitted Class 1 disposal facility located in CA under the requirements of the disposal facility operator within 30 days after accumulating 220 pounds of residue and dust.

If less than 220 pounds of hazardous waste residue and dust is generated in total, it must be disposed of within 30 days after the start of accumulation of the residue and dust.

Use a hazardous waste manifest and a transporter registered with the CA Department of Toxic Substance Control and in compliance with the CHP BIT Program. The Engineer will obtain the U.S. EPA ID no. and will sign all manifests as the generator within 2 business days of receiving and accepting the analytical test results and receiving your request for the U.S. EPA ID no.

If analytical test results demonstrate that the residue is a non-hazardous waste and the Engineer agrees, dispose of the residue at an appropriately permitted Class II or Class III facility under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

MEASUREMENT AND PAYMENT

The contract price paid per linear foot for remove yellow thermoplastic traffic stripe (hazardous waste) and remove yellow painted traffic stripe (hazardous waste) or per square foot for remove yellow thermoplastic pavement marking (hazardous waste) and remove yellow painted pavement marking (hazardous waste) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all of the work involved in removal, containment, storage, and disposal, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for (1) work plan for the removal, containment, storage, and disposal of yellow thermoplastic and yellow painted traffic stripe and pavement marking hazardous waste residue, (2) analytical test results, (3) US EPA ID no. request, and (4) receiving landfill documentation of proper disposal are included in the contract prices paid per linear foot for remove yellow thermoplastic traffic stripe and remove yellow painted traffic stripe or per square foot for remove yellow thermoplastic pavement marking and remove yellow painted pavement marking and no separate payment will be made therefor.

Additional disposal costs for hazardous waste residue regulated under RCRA, as determined by test results, will be paid for as extra work as specified in Section 4-1.03D, "Extra Work," of the Standard Specifications.

If analytical test results demonstrate that the residue is a non-hazardous waste and the Engineer agrees to disposal at a non-hazardous waste disposal facility, no cost adjustment will be made.

10-1.39 TREATED WOOD WASTE

GENERAL

Summary

This work includes handling, storing, transporting, and disposing of treated wood waste (TWW).

Wood removed from metal beam guard railing and roadside signs is treated with one or more of the following:

1. Creosote
2. Pentachlorophenol

3. Copper azole
4. Copper boron azole
5. Chromated copper arsenate
6. Ammoniacal copper zinc arsenate
7. Copper naphthenate
8. Alkaline copper quaternary

Manage TWW under Title 22 CA Code of Regulations, Division 4.5, Chapter 34.

Submittals

For disposal of TWW submit a copy of each completed shipping record and weight receipt to the Engineer within 5 business days of disposal.

CONSTRUCTION

Provide training to personnel who handle TWW or may come in contact with TWW that includes:

1. All applicable requirements of Title 8 CA Code of Regulations
2. Procedures for identifying and segregating TWW
3. Safe handling practices
4. Requirements of Title 22 CA Code of Regulations, Division 4.5, Chapter 34
5. Proper disposal methods

Store TWW before disposal using any of the following methods:

1. Elevate on blocks above a reasonably foreseeable run-on elevation and protect from precipitation
2. Place in water-resistant containers designed for shipping or solid waste collection
3. Place on a containment surface or pad protected from run-on and precipitation
4. Place in a storage building as defined in Title 22 CA Code of Regulations, Div. 4.5, Chp. 34, Section 67386.6 (a)(2)(c).

Prevent unauthorized access to TWW using a secured enclosure such as a locked chain link fenced area or a lockable shipping container located within the project limits.

Resize and segregate TWW at a location where debris from the operation including sawdust and chips can be contained. Collect and manage the debris as TWW.

Provide water-resistant labels, that comply with Title 22 CA Code of Regulations, Division 4.5, Chapter 34, to clearly mark and identify TWW and accumulation areas. Labels must include:

1. Caltrans, District number, Construction, contract number
2. District office address
3. Engineer's name, address, and telephone number
4. Contractor's contact name and telephone number
5. Date placed in storage

Before transporting TWW, obtain an agreement from the receiving facility that the treated wood waste will be accepted. Protect shipments of treated wood waste from loss and exposure to precipitation. For projects with 10,000 pounds or more of TWW, request a hazardous waste generator identification number from the Engineer at least 5 business days before the first shipment. Each shipment must be accompanied by a shipping record such as a bill of lading or invoice that includes:

1. Caltrans with district number
2. Construction contract number
3. District office address
4. Engineer's name, address, and telephone number
5. Contractor's contact name and telephone number
6. Receiving facility name and address
7. Waste description: treated wood waste (preservative type if known or unknown/mixture)
8. Project location
9. Estimated quantity of shipment by weight or volume

10. Date of transport
11. Date of receipt by the receiving TWW facility
12. Weight of shipment as measured by the receiving TWW facility
13. For projects with 10,000 pounds or more of TWW include the generator identification number

The shipping record must be at least a 4-part carbon or carbonless 8-1/2" x 11" form to allow retention of copies by the Engineer, transporter, and disposal facility.

Dispose of TWW at an approved TWW facility. A list of currently approved TWW facilities may be viewed at:

<http://www.dtsc.ca.gov/HazardousWaste/upload/lanfillapr11updated1.pdf>

Dispose of TWW within:

1. 90 days of generation if stored on blocks
2. 180 days of generation if stored on a containment surface or pad.
3. One year of generation if filling a water-resistant container, or 90 days after the container is full, whichever is shorter
4. One year of generation if storing in a storage building as defined in Title 22 CA code of Regulations, Div. 4.5, Chp. 34, Section 67386.6(a)(2)(C)

MEASUREMENT AND PAYMENT

Full compensation for handling, storing, transporting, and disposing TWW, including personnel training, is included in the contract price paid for the various items of work involved and no additional compensation will be allowed therefor.

10-1.40 EXISTING HIGHWAY FACILITIES

The work performed in connection with various existing highway facilities shall conform to the provisions in Section 15, "Existing Highway Facilities," of the Standard Specifications and these special provisions.

Attention is directed to Section 7-1.06, "Safety and Health Provisions," of the Standard Specifications. Work practices and worker health and safety shall conform to the California Division of Occupational Safety and Health Construction Safety Orders Title 8, of the California Code of Regulations including Section 5158, "Other Confined Space Operations."

Existing footing concrete that is below ground and outside of the footing limits shown on the contract plans or original contract plans shall be removed as directed by the Engineer and will be paid in conformance with Section 4-1.03D, "Extra Work," of the Standard Specifications.

Additional exploratory work of bridge members for unforeseen damage shall be done when directed by the Engineer and will be paid in conformance with Section 4-1.03D, "Extra Work," of the Standard Specifications.

EXISTING PAINT SYSTEMS

The existing paint systems on Bridge Number 53-1089 (Burbank Blvd Bridge), Bridge No. B2820 (Victory Place Bridge), Bridge No. B2819 (Victory Place Railroad Bridge), and Bridge No. 53-AMBE (Route 5 Southbound Exit Ramp to San Fernando Blvd) shown on the plans consist of lead based paint. Any work that disturbs the existing paint system will expose workers to health hazards and will (1) produce debris containing heavy metal in amounts that exceed the thresholds established in Titles 8 and 22 of the California Code of Regulations or (2) produce toxic fumes when heated. The grime and debris on the bridge may also contain lead. Consider the grime and debris part of the paint system. All debris produced when the existing paint system is disturbed must be contained.

Debris Containment and Collection Program

Prior to starting work, the Contractor must submit a debris containment and collection program to the Engineer in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, for debris produced when the existing paint system is disturbed. The program must identify materials, equipment, and methods to be used when the existing paint system is disturbed and must include working drawings of containment systems, loads applied to the bridge by containment structures, provisions for ventilation and air movement for visibility and worker safety, name and address of analytical lab that will perform the analyses, CA Department of Toxic Substances Control registration certificate and documentation of compliance with the CA Highway Patrol Biennial Inspection of Terminals Program of the hazardous waste hauler that will transport the hazardous waste, and the name and address of the disposal site that will accept the hazardous waste residue.

If the measures being taken by the Contractor are inadequate to provide for the containment and collection of debris produced when the existing paint system is disturbed, the Engineer will direct the Contractor to revise the operations and the debris containment and collection program. The directions will be in writing and will specify the items of work for which the Contractor's debris containment and collection program is inadequate. No further work must be performed on the items until the debris containment and collection program is adequate and, if required, a revised program has been approved for the containment and collection of debris produced when the existing paint system is disturbed.

The Engineer will notify the Contractor of the approval or rejection of the submitted or revised debris containment and collection program within 2 weeks of submittal of the Contractor's program or revised program.

The State will not be liable to the Contractor for failure to approve all or any portion of an originally submitted or revised debris containment and collection program, nor for delays to the work due to the Contractor's failure to submit an acceptable program.

Full compensation for the debris containment and collection program must be considered as included in the contract price paid for the item of work causing the existing paint system to be disturbed, and no additional compensation will be allowed therefor.

Safety and Health Provisions

Attention is directed to Section 7-1.06, "Safety and Health Provisions," of the Standard Specifications. Work practices and worker health and safety must conform to the California Code of Regulations, Title 8, Construction Safety Orders, including Section 1532.1, "Lead."

The Contractor must furnish the Engineer a written Code of Safe Practices and must implement an Injury and Illness Prevention Program and a Hazard Communication Program in conformance with the requirements of Construction Safety Orders, Sections 1509 and 1510.

Prior to starting work that disturbs the existing paint system, and when revisions to the compliance program are required submit a lead compliance plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications. Copies of all air monitoring or jobsite inspection reports made by or under the direction of the CIH in conformance with Section 1532.1, "Lead," must be furnished to the Engineer within 10 days after the date of monitoring or inspection.

Full compensation for furnishing the Engineer with the submittals and for implementing the programs required by this safety and health section must be considered as included in the contract price paid for the item of work causing the existing paint system to be disturbed, and no additional compensation will be allowed therefor.

Debris Handling

Debris produced when the existing paint system is disturbed must not be temporarily stored on the ground. Debris accumulated inside the containment system must be removed before the end of each work shift. Debris must be stored in metal containers approved by the U.S. Department of Transportation for the transportation and temporary storage of hazardous waste. The containers must be handled such that no spillage occurs. The containers must be stored in a secured enclosure. Acceptable secure enclosures include a locked chain link fenced area or a lockable shipping container located within the project limits until disposal as approved.

Handling, storing, transporting, and disposing of debris produced when the existing paint system is disturbed must be performed in conformance with all applicable Federal, State, and local hazardous waste laws. Laws that govern this work include:

1. Health and Safety Code, Division 20, Chapter 6.5 (California Hazardous Waste Control Act).
2. Title 22; California Code of Regulations, Division 4.5, (Environmental Health Standards for the Management of Hazardous Waste).
3. Title 8, California Code of Regulations.

The Contractor must make necessary arrangements to test the debris as required by the disposal facility and as specified. Testing must include at a minimum:

1. Total 32 by US EPA Method 6010B
2. Soluble 32 by CA WET
3. Soluble 8 by Toxicity Characteristic Leaching Procedure (TCLP)

From the first 220 gal of hazardous waste or portion thereof if less than 220 gal of hazardous waste are produced, a minimum of 4 randomly selected samples must be taken and analyzed individually. Samples must not be composited. From each additional 880 gal of hazardous waste or portion thereof if less than 880 gal are

produced, a minimum of 1 additional random sample must be taken and analyzed. Use chain of custody procedures consistent with Chapter 9 of the US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) while transporting samples from the project to the laboratory. Each sample must be homogenized before analysis by the laboratory performing the analyses. A sample aliquot sufficient to cover the amount necessary for the total and the soluble analyses must then be taken. This aliquot must be homogenized a second time and the total and soluble analyses run on this aliquot. The homogenization process must not include grinding of the samples. Submit the name and location of the disposal facility that will be accepting the hazardous waste and the analytical laboratory along with the testing requirements not less than 5 business days before the start of the work that disturbs the existing paint system. The analytical laboratory must be certified by the CDPH ELAP for all analyses to be performed.

Submit analytical test results of the debris, including chain of custody documentation, for review and acceptance before:

1. Requesting the Engineer's signature on the waste profile requested by the disposal facility
2. Requesting the Engineer obtain a US EPA Generator Identification Number for disposal
3. Removing the residue from the site

Submit a request for the US EPA Generator Identification Number when the Engineer accepts the waste characterization analytical test results documenting that the debris is a hazardous waste.

Except as otherwise provided herein, debris produced when the existing paint system is disturbed must be disposed of by the Contractor at an approved California Department of Toxic Substances Control permitted Class I disposal facility within California in conformance with the requirements of the disposal facility operator. The Engineer will obtain the US EPA Generator Identification Number and will sign all manifests as the generator within 2 business days of receiving and accepting the waste characterization analytical test results and receiving your request for the US EPA Generator Identification Number. Disposal must occur after the Engineer accepts the waste characterization analytical test results and within 30 days after accumulating 220 pounds of residue and dust.

If less than 220 pounds of hazardous waste debris is generated in total, dispose of it within 30 days after the start of accumulation of the debris.

The debris must be hauled by a transporter currently registered with the California Department of Toxic Substances Control and in compliance with the CA Highway Patrol Biennial Inspection of Terminals Program using correct manifesting procedures. The Contractor must make all arrangements with the operator of the disposal facility and perform any testing of the debris required by the operator.

If analytical test results demonstrate that the residue is a non-hazardous waste and the Engineer agrees, dispose of the residue at an appropriately permitted Class II or Class III facility or recycle it.

At the option of the Contractor, the debris produced when the existing paint system is disturbed may be disposed of by the Contractor at a facility equipped to recycle the debris, subject to the following requirements:

1. Copper slag abrasive blended by the supplier with a calcium silicate compound must be used for blast cleaning.
2. The debris produced when the existing paint system is disturbed must be tested by the Contractor to confirm that the solubility of the heavy metals is below regulatory limits and that the debris may be transported to the recycling facility as a nonhazardous waste.
3. The Contractor must make all arrangements with the operator of the recycling facility and perform any testing of the debris produced when the existing paint system is disturbed that is required by the operator.

Submit receiving landfill or recycling facility documentation of proper disposal within 5 business days of debris transport from the project.

Full compensation for debris handling and disposal must be considered as included in the contract price paid for the item of work causing the existing paint system to be disturbed, and no additional compensation will be allowed therefor.

If analytical test results demonstrate that the debris is a non-hazardous waste, the Engineer agrees, and debris is disposed of at an appropriately permitted Class II, Class III, or recycling facility, the Department does not adjust payment.

REMOVE METAL BEAM GUARD RAILING

Existing metal beam guard railing, where shown on the plans to be removed, shall be removed and disposed of.

Existing concrete anchors or steel foundation tubes shall be completely removed and disposed of. Full compensation for removing concrete anchors shall be considered as included in the contract price paid per linear foot for remove metal beam guard railing and no separate payment will be made therefor.

Full compensation for removing cable anchor assemblies, terminal anchor assemblies or steel foundation tubes shall be considered as included in the contract price paid per linear foot for remove metal beam guard railing and no separate payment will be made therefor.

REMOVE CABLE RAILING

Existing cable railing, where shown on the plans to be removed, shall be removed and disposed of.

Existing concrete anchors or steel foundation tubes shall be completely removed and disposed of. Full compensation for cutting off pipe post sleeves or other post anchorages on structure shall be considered as included in the contract price paid per linear foot for remove cable railing and no separate payment will be made therefor.

REMOVE HANDRAIL

Existing handrail, where shown on the plans to be removed, shall be removed and disposed of.

Existing concrete anchors or steel foundation tubes shall be completely removed and disposed of. Full compensation for cutting off pipe post sleeves or other post anchorages on structure shall be considered as included in the contract price paid per linear foot for remove handrail and no separate payment will be made therefor.

REMOVE SIGN STRUCTURE

Existing sign structures, where shown on the plans to be removed, shall be removed and disposed of.

Overhead sign structure removal shall consist of removing posts, frames, portions of foundations, sign panels, walkways with safety railings, and sign lighting electrical equipment.

Bridge mounted sign structure removal shall consist of removing sign panels and frames, sign lighting electrical equipment, walkways with safety railings, structural braces and supports, and hardware.

A sign structure shall not be removed until the structure is no longer required for the direction of public traffic.

Concrete foundations may be abandoned in place, except that the top portion, including anchor bolts, reinforcing steel, and conduits shall be removed to a depth of not less than 3 feet below the adjacent finished grade. The resulting holes shall be backfilled and compacted with material equivalent to the surrounding material.

Electrical wiring shall be removed to the nearest pull box. Fuses within spliced connections in the pull box shall be removed and disposed of.

Electrical equipment, where shown on the plans, shall be salvaged.

REMOVE PAVEMENT MARKER

Existing pavement markers, including underlying adhesive, when no longer required for traffic lane delineation as determined by the Engineer, shall be removed and disposed of.

REMOVE CHAIN LINK FENCE

Existing chain link fence, including post footings and anchor blocks, where shown on the plans, shall be removed and disposed of.

Full compensation for backfilling and compacting post holes shall be considered as included in the contract price paid per linear foot for remove chain link fence and no additional compensation will be allowed therefor.

REPLACE UNDERLYING BASE

Summary

This work includes removing existing underlying base and replacing with lean concrete base rapid setting (LCBRS). The Engineer determines the exact limits of replaced underlying base.

LCBRS must conform to the provisions for LCBRS in the special provisions.

Construction

The finished surface of lean concrete base must not be above the grade established by the Engineer, or more than 0.05-foot below the grade established by the Engineer.

If the underlying base is treated, before removing cut neat lines with a saw to full depth of the existing underlying treated base. Do not damage base remaining in place

After removing the underlying base to the required depth, grade to a uniform plane. Water and compact the material remaining in place to a firm and stable base. The finished surface of the remaining material must not extend above the grade established by the Engineer. At your expense, fill areas that were over-excavated during base removal with replacement material in the same operation as the base replacement.

Dispose of removed material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Measurement and Payment

The Engineer measures replace underlying base based on the specified dimensions and any adjustments ordered.

The contract price paid per cubic yard for replace underlying base includes full compensation for furnishing all labor, materials (including cementitious material and chemical admixtures in the amount determined by the Contractor), tools, equipment, and incidentals, removing and disposing of existing underlying base, and for doing all work involved in constructing, sampling, and testing LCBRS, as specified in the Standard Specifications and the special provisions, and as directed by the Engineer.

If calibration of volumetric batch-trucks is performed more than 100 miles from the project limits, additional inspection expenses will be sustained by the State. Whereas it is and will be impracticable and extremely difficult to ascertain and determine the actual increase in these expenses, your payment for LCBRS will be reduced \$1,000 per calibration session.

REMOVE TRAFFIC STRIPE AND PAVEMENT MARKING

This work includes removing existing traffic stripe and pavement marking at the locations shown on the plans.

Submit a lead compliance plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

Waste residue from removal of thermoplastic and painted traffic stripe and pavement marking is a non-hazardous waste residue and contains lead in average concentrations less than 1000 mg/kg total lead and 5 mg/L soluble lead. This waste residue does not contain heavy metals in concentrations that exceed thresholds established by the Health and Safety Code and 22 CA Code of Regs and is not regulated under the Federal Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 et seq.

REMOVE DRAINAGE FACILITY

Existing inlets, slotted corrugated steel pipe, headwalls and pipe, where any portion of these structures is within 3 feet of the grading plane in excavation areas, or within one foot of original ground in embankment areas, or where shown on the plans to be removed, shall be completely removed and disposed of.

REMOVE ROADSIDE SIGN

Existing roadside signs, at those locations shown on the plans to be removed, shall be removed and disposed of.

Existing roadside signs shall not be removed until replacement signs have been installed or until the existing signs are no longer required for the direction of public traffic, unless otherwise directed by the Engineer.

RELOCATE ROADSIDE SIGN

Existing roadside signs shall be removed and relocated to the new locations shown on the plans.

Each roadside sign shall be installed at the new location on the same day that the sign is removed from its original location.

Two holes shall be drilled in each existing post as required to provide the breakaway feature shown on the plans.

ADJUST INLET

Existing pipe inlets and concrete drainage inlets shall be adjusted as shown on the plans.

Concrete shall be minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications. The concrete shall contain not less than 590 pounds of cementitious material per cubic yard.

Where inlets are located in areas to be paved or surfaced, no individual structure shall be constructed to final grade until the paving or surfacing has been completed immediately adjacent to the structure.

OBLITERATE SURFACING

Existing surfacing, when no longer required for the passage of public traffic, shall be obliterated at the locations shown on the plans.

Surfacing shall not be obliterated by the earth cover method.

Obliteration shall consist of rooting, plowing, pulverizing or scarifying the existing surfacing in conformance with the provisions in Section 15-2.02A, "Obliterating Roads and Detours," of the Standard Specifications.

REMOVE PORTLAND CEMENT CONCRETE PAVEMENT

Removing portland cement concrete pavement shall conform to the provisions in Section 15-3, "Removing Concrete," of the Standard Specifications.

Where no joint exists in the pavement on the line at which concrete is to be removed, a straight, neat cut with a power driven saw shall be made along the line to a minimum depth of 2 inches before removing the concrete.

The quantities of portland cement concrete pavement removed will be measured and paid for by the square yard.

No deduction will be made from any excavation quantities for the quantity of portland cement concrete pavement removed.

Full compensation for removing bituminous or other overlying material and sawing joints at removal lines, as required, shall be considered as included in the contract price paid per square yard for remove concrete pavement and no additional compensation will be allowed therefor.

COLD PLANE ASPHALT CONCRETE PAVEMENT

GENERAL

Summary

This work includes cold planing existing asphalt concrete pavement.

Sequencing and Scheduling

Schedule cold planing activities to ensure hot mix asphalt (HMA) is placed over cold planed area during the same work shift before opening to traffic. If you cannot place HMA over the entire cold planed area before opening it to traffic:

1. Construct a temporary HMA taper to the level of the existing pavement.
2. Place HMA during the next lane or shoulder closure for that area.
3. Submit a corrective action plan that shows that you are able to cold plane and place HMA in the same work shift. Do not perform cold planing work until the Engineer approves the corrective action plan.

MATERIALS

HMA for temporary tapers must be of the same quality as the HMA used elsewhere on the project or comply with "Minor Hot Mix Asphalt" of these special provisions.

CONSTRUCTION

General

Perform planing of asphalt concrete pavement without the use of a heating device to soften the pavement.

Cold Planing Equipment

Cold planing machine must be:

1. Equipped with a cutter head width that matches the planing width. If the only available cutter head width is wider than the cold plane area shown, submit to the Engineer a request for using a wider cutter head. Do not cold plane until the Engineer approves your request.
2. Equipped with automatic controls to control the longitudinal grade and transverse slope of the cutter head and:
 - 2.1. If a ski device is used, it must be at least 30 feet long, rigid, and 1 piece unit. The entire length must be used in activating the sensor.
 - 2.2. If referencing from existing pavement, the cold planing machine must be controlled by a self-contained grade reference system. The system must be used at or near the centerline of the roadway. On the adjacent pass with the cold planing machine, a joint matching shoe may be used.
3. Equipped to effectively control dust generated by the planing operation.
4. Operated so that no fumes or smoke is produced.

Replace broken, missing, or worn machine teeth.

Grade Control and Surface Smoothness

Furnish, install, and maintain grade and transverse slope references.

The depth, length, width, and shape of the cut must be as shown or as ordered. The final cut must result in a neat and uniform surface. Do not damage remaining surface.

The completed surface of the planed asphalt concrete pavement must not vary more than 0.02 foot when measured with a 12-foot straightedge parallel with the centerline. The transverse slope of the planed surface must not vary more than 0.03 foot from the straightedge when placed at right angles to the centerline.

A drop-off of more than 0.15 foot is not allowed between adjacent lanes open to public traffic.

Temporary HMA Tapers

If a drop-off between the existing pavement and the planed area at transverse joints cannot be avoided before opening to traffic, construct a temporary HMA taper. HMA for temporary taper must be:

1. Placed to the level of the existing pavement and tapered on a slope of 30:1 (Horizontal: Vertical) or flatter to the level of the planed area
2. Compacted by any method that will produce a smooth riding surface
3. Completely removed before placing the permanent surfacing. The removed material must be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Disposal of Planed Material

Remove cold planed material concurrent with planing activities, within 50 feet of the planer or as ordered.

Dispose of planed material and under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Cold plane asphalt concrete pavement is measured by the square yard.

The contract price paid per square yard for cold plane asphalt concrete pavement includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in cold planing asphalt concrete surfacing and disposing of planed material, including constructing, maintaining, removing temporary HMA tapers if applicable, as specified in the Standard Specifications and these special provisions and as directed by the Engineer.

Full compensation for removal of thermoplastic traffic stripe, painted traffic stripe, and pavement marking in areas of cold plane asphalt concrete is included in the contract price paid for cold plane asphalt concrete and no separate payment will be made therefor.

CAP INLET

Existing pipe inlets and concrete drainage inlets, where shown on the plans to be capped, shall be capped and the bottoms of the inlets shall be rounded with portland cement concrete as shown on the plans.

Concrete shall be minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications. The concrete shall contain not less than 590 pounds of cementitious material per cubic yard.

Inlets shall be removed to a depth of at least one foot below the grading plane.

Concrete removal shall be performed without damage to portions of the inlet that are to remain in place. Damage to existing concrete, which is to remain in place, shall be repaired by the Contractor to a condition equal to that existing prior to the beginning of removal operations. The repair of existing concrete damaged by the Contractor's operations shall be at the Contractor's expense.

Existing reinforcement that is to be incorporated in the new work shall be protected from damage and shall be thoroughly cleaned of adhering material before being embedded in the new concrete.

The quantity of capping inlets will be determined as units from actual count.

The contract unit price paid for cap inlet shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in capping inlets, including removing portions of inlets, rounding bottoms of inlets, bar reinforcing steel, and structure excavation and structure backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

BRIDGE REMOVAL

Removing bridges or portions of bridges shall conform to the provisions in Section 15-4, "Bridge Removal," of the Standard Specifications and these special provisions.

Removing bridges or portions of bridges shall be performed as shown on the plans at the following locations:

LOCATION A
EMPIRE AVE UC
(Bridge No. 53-2920)

Bridge removal Location A shall consist of removing the existing Empire Ave UC.

LOCATION B
SAN FERNANDO BLVD UC - BRIDGE B
(Bridge No. 53-0536)

Bridge removal (Portion) Location B shall consist of removing portions of the existing San Fernando Blvd UC - Bridge B.

LOCATION C
SAN FERNANDO BLVD UC - OFF RAMP
(Bridge No. 53-0535K)

Bridge removal (Portion) Location C shall consist of removing portions of the existing San Fernando Blvd UC - Off Ramp.

LOCATION D
BURBANK BLVD OC
(Bridge No. 53-3057)

Bridge removal Location D shall consist of removing the existing Burbank Blvd OC including footings at bent 3 and portions of piles.

LOCATION E
BUENA VISTA - WINONA UC
(Bridge No. 53-1110)

Bridge removal (Portion) Location E shall consist of removing portions of the existing Buena Vista - Winona UC.

LOCATION F
SAN FERNANDO BLVD UC - NORTHBOUND
(Bridge No. 53-1109)

Bridge removal (Portion) Location F shall consist of removing the existing portions of San Fernando Blvd UC - Northbound.

LOCATION G
BURBANK WESTERN CHANNEL COVER
(Bridge No. N/A)

Bridge removal (Portion) Location G shall consist of removing portions of the existing channel and chain link fencing.

REMOVE EXISTING RAILROAD BRIDGES OVER SAN FERNANDO
(Bridge No. N/A)

Bridge removal (existing railroad bridges over San Fernando) shall consist of removing the existing bridges.

Removed materials that are not to be salvaged or used in the reconstruction shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

The Contractor shall submit a complete bridge removal plan to the Engineer for each bridge listed above, detailing procedures, sequences, and all features required to perform the removal in a safe and controlled manner.

The bridge removal plan shall include, but not be limited to, the following:

- A. The removal sequence, including staging of removal operations.
- B. Equipment locations on the structure during removal operations.

- C. Temporary support shoring or temporary bracing.
- D. Locations where work is to be performed over traffic, utilities, or railroad property.
- E. Details, locations, and types of protective covers to be used.
- F. Measures to assure that people, property, utilities, and improvements will not be endangered.
- G. Details and measures for preventing material, equipment, and debris from falling onto public traffic, or railroad property.

When protective covers are required for removal of portions of a bridge or when superstructure removal work on bridges is involved, the Contractor shall submit working drawings with design calculations to the Engineer for the proposed bridge removal plan, and the bridge removal plan shall be prepared and signed by an engineer who is registered as a Civil Engineer in the State of California. The design calculations shall be adequate to demonstrate the stability of the structure during all stages of the removal operations. Calculations shall be provided for each stage of bridge removal and shall include dead and live load values assumed in the design of protective covers. At a minimum, a stage will be considered to be removal of the deck, the soffit, or the girders, in any span; or walls, bent caps, or columns at support locations.

Temporary support shoring, temporary bracing, and protective covers, as required, shall be designed and constructed in conformance with the provisions in Section 51-1.06, "Falsework," of the Standard Specifications and these special provisions.

The assumed horizontal load to be resisted by the temporary support shoring and temporary bracing, for removal operations only, shall be the sum of the actual horizontal loads due to equipment, construction sequence, or other causes and an allowance for wind, but in no case shall the assumed horizontal load to be resisted in any direction be less than 5 percent of the total dead load of the structure to be removed.

The bridge removal plan shall conform to the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The number of sets of drawings, design calculations, the time for reviewing bridge removal plans shall be the same as specified for falsework working drawings in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications.

For bridge removal over railroad property, approval by the Engineer of the bridge removal plans will be contingent upon the drawings being satisfactory to the railroad company involved.

Temporary support shoring, temporary bracing, and protective covers over railroad property shall conform to the latest guidelines of the railroad company involved and shall provide the minimum clearances required under "Relations with Railroad Company" of these special provisions for the passage of railroad traffic.

The following additional requirements apply to the removal of bridges or portions of bridges that are over or adjacent to roadways that may be closed to public traffic for only brief periods of time:

- A. The closure of roadways to public traffic shall conform to the provisions in "Order of Work" and "Maintaining Traffic" of these special provisions.
- B. Prior to closing a roadway to traffic to accommodate bridge removal operations, the Contractor shall have all necessary workers, materials, and equipment at the site as needed to proceed with the removal work in an expeditious manner. While the roadway is closed to public traffic, work shall be pursued promptly and without interruption until the roadway is reopened to public traffic.
- C. Bridge removal operations shall be performed during periods of time that the roadway is closed to public traffic except as specified herein for preliminary work.
- D. Preliminary work shall be limited to operations that will not reduce the structural strength or stability of the bridge, or any element thereof, to a level that in the judgment of the Engineer would constitute a hazard to the public. This preliminary work shall also be limited to operations that cannot cause debris or any other material to fall onto the roadway. Protective covers may be used to perform preliminary work such as chipping or cutting the superstructure into segments, provided the covers are of sufficient strength to support all loads and are sufficiently tight to prevent dust and fine material from sifting down onto the traveled way. Protective covers shall extend at least 4 feet beyond the limit of the work underway. Bottom slabs of box girders may be considered to be protective covers for preliminary work performed on the top slab inside the limits of the exterior girders.
- E. Temporary support shoring and temporary bracing shall be used in conjunction with preliminary work when necessary to ensure the stability of the bridge.
- F. Temporary support shoring, temporary bracing, and protective covers shall not encroach closer than 8 feet horizontally from the edge or 15 feet vertically above any traffic lane or shoulder that is open to public traffic.
- G. During periods when the roadway is closed to public traffic, debris from bridge removal operations may be allowed to fall directly onto the lower roadway provided adequate protection is furnished for all highway facilities. The minimum protection for paved areas shall be a 2-foot-thick earthen pad or a 1-inch-thick

steel plate placed over the area where debris can fall. Prior to reopening the roadway to public traffic, all debris, protective pads, and devices shall be removed and the roadway swept clean with wet power sweepers or equivalent methods.

- H. The removal operations shall be conducted in such a manner that the portion of the structure not yet removed remains in a stable condition at all times. For girder bridges, each girder shall be completely removed within a span before the removal of the adjacent girder is begun. For slab type bridges, removal operations within a span shall be performed along a front that roughly parallels the primary reinforcing steel.

The following additional requirements apply to the removal of bridges or portions of bridges whenever the removal work is to be performed over public traffic or railroad property:

- A. A protective cover shall be constructed before beginning bridge removal work. The protective cover shall be supported by shoring, falsework, or members of the existing structure. The Contractor shall be responsible for designing and constructing safe and adequate protective covers, shoring, and falsework with sufficient strength and rigidity to support the entire load to be imposed.
- B. The construction and removal of the protective cover, and the installation and removal of temporary railings shall conform to the provisions in "Order of Work," "Maintaining Traffic," "Temporary Railings" of these special provisions.
- C. Bridge removal methods shall be described in the working drawings and shall be supported by calculations with sufficient details to substantiate live loads used in the protective cover design. Dead and live load values assumed for designing the protective cover shall be shown on the working drawings.
- D. The protective cover shall prevent any materials, equipment, or debris from falling onto public traffic or railroad property. The protective cover shall have a minimum strength equivalent to that provided by good, sound Douglas fir planking having a nominal thickness of 2 inches. Additional layers of material shall be furnished as necessary to prevent fine materials or debris from sifting down upon the traveled way and shoulders.
- E. During the removal of bridge segments, and when portions of the bridge, such as deck slabs or box girder slabs, comply with the requirements for the protective cover, a separate protective cover need not be constructed.
- F. At locations where only bridge railing is to be removed, the protective cover shall extend from the face of the exterior girder or at least 2 feet inside of the bridge railing to be removed, whichever is less, to at least 4 feet beyond the outside face of the bridge railing.
- G. At locations where entire girders are to be removed, the protective cover shall extend at least 10 feet beyond the outside face of the bridge railing.
- H. The protective cover shall extend at least 10 feet beyond the outside face of the bridge railing, except that, at locations where the bridge railing is to be removed and new girders are not constructed, the protective cover shall extend from the face of the exterior girder or at least 2 feet inside of the bridge railing to be removed, whichever is less, to at least 4 feet beyond the outside face of the bridge railing.
- I. The protective cover shall provide the openings specified under "Maintaining Traffic" of these special provisions, except that when no openings are specified for bridge removal, a vertical opening of 15 feet and a horizontal opening of 32 feet shall be provided for the passage of public traffic.
- J. Falsework or supports for protective covers shall not extend below the vertical clearance level nor to the ground line at any location within the roadbed.
- K. The construction of the protective cover as specified herein shall not relieve the Contractor of responsibilities specified in Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications.
- L. Before removal of the protective cover, the Contractor shall clean the protective cover of all debris and fine material.

For bridge removal work that requires the Contractor's registered engineer to prepare and sign the bridge removal plan, the Contractor's registered engineer shall be present at all times when bridge removal operations are in progress. The Contractor's registered engineer shall inspect the bridge removal operation and report in writing on a daily basis the progress of the operation and the status of the remaining structure. A copy of the daily report shall be available at the site of the work at all times. Should an unplanned event occur or the bridge operation deviate from the approved bridge removal plan, the Contractor's registered engineer shall submit immediately to the Engineer for approval the procedure of operation proposed to correct or remedy the occurrence.

ACCESS OPENING, SOFFIT

Access openings in bridge soffits shall consist of removing portions of existing box girder bridge soffits at the locations and to the dimensions shown on the plans.

A 1-inch deep saw cut shall be made around the perimeter of the soffit areas to be removed.

Bar reinforcing steel shall be removed as shown on the plans. The ends of the remaining bars shall be coated with 2 applications of a zinc-rich primer in the same manner specified for exposed ends of prestressing steel in Section 50-1.05, "Prestressing Steel," of the Standard Specifications.

Within a cell where work is to be performed, existing formwork and miscellaneous concrete that will interfere with the work shall be removed. In addition, when the work is to be done in a cell that adjoins a bent cap, all existing forms and sharp projections in the cell between the hinge and 5 feet past the access opening shall be removed.

All material removed shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

When no longer required, soffit access openings shall be closed as shown on the plans. All materials, including galvanized sheet metal covers, steel hardware, hinges, and corrosion resistant concrete expansion anchorage devices, shall be commercial quality.

Thread locking system shall conform to the provisions in Section 75, "Miscellaneous Metal," of the Standard Specifications.

Unless specified as an option, using deck access openings in lieu of soffit access openings will not be allowed.

Access openings through soffits will be measured and paid for by the unit as access opening, soffit. Openings to be paid for will be determined from actual count of the completed units in place.

The contract unit price paid for access opening, soffit shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the soffit access opening, complete in place, including closing the soffit access opening and removing forms and miscellaneous concrete, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

PREPARE CONCRETE BRIDGE DECK SURFACE

This work includes abrasive blast cleaning the concrete deck surface with steel shot and blowing the deck surface clean.

Steel shot must comply with SSPC-AB3. Recycled steel shot must comply with SSPC-AB2.

Abrasive blast clean the deck surface with steel shot. Remove all laitance, contaminants, and foreign material. Sweep the deck surface. Blow the deck surface clean using high-pressure air.

Coarse aggregate remaining above the removal limit must be firmly embedded in the remaining concrete.

The deck must be dry when abrasive blast cleaning is performed. Removal of unsound concrete under "Remove Unsound Concrete" of these special provisions and any concrete deck or asphaltic concrete removal must be performed before abrasive blast cleaning.

Laitance, surface contaminants, and foreign material must be removed from the concrete deck surface.

If the deck surface becomes contaminated before placing the overlay, abrasive blast clean the contaminated area and sweep the deck clean.

Residue from abrasive blasting must be removed by a vacuum attachment operating concurrently with blasting equipment when abrasive blasting within 10 feet of public traffic.

Dispose of removed materials under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Prepare concrete bridge deck surface will be measured and paid for by the square foot of deck surface prepared.

The contract price paid per square foot for prepare concrete bridge deck surface shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in preparing the concrete bridge deck surface, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

REMOVE CONCRETE

Concrete, concrete curb, concrete gutter, concrete sidewalk and driveway, concrete retaining wall, sound wall, and concrete barrier, where shown on the plans to be removed, shall be removed.

The pay quantities of concrete to be removed will be measured by the cubic yard, measured before and during removal operations.

Removing concrete curb, concrete retaining wall, sound wall, concrete barrier, and concrete sidewalk will be measured by the linear foot, measured along the curb, retaining wall, sound wall, barrier or sidewalk before removal operations.

Concrete removed shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

10-1.41 CLEARING AND DEMOLITION

Clearing and demolition consists of all labor, materials, and equipment necessary and incidental to the demolition, removal, and disposal of miscellaneous items from the worksite as shown on the plans.

Vegetation shall be cleared and grubbed only within the areas shown on the plans. No on-site burning or burial of demolition material is permitted.

Vegetable growth from clearing and grubbing operations may be disposed of in embankments in conformance with the provisions in "Earthwork" of these special provisions.

10-1.42 EARTHWORK

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Where a portion of the existing surfacing is to be removed, the outline of the area to be removed shall be cut on a neat line with a power-driven saw to a minimum depth of 0.17-foot before removing the surfacing. Full compensation for cutting the existing surfacing shall be considered as included in the contract price paid per cubic yard for roadway excavation and no additional compensation will be allowed therefor.

The portion of imported borrow placed within 4 feet of the finished grade shall have a Resistance (R-Value) of not less than 15.

Reinforcement or metal attached to reinforced concrete rubble placed in embankments shall not protrude above the grading plane. Prior to placement within 2 feet below the grading plane of embankments, reinforcement or metal shall be trimmed to no greater than 3/4 inch from the face of reinforced concrete rubble. Full compensation for trimming reinforcement or metal shall be considered as included in the contract prices paid per cubic yard for the types of excavation shown in the Bid Item List, or the contract prices paid for furnishing and placing imported borrow or embankment material, as the case may be, and no additional compensation will be allowed therefor.

Imported borrow shall be mineral material including rock, sand, gravel, or earth. The Contractor shall not use man-made refuse in imported borrow including:

- A. Portland cement concrete
- B. Asphalt concrete
- C. Hot mix asphalt
- D. Material planed from roadway surfaces
- E. Residue from grooving or grinding operations
- F. Metal
- G. Rubber
- H. Mixed debris
- I. Rubble

Full compensation for removing of conduits and encasement will be considered as included in the contract price paid per cubic yard for roadway excavation and no additional compensation will be allowed therefor.

Full compensation for constructing temporary retention basin as shown on the plans will be considered as included in the contract price paid per cubic yard for roadway excavation and no additional compensation will be allowed therefor.

Settlement periods are required for the bridge approach embankments at the bridges listed in the following table.

At the bridges listed in the following table, excavation for the footings, drilling holes for cast-in-place piles, or driving the foundation piles at each location shall not be done until the expiration of the settlement period for the embankment.

Bridge Name or Number	Abutment Number		Surcharge Height (feet)	Settlement Period (days)
Buena Vista-Winona UC	1 & 6		0.0*	30
Burbank Blvd OC	1 & 3		0.0*	30

* At this location, the surcharge embankment shall be constructed by extending the grading plane (GP) in the "Elevation" view of the "Bridge Embankment Surcharge" detail of Standard Plan A62B horizontally to the centerline of abutment.

The duration of the required settlement period at each location will be determined by the Engineer. The estimated duration of the settlement periods are listed in the tables of settlement data. The Engineer may order an increase or decrease in any settlement period. An ordered increase or decrease in any settlement period will result in an increase or decrease in the number of contract working days if the settlement period involved is considered to be the current controlling operation in conformance with the provisions in Section 8-1.06, "Time of Completion," of the Standard Specifications. Adjustments of contract time due to increases or decreases in settlement periods will be made by contract change order.

At the locations and to the limits shown on the plans, material below the bottom of retaining wall footings shall be removed and replaced with Class 2 aggregate base material in conformance with the placing and compacting requirements for structure backfill. The relative compaction shall be not less than 95 percent. Removal of the material will be measured and paid for by the cubic yard as structure excavation (retaining wall) and furnishing, placing, and compacting the replacement material will be measured and paid for by the cubic yard as structure backfill (retaining wall).

At the footings where material is removed and replaced, as described herein, a relative compaction of not less than 95 percent shall be obtained for a minimum depth of 0.5 foot below the bottom of excavation.

If the Contractor elects to use the "Weep Hole and Geocomposite Drain" alternative where permitted on the plans, the geocomposite drain shall conform to the details shown on the plans and the following:

- A. Geocomposite wall drain shall consist of a manufactured core not less than 0.25 inch thick nor more than 2 inches thick with one or both sides covered with a layer of filter fabric that will provide a drainage void. The drain shall produce a flow rate through the drainage void of at least 2.0 gallons per minute per foot of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 5,000 psf.
- B. A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for the geocomposite drain certifying that the drain produces the required flow rate and complies with these special provisions. The Certificate of Compliance shall be accompanied by a flow capability graph for the geocomposite drain showing flow rates for externally applied pressures and hydraulic gradients. The flow capability graph shall be stamped with the verification of an independent testing laboratory.
- C. Filter fabric for geocomposite wall drain shall conform to the provisions in Section 88-1.02, "Filtration," of the Standard Specifications. Filter fabric shall be Class A.
- D. The manufactured core shall be either a preformed grid of embossed plastic, a mat of random shapes of plastic fibers, a drainage net consisting of a uniform pattern of polymeric strands forming 2 sets of continuous flow channels, or a system of plastic pillars and interconnections forming a semirigid mat.
- E. The core material and filter fabric shall be capable of maintaining the drainage void for the entire height of geocomposite drain. Filter fabric shall be integrally bonded to the side of the core material with the drainage void. Core material manufactured from impermeable plastic sheeting having nonconnecting corrugations shall be placed with the corrugations approximately perpendicular to the drainage collection system.
- F. The geocomposite drain shall be installed with the drainage void and the filter fabric facing the embankment. The fabric facing the embankment side shall overlap a minimum of 3 inches at all joints and wrap around the exterior edges a minimum of 3 inches beyond the exterior edge. If additional fabric is needed to provide overlap at joints and wrap-around at edges, the added fabric shall overlap the fabric on the geocomposite drain at least 6 inches and be attached thereto.
- G. Should the fabric on the geocomposite drain be torn or punctured, the damaged section shall be replaced completely or repaired by placing a piece of fabric that is large enough to cover the damaged area and provide a minimum 6-inch overlap.
- H. Plastic pipe shall conform to the provisions for edge drain pipe and edge drain outlets in Section 68-3, "Edge Drains," of the Standard Specifications.
- I. Treated permeable base to be placed around the slotted plastic pipe at the bottom of the geocomposite drain shall be cement treated permeable base conforming to the provisions for cement treated permeable base in Section 29, "Treated Permeable Bases," of the Standard Specifications and these special provisions.
- J. The treated permeable base shall be enclosed with a high density polyethylene sheet or PVC geomembrane, not less than 10 mils thick, that is bonded with a suitable adhesive to the concrete and geocomposite drain. Surfaces to receive the polyethylene sheet shall be cleaned before applying the adhesive. The treated permeable base shall be compacted with a vibrating shoe type compactor.

If structure excavation or structure backfill for bridges is not otherwise designated by type and payment for the structure excavation or structure backfill has not otherwise been provided for in the Standard Specifications or these

special provisions, the structure excavation or structure backfill will be measured and paid for as structure excavation (bridge) or structure backfill (bridge), respectively.

10-1.43 EARTH RETAINING STRUCTURES

Earth retaining structures, consisting of mechanically stabilized embankment, shall conform to the details shown on the plans and these special provisions.

Attention is directed to "Precast Concrete Quality Control" of these special provisions.

At the Contractor's option, one of the following acceptable alternative earth retaining systems may be constructed at Retaining Wall No.1, Retaining Wall No. 2, Retaining Wall No. 3, Retaining Wall No. 4 and Retaining Wall No. 5:

Proprietary Earth Retaining System	Address and Phone Number	Web Site
Reinforced Earth – 5 ft cruciform	The Reinforced Earth Company 1660 Hotel Circle North, Suite 304 San Diego, CA 92108 (619) 688-2400	www.reinforcedearth.com
Reinforced Earth – 5 ft square	The Reinforced Earth Company 1660 Hotel Circle North, Suite 304 San Diego, CA 92108 (619) 688-2400	www.reinforcedearth.com
Retained Earth	The Reinforced Earth Company 1660 Hotel Circle North, Suite 304 San Diego, CA 92108 (619) 688-2400	www.reinforcedearth.com
ARES – 9 by 5 ft	Tensar International Corporation 2500 Northwind Parkway, Suite 500 Alpharetta, GA 30009 (888) 828-5126	www.tensarcorp.com
KeySystem 1	Keystone Retaining Wall Systems 4444 West 78th Street Minneapolis, MN 55435 (952) 897-1040	www.keystonewalls.com

At the Contractor's option, one of the following acceptable alternative earth retaining systems may be constructed at Retaining Wall No. 1565, Retaining Wall No. 1567, Retaining Wall No. 1575, and Retaining Wall No. 1585.

Proprietary Earth Retaining System	Address and Phone Number	Web Site
Welded Wire Wall	Hilfiker Retaining Walls 1902 Hilfiker Lane Eureka, CA 95503-5711 (707) 443-5093 or (800) 762-8962	www.hilfiker.com
Reinforced Earth – 5 ft cruciform	The Reinforced Earth Company 1660 Hotel Circle North, Suite 304 San Diego, CA 92108 (619) 688-2400	www.reinforcedearth.com
Reinforced Earth – 5 ft square	The Reinforced Earth Company 1660 Hotel Circle North, Suite 304 San Diego, CA 92108 (619) 688-2400	www.reinforcedearth.com
Retained Earth	The Reinforced Earth Company 1660 Hotel Circle North, Suite 304 San Diego, CA 92108 (619) 688-2400	www.reinforcedearth.com
Criblock	Retaining Walls Company 1525 Grand Ave. San Marcos, CA 92083 (760) 471-2500	www.rwc.net
Port-O-Wall Precast Concrete Retaining Wall System	Port-O-Wall Systems, LLC 585 Fifth Street West PMB 182 Sonoma, CA 95476 (707) 938-4516	www.port-o-wall.com
ARES – 9 by 5 ft	Tensar International Corporation 2500 Northwind Parkway, Suite 500 Alpharetta, GA 30009 (888) 828-5126	www.tensarcorp.com
Landmark Reinforced Soil Wall System	Anchor Wall Systems, Inc. 5959 Baker Road, Suite 390 Minnetonka, MN 55345-5995 (877) 295-5415	www.anchorwall.com
KeySystem 1	Keystone Retaining Wall Systems 4444 West 78th Street Minneapolis, MN 55435 (952) 897-1040	www.keystonewalls.com
Vendura Segmental Retaining Wall System	Soil Retention Products 2501 State Street Carlsbad, Ca 92008 (800) 346-7995	www.soilretention.com
Mesa Retaining Wall System	Tensar International Corporation 2500 Northwind Parkway, Suite 500 Alpharetta, GA 30009 (888) 828-5126	www.tensarcorp.com

Only one type of earth retaining system shall be used at any one location.

The above list of acceptable alternative earth retaining systems has been selected from the Department's current list of prequalified earth retaining systems and is limited only to those systems determined to have characteristics suitable for this project. Among the alternatives shown, some systems may be proprietary.

The list of prequalified earth retaining systems has been developed from data previously furnished by suppliers or manufacturers of each system. Approval of additional earth retaining systems is contingent on the system meeting the full range of parameters for which prequalification is required. The prequalification requirements are available at:

<http://www.dot.ca.gov/hq/esc/Translab/NewProducts/index.htm>

WORKING DRAWINGS

If the Contractor elects to use a proprietary earth retaining system from the list of acceptable alternative systems, the Contractor shall submit complete working drawings for each installation of the system in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. For initial review, 5 sets of drawings shall be submitted. After review between 6 and 12 sets, as requested by the Engineer, shall be submitted for final approval and use during construction. Working drawings shall be submitted to the Offices of Structure Design, Documents Unit.

Working drawings shall be 11" x 17" in size, and each drawing and calculation sheet shall include the State assigned designations for the contract number, bridge number, full name of the structure as shown on the contract plans, and District-County-Route-Post Mile. The design firm's name, address, and phone number shall be shown on the working drawings. Each sheet shall be numbered in the lower right hand corner and shall contain a blank space in the upper right hand corner for future contract sheet numbers.

The Contractor shall verify the existing ground elevations at the site before preparing the working drawings. The working drawings shall contain all information required for the proper construction of the system at each location including existing ground line at face of wall as verified at the site and any required revisions or additions to drainage systems or other facilities. The working drawings shall include "General Notes" that contain design parameters, material notes, and wall construction procedures and shall be accompanied with calculations. The working drawings and calculations shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California. The Contractor shall allow the Engineer 30 days to review the drawings after a complete set has been received.

Unless otherwise specified, at the completion of each structure for which working drawings were submitted and if the work detailed in these working drawings is permanent, the Contractor shall submit to the Engineer one set of corrected as-built prints 11" x 17" in size and on 20-pound (minimum) bond paper, showing as built conditions. As-built drawings that are common to more than one structure shall be submitted for each structure.

MATERIALS

Earthwork

Excavation and backfill shall conform to the details shown on the plans, the provisions in Section 19, "Earthwork," of the Standard Specifications, and these special provisions.

Structure backfill for earth retaining structures with soil reinforcement shall be free of organic material and substantially free of shale or other soft materials of poor durability. Structure backfill shall not contain slag aggregate or recycled materials such as glass, shredded tires, portland cement concrete rubble, asphaltic concrete rubble, or other unsuitable material as determined by the Engineer.

Structure backfill for earth retaining structures with soil reinforcement shall conform to the following requirements:

Gradation Requirements		
Sieve Size	Percentage Passing	California Test
6"	100	202
3"	78-100	202
No. 4	----	202
No. 30	0-60	202
No. 200	0-15	202

Property Requirements		
Test	Requirement	California Test
Sand Equivalent	12 minimum	217
Plasticity Index	6 maximum	204
Minimum Resistivity	2000 ohm-cm	643
Chlorides	< 250 ppm	422
Sulfates	< 500 ppm	417
pH	5.5 to 10.0	643

If 12 percent or less passes the No. 200 sieve and 50 percent or less passes the No. 4, the Sand Equivalent and Plasticity Index requirements shall not apply.

Permeable material shall be used for the portion of the structure backfill for earth retaining structures with soil reinforcement within the limits shown on the plans. Permeable material shall be Class 1, Type B, conforming to the provisions in Section 68-1.025, "Permeable Material," of the Standard Specifications.

Permeable material for earth retaining structures with metallic soil reinforcement shall conform to the following requirements:

Property Requirements		
Test	Requirement	California Test
Minimum Resistivity	2000 ohm-cm	643
Chlorides	< 250 ppm	422
Sulfates	< 500 ppm	417
pH	5.5 to 10.0	643

Water used for earthwork or dust control within 500 feet of earth retaining structures with metallic soil reinforcement shall conform to the provisions for water in Section 90-2.03, "Water," of the Standard Specifications.

Concrete

Concrete used in precast and cast-in-place reinforced concrete members of earth retaining structures shall conform to the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

The concrete leveling pads for the Mechanically Stabilized Embankment (MSE) system shall conform to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications.

Reinforcement

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

Galvanizing

Soil reinforcement, connecting elements, and other steel components that are in contact with the earth shall be galvanized in conformance with the provisions in Section 75-1.05, "Galvanizing," of the Standard Specifications.

Inspection Elements

If a proprietary alternative system is selected, inspection elements representative of the particular soil reinforcement shall be furnished in the same number and approximate location as shown on the plans for the MSE system.

When metallic soil reinforcement is used, the threaded end of the inspection wire may be formed before or after galvanizing. The end 4 inches of the wire shall be coated with two applications of an approved unthinned commercial quality zinc-rich primer (organic vehicle type). The threaded end of the wire shall be encapsulated with corrosion inhibiting, mastic filled, round vinyl enclosure secured with a nylon tie as shown on the plans. If the threaded end is galvanized after threading, the threads shall be cleaned before painting. There shall be no damage to the unthreaded portion of the galvanized inspection wire.

Drainage System

The drainage system shall conform to the details shown on the plans and these special provisions.

Corrugated steel pipe shall conform to the provisions in Section 66, "Corrugated Metal Pipe," of the Standard Specifications.

Perforated steel pipe underdrains and underdrain outlets and risers shall conform to the provisions in Section 68-1, "Underdrains," of the Standard Specifications.

The class of rock used for rock slope protection at drain pipe outlets shall be No. 3 Backing and shall conform to the provisions in Section 72-2, "Rock Slope Protection," of the Standard Specifications.

Filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," of the Standard Specifications and these special provisions. Filter fabric shall be Class A.

Adhesive for bonding filter fabric to concrete panels shall be commercial grade.

Soil Reinforcement

Soil reinforcement shall conform to the details shown on the contract plans, the approved working drawings, the preapproved proprietary system details, and these special provisions.

Steel wire shall conform to the requirements in ASTM Designation: A 82/A 82M. The welded wire mat shall conform to the requirements in ASTM Designation: A 185/A 185M.

The button on button-head wires shall conform to the provisions in Section 50-1.05, "Prestressing Steel," of the Standard Specifications.

The coupler at the wire mat connection shall be a seamless steel sleeve. The coupler shall be applied over the button-head wires and swaged by means of a hydraulic press. The coupler shall develop the minimum tensile strength of the wire without exceeding a total slip of the wires of 3/16 inch.

Sample button-head wire and coupler connectors shall develop the minimum tensile requirements for steel wire in ASTM Designation: A 82/A 82M without exceeding a total slip of the wires of 3/16 inch when tested in conformance with the provisions for tension testing of round wire samples in ASTM Designation: A 370. An independent testing laboratory shall perform button-head wire and coupler connection testing. Samples shall consist of 2 button-head wires each 24 inches long connected by a swaged coupler.

Prior to the start of wall construction, the Contractor shall furnish test results to the Engineer from tension and slip tests conducted on 6 proposed button-head wire and coupler connections. Failure of any of the proposed button-head wire and coupler connector samples to meet the slip and tensile strength requirements herein shall require the connection be redesigned by the Contractor.

No installation of face panels shall be allowed until the Contractor has successfully completed tension and slip testing for proposed button-head wire and coupler connectors.

During wall construction, the Contractor shall furnish test results to the Engineer from tension and slip testing of 4 samples of production button-head wire and coupler connections for each lot of 500 individual mat wire connections incorporated into the work. Production testing shall consist of testing each of the 4 sample connections for both slip and tensile requirements herein. If 2 or more of the production samples fail to meet slip or tensile test requirements, the entire lot represented by these samples shall be rejected. If one of the production samples fails to meet slip or tensile test requirements, an additional 4 samples shall be tested. Should any of the additional samples fail to meet the slip or tensile requirements, the entire lot represented by these samples shall be rejected.

Splicing of the welded wire mat along its length shall be by mechanical coupler that shall develop the minimum tensile strength of the wire. The mechanical coupler shall be approved by the Engineer.

Miscellaneous

Resin bonded cork for horizontal joints shall conform to the requirements in ASTM Designation: D 1752, Type II, with a compressive load of not less than 100 psi.

Pipe for the pipe pin shall conform to the requirements in ASTM Designation: A 53/A 53M, Standard weight, except the amount of the zinc coating per square foot of actual surface shall average not less than 2.0 ounces and no individual specimen shall be less than 1.8 ounces.

CONSTRUCTION

Earth retaining structures shall be constructed to the lines, grades, and details shown on the plans, and shall conform to these special provisions.

Earthwork

The foundation for the structure shall be graded level for a width equal to the length of soil reinforcement elements plus 12 inches or as shown on the contract plans. The foundation material shall be compacted to a relative compaction of not less than 95 percent. The Engineer shall approve the compacted foundation area prior to commencement of wall construction.

The Contractor shall remove unsuitable material as determined and directed by the Engineer. This work shall be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Structure backfill material shall be placed and compacted simultaneously with the erection of the facing panels. Placement and compaction shall be accomplished without distortion of the soil reinforcement or displacement of facing panels. Structure backfill at the front of the wall shall be completed prior to backfilling more than 15 feet above the bottom of the lowermost face element.

Vertical and horizontal alignment tolerances of panels shall not exceed 3/4 inch when measured along a 10-foot straightedge. The maximum allowable offset in any panel joint shall not exceed 3/4 inch.

Structure backfill for earth retaining structures with soil reinforcement shall be compacted to a relative compaction of not less than 95 percent.

A relative compaction of not less than 95 percent shall be obtained for embankment under earth retaining structures with soil reinforcement within the limits established by inclined planes sloping 1.5:1 (horizontal:vertical) out and down from lines one foot outside the bottom limits of the structure, including permeable material when required.

Soil reinforcement shall be tensioned in the direction perpendicular to the wall face with enough force to remove any slack in the connection or in the soil reinforcement itself. Soil reinforcement shall be secured in place to prevent movement during placement of additional soil reinforcement and structure backfill until the initial lift of structure backfill is compacted.

Geogrid soil reinforcement shall be placed in full-length sections.

Soil reinforcement shall be covered with structure backfill during the same work shift that it is placed.

Placement and compaction of structure backfill shall begin one foot from the back face of wall panels and progress towards the free end of the soil reinforcement. Compaction equipment shall be operated parallel to the wall facing. The remaining width of backfill behind the wall panels shall be placed and compacted after soil reinforcement has been covered to a depth of 6 inches.

Sheepsfoot or grid-type rollers shall not be used for compacting material within the limits of the soil reinforcement. Hand-held or hand-guided compacting equipment shall be used to compact structure backfill material within 3 feet of the facing panels.

Construction equipment shall not be operated directly on the soil reinforcement. A layer of structure backfill material not less than 6 inches in thickness shall be maintained between the soil reinforcement and construction equipment of any type.

Structure backfill material for earth retaining structures with geogrid soil reinforcement shall be placed in lifts not to exceed 6 inches where hand-operated compacting equipment is used and 8 inches where heavy compaction equipment is used.

At each level of the soil reinforcement the structure backfill shall be constructed to a plane 2 inches above the elevation of the soil reinforcement connection and shall start 3 feet from the back of the face panel and extend for at least the remaining length of soil reinforcement. This grading shall be complete before placing the next layer of soil reinforcement.

Permeable material and filter fabric shall be placed along with structure backfill as shown on the plans. Permeable material shall be placed in layers not exceeding 2 feet in thickness. Compaction of the permeable material for the drainage system outside the limits of the soil reinforcement is not required, and equipment shall not be operated directly on the permeable material or filter fabric. If a sloped layer of permeable material is placed to facilitate the work or to satisfy safety considerations, the vertical limits of permeable material shall remain unchanged and the thickness of the layer of permeable material shall be measured normal to the slope.

The Contractor shall grade the reinforced backfill to rapidly drain away from the wall face at the end of each work shift. Berms or ditches shall be provided to direct runoff away from the wall site. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

Filter Fabric

Filter fabric shall be placed at the locations and in conformance with the details shown on the plans and these special provisions.

Immediately prior to placing filter fabric, the subgrade to receive the filter fabric shall conform to the compaction and elevation tolerance specified for the material involved and shall be free of loose or extraneous material and sharp objects that may damage the filter fabric during installation.

Concrete panel surfaces to receive filter fabric shall be dry and thoroughly cleaned of dust and deleterious materials.

Filter fabric shall be handled and placed in conformance with the manufacturer's recommendations.

Filter fabric shall be stretched, aligned, and placed in a wrinkle-free manner.

Adjacent borders of filter fabric shall be stitched or overlapped from 12 inches to 18 inches. The preceding roll shall overlap the following roll in the direction the material is being spread or shall be stitched. When filter fabric is joined by stitching it shall be stitched with yarn of a contrasting color. The size and composition of the yarn shall be as recommended by the filter fabric manufacturer. The stitches shall number 5 to 7 per inch of seam.

If the filter fabric is damaged during installation, it shall be repaired by placing a piece of filter fabric that is large enough to cover the damaged area and that meets the overlap requirement.

During spreading of the permeable material, a minimum of 6 inches of the material shall be maintained between the filter fabric and the Contractor's equipment. Where structure backfill material is to be placed on filter fabric, a minimum of 18 inches of structure backfill material shall be maintained between the filter fabric and the Contractor's equipment. Equipment or vehicles shall not be operated or driven directly on filter fabric.

Concrete

Concrete for the leveling pads shall be placed at least 24 hours prior to erecting face panels.

Exposed surfaces of precast and cast-in-place concrete members shall receive a surface finish conforming to the provisions in Section 51-1.18B, "Class 1 Surface Finish," of the Standard Specifications unless architectural

treatment is specified in section "Architectural Treatment" for surface finish requirements of architecturally treated members in these special provisions.

After placement of an inspection element and placement of backfill to a level at least 2 feet above the inspection element, the void in the face panel shall be dry packed with mortar as shown on the plans. Dry pack shall conform to the provisions in Section 51-1.135, "Mortar," of the Standard Specifications, except that the proportion of cementitious material to sand shall be that required to achieve a 28-day mortar compressive strength of 1000 psi to 1500 psi.

Proprietary Earth Retaining Systems

If the Contractor elects to construct one of the acceptable proprietary alternative earth retaining systems, the structure shall be constructed to the lines and grades shown on the plans. Vertical and horizontal alignment shall be checked at every course throughout the erection process. The construction shall include a drainage system where shown on the plans, and shall conform to the details shown on the approved working drawings, approved proprietary system details, and these special provisions.

The Contractor shall supply a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications stating the supplied material meets the respective index criteria set forth when the proprietary alternative earth retaining system was prequalified by the Department, as measured in accordance with all test methods and standards specified in the Standard Specifications, these special provisions, and the approved working drawings.

A qualified representative of the proprietary earth retaining system manufacturer shall be present during erection and backfill of the first 10 feet of height of the entire length of the wall and shall be available during any remaining installations. The manufacturer's representative shall not be an employee of the Contractor.

Alternative earth retaining structures shall be constructed to accommodate the wall-mounted lighting, the wall mounted drainpipe, and the panels for drainage inlets, as shown on the plans.

The top of wall profile of alternative earth retaining systems shall conform to the profile shown on the plans. The bottom of wall elevations shall be at or below the elevations shown on the plans. The height and length to be used for any system shall be the minimums for that system that will effectively retain the earth behind the structure for the loading conditions and the contours, profile, or slope lines shown on the plans. The length of soil reinforcement for any system shall be not less than that shown on the plans. In addition, if the plans or special provisions indicate limiting parameters for alternative systems, the system shall conform to those parameters.

The top of face panels, assuming no leveling pad settlement, shall be covered by the coping lip or concrete barrier slab lip at a minimum of 7 inches.

The top level of soil reinforcement shall be placed parallel to the top of the concrete panel at a distance below the top of the wall as shown on the plans. The top level of soil reinforcement shall also be (1) placed a minimum of 3 inches below the bottom of the barrier slab lip or the bottom of the concrete gutter behind coping and (2) placed a minimum of 5 inches below the top edge of the concrete panel.

MEASUREMENT AND PAYMENT

Mechanically stabilized embankments will be measured and paid for by the square foot. Regardless of the type of mechanically stabilized embankment actually constructed, the square foot area for payment will be based on the length and vertical height of each section of system shown on the plans that was or would have been constructed. The vertical height of each section will be taken as the difference in elevation on the outer face from the top of footing to the top of wall profile.

The contract price paid per square foot for mechanically stabilized embankment at each location shown on the plans shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the mechanically stabilized embankment and inspection elements, including earthwork, leveling pad, coping, bearing pads, and drainage systems, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for furnishing and testing sample mechanical connectors shall be considered as included in the contract price paid per square foot for mechanically stabilized embankment, and no separate payment will be made therefor.

Full compensation for revisions to the barrier support, drainage system, or other facilities made necessary by the use of an alternative earth retaining system shall be considered as included in the contract price paid per square foot for mechanically stabilized embankment, and no separate payment will be made therefor.

The contract price paid per cubic yard for structural concrete, barrier slab shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the barrier slab, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.44 FILTER MEDIA (SAND BED) (AUSTIN VAULT)

Filter media (sand bed) (austin vault) shall conform to the details shown on the plans and these special provisions. Filter material for use in media filters shall consist of hard, durable, clean sand, and shall be free from organic material, clay balls or other deleterious substances.

SUBMITTALS

At least 5 business days before installing filter media;

- 1. ASTM 6913 test of source material

Once installed a minimum of one ASTM 6913 test shall be performed on media placed at the location determined by the engineer. The media must meet the grading requirements of this specification.

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

- 1. Filter media (sand bed)

Filter media (sand bed) (austin vault) shall conform to the following grading requirements:

Grading Requirements

Sieve Sizes	Percentage Passing
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	45-85
No. 30	15-60
No. 50	3-15
No. 100	0-4
No. 200	0

Standard ASTM 6913	Range
Effective Particle size (Es) = (D ₁₀)	0.0098-0.0197 inch
Uniformity Coefficient Uc = (D ₆₀ /D ₁₀)	< 4

The filter media material shall be washed prior to placement, so that all silt and clay particles are removed. Filter media shall be thoroughly washed, with a minimum of four times the media volume of potable water, prior to placing in the vault. The maximum amount of washing required will depend on the source material used. The wash water shall be disposed of outside of the state right of way. Once the material is placed in the vault, the material shall be washed again until the water discharged from the media filter has a turbidity reading of 200 NTU or less. Wash water above 200 NTU shall become the property of the Contractor and shall be disposed of in conformance with the provisions in section 7-1.1.3, "Disposal of Material Outside of the Highway Right of Way," of the Standard Specifications.

PLACEMENT

Placement of the filter media shall conform to the following requirements:

- A. The filter media shall be placed in a manner that will not damage or cause permanent displacement of the filter fabric.
- B. The filter media shall be spread by methods that will produce a uniform finished surface to the grades shown on the plans.

MEASUREMENT

Filter media will be measured by the cubic yard. The quantity to be paid will be calculated on the basis of the dimensions shown on the plans.

PAYMENT

The contract price paid per cubic yard for filter media (sand bed) (austin vault) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and placing the media, complete in place, including washing material and disposing of the water, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.45 LIGHTWEIGHT FILL (EPS GEOFOAM BLOCK)

GENERAL

Reference

ASTM D 6817- Standard Specification for Rigid, Cellular Polystyrene Geofoam.

Submittals

Submit:

1. A certificate of compliance for EPS Geofoam blocks and Gasoline Resistant Geomembrane (GRG) to the Engineer.
2. Material data sheets and 10-year physical property warranty.
3. Shop drawings for EPS Geofoam blocks to OSD, Documents Unit. Notify Engineer of the submittal. Submit 5 sets of shop drawings for initial review. After review, submit from 6 to 12 sets, as requested, for authorization and use during construction.
4. Summary of the manufacturer's test compliance with specified performance characteristics and physical properties.
5. Manufacturer product certificate showing evidence of Third Party Quality Control.

MATERIALS

Expanded Polystyrene (EPS Geofoam block)

EPS geofoam block material need to meet or exceed the requirements of the ASTM D6817, Type EPS29 Manufacturer's standard size EPS geofoam blocks measuring approximately 2-ft x 4-ft x 8-ft are acceptable.

Prevent mechanical damage to EPS geofoam block during delivery, storage and construction. Protect EPS geofoam block from petroleum products and ultraviolet light exposure.

EPS geofoam block must have the values shown in the following table:

Property	Test	Value
Density, lb/cubic ft min	ASTM C 303	1.5
Density, lb/cubic ft max	ASTM C 303	2.0
Compressive Strength, at 1% deformation, psi min	ASTM D 1621	14.5
Flexural Strength, psi min	ASTM C 203	43.5
Tensile Strength, psi min	ASTM D 1623	20.0
Water Absorption by volume percent max	ASTM C 272	2.0

Gasoline Resistant Geomembrane (GRG)

GRG must be a tri-polymer membrane manufactured from polyvinyl chloride (PVC), ethylene interpolymer alloy and polyurethane, or a comparable polymer combination. GRG must confine spilled liquid hydrocarbons, including gasoline, diesel fuel, kerosene, hydraulic fluid, methanol, ethanol, mineral spirits, and naphtha. GRG must cover and closely conform to 90-degree edges and corners of EPS blocks at ambient temperatures down to 45°F, without applying heat.

GRG must have the values shown in the following table:

Property	Test	Value ¹
Unleaded Gasoline Permeability, ounce per square foot max per 24 hours	ASTM D 814	0.4
Thickness, mils min	ASTM D 751 ²	28
Grab Tensile Strength (1" grip, 4" x 8" sample), pound foot min each direction	ASTM D 751 ²	600
Tensile Strength, psi min	ASTM D 1623	20
Elongation at break, percent min	ASTM D 4632 ²	20
Toughness (Percent elongation by Grab Tensile Strength), pound foot min	N/A	14,000
Puncture Resistance (ball tip), pound foot min	ASTM D 751 ³	800
Cold Crack Resistance (1" mandrel, 4 hours)	ASTM D 2138 ²	Pass at -30°F
Factory Produced Seams, Bonded Width, inches min	ASTM D 751 ⁴	1.25
Factory Produced Seams, Shear Strength, pound foot min	ASTM D 751 ⁴	320
Field Produced Seams, Vapor Tight Seal	ASTM D 5641	Pass
¹ Specified as Minimum or Maximum, not average roll properties. ² Or ASTM test method appropriate for specific polymer. ³ Or FTMS 101C, Method 2065. ⁴ Modified per NSF Standard No. 54.		

CONSTRUCTION

Comply with accepted shop drawings and construction details. Comply with manufacturer's instructions for handling, seaming and placement of materials.

During construction, EPS geofoam block must not be exposed to direct sunlight for more than 12 hours.

Overlap CG material 18-inch beyond any damage.

Do not operate construction equipment directly on GRG or EPS geofoam block.

If soil materials larger than the No. 4 sieve are encountered in the subgrade then the Contractor shall place 0.5 foot of clean sand bedding prior to placing the Geomembrane and the EPS geofoam block.

Prepare the subgrade to receive the GRG and the EPS geofoam block with grading plane not more than 0.05 foot above or below the grade established by the Engineer.

Place lightweight fill (EPS geofoam) block components on finished grade or clean sand bedding in this order:

1. GRG.
2. EPS geofoam block.

Completely encase EPS geofoam block with GRG. Bond GRG field seams under manufacturer's instructions. The field seams of GRG must have a temperature below 165 degree F before GRG can be in contact with the EPS geofoam block.

Completely encase GRG within CG. Overlap each CG seam a minimum of 12-inch in successive direction to prevent infiltration of subgrade materials.

Place roadway structural section following the instructions of the EPS geofoam block manufacturer.

Construct EPS geofoam block to the lines, grades and dimensions shown on the plans. The horizontal surface of each layer of EPS blocks must be level across each layer, and the grade must not vary more than 0.05 foot over a 10-foot horizontal distance.

Fit blocks against adjacent blocks. Maximum distance between adjacent blocks is 0.05-foot.

Any sections of EPS geofoam block must not be less than 0.5-foot thick.

Rotate the long axis of each layer of EPS geofoam block horizontally 90 degrees to adjacent layers. The joints of adjoining EPS geofoam block must be offset.

Secure EPS geofoam block from sliding along horizontal contact.

Timber fasteners must have 16 prongs on opposite sides of the fastener. Prongs must penetrate 1/2-inch into EPS geofoam block layers above and below the horizontal joint. Timber fasteners must be at least 0.75-foot from edges of EPS geofoam block.

Construct glue joints as recommended by the manufacturer. Glue joints must develop a minimum of 12.3 psi shear strength in accordance with ASTM D 732 test procedures.

The finish grade of EPS geofoam block must be no more than 0.05-foot above or below grade established by the Engineer.

Use custom-cut or field-cut blocks for irregular slope areas and roadway subgrade geometrics.

MEASUREMENT AND PAYMENT

The payment quantity of Gasoline Resistant Geomembrane is for square yard based on the dimensions shown. This includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing GRG.

The payment quantity of EPS Geofoam Block is for cubic yard based on the dimensions shown. This includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing EPS Geofoam Block.

10-1.46 SOIL CONTAINING PETROLEUM HYDROCARBONS AND CHEMICALS OF CONCERN

This work consists of handling soil impacted by total petroleum hydrocarbon (TPH) and other chemicals of concern in conformance with the Standard Specifications and these special provisions.

Non-hazardous levels of TPH and other chemicals of concern have been detected at various depths, as shown on plans.

Attention is directed to "Supplemental Project Information" of these special provisions.

Soils underlying parcels 79660-1 and 79660-2 (located south of the existing freeway between Sta 1559+00 and Sta 1573+00) contain TPH and other chemicals of concern, including trichloroethane (TCE) and perchloroethane (PCE). These soils have been found to be suitable for reuse pursuant to approval of a DWR permit from Regional Water Quality Control Board. Secure the required permits and provide copies to the Engineer prior to reuse of these soils. These soils can be reused in roadway structural section or in embankment following conditions set in the approved permits.

Soils underlying parcels 80239-1 (located south of the existing freeway between Sta 1587+00 and Sta 1606+00) and 79779-1 (located south of the existing freeway between Sta 1609+00 and Sta 1618+00) are impacted with total petroleum hydrocarbon (TPH) and aerially deposited lead (ADL). Excavated soils from these areas must be disposed of at a Class I landfill in the same manner specified in Section 19, "Earthwork," of the Standard Specifications.

Handling soils containing petroleum hydrocarbon and other chemicals of concern must be in conformance with applicable rules and regulations including all agencies having jurisdiction, but not limited to the following:

- A. California Environmental Protection Agency,
- B. California Department of Health Services,
- C. California Division of Occupational Safety and Health Administration,
- D. Regional Water Quality Control Board, Region 4, Los Angeles,
- E. California Air Resources Control Board, and
- F. South Coast Air Quality Management District

HEALTH AND SAFETY PLAN

You must prepare a project specific Health and Safety Plan (HASP) to prevent or minimize worker exposure to petroleum hydrocarbon and other chemicals of concern while handling soil containing these materials.

The HASP must contain the elements listed in Title 8, California Code of Regulations. Before submission to the engineer, the HASP must be approved by an Industrial Hygienist certified by the American Board of Industrial Hygiene. The HASP must be submitted to the engineer at least 7 days prior to beginning of work in the above-mentioned areas .

Prior to performing work in those areas, personnel who have no prior training, including State personnel, must complete a safety training program provided by you that meets the requirements of Title 8, California Code of Regulations.

Personal Protective Equipment and washing facilities and other related items required by your Health and Safety Plan must be supplied to the State personnel by you. The number of the State personnel will be 4.

SOIL HANDLING

Handling of soils containing petroleum hydrocarbon and other chemicals of concern must result in no visible dust. You must have dust control available at all times while handling soil.

MEASUREMENT AND PAYMENT

Quantities of excavated soil suitable for reuse will be measured and paid per cubic yard for roadway excavation (petroleum hydrocarbon) and structure excavation (petroleum hydrocarbon) that are shown on the plans and specified in the manner for roadway excavation and structure excavation in Section 19, "Earthwork," of the Standard Specifications and no additional compensation will be allowed therefor.

Quantities of roadway excavation impacted by petroleum hydrocarbon and ADL to be disposed of in a Class I landfill shall be measured and paid by the cubic yard for roadway excavation (petroleum hydrocarbon and aerially deposited lead) and structure excavation (petroleum hydrocarbon and aerially deposited lead) in the same manner specified for roadway excavation and structure excavation in Section 19, "Earthwork" of the Standard Specifications.

Full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work to prepare the HASP and associated work; including supplying the personal protective equipment to the State personnel, will be considered as included in the contract price paid per cubic yard for roadway excavation (petroleum hydrocarbon) and structure excavation (petroleum hydrocarbon), as well as roadway excavation (petroleum hydrocarbon and aerially deposited lead) and structure excavation (petroleum hydrocarbon and aerially deposited lead) and no additional compensation will be allowed therefor.

10-1.47 SOIL CONTAINING VOLATILE ORGANIC COMPOUNDS, PETROLEUM HYDROCARBONS AND METALS

This work consists of handling soil impacted by volatile organic compounds (VOCs), petroleum hydrocarbons, and metals within the proposed City-owned Empire Avenue footprint in conformance with the Standard Specifications and these special provisions.

SITE CONDITIONS

Soil containing VOCs, gasoline/diesel/oil based petroleum hydrocarbons and toxic metals (hexavalent chromium and others) is present at hazardous levels within the proposed Empire Ave. footprint, outside the State right of way and railroad right-of-way. Contaminated soil encountered during construction must be disposed of at an appropriately permitted facilities. Perform additional sampling and testing of soil according to the requirements of the disposal/receiving facility. Obtain signatures required on the hazardous waste manifest from the owner and City of Burbank.

HEALTH AND SAFETY PLAN

You must prepare a project specific Health and Safety Plan (HASP) to prevent or minimize workers exposure to VOCs, lead, hexavalent chromium, and other chemicals while handling soil containing these materials.

The HASP must contain the elements listed in Title 8, California Code of Regulations. Before submission to the engineer, the HASP must be approved by an Industrial Hygienist certified by the American Board of Industrial Hygiene. The HASP must be submitted to the Engineer at least 7 days prior to beginning of work for the construction of Empire Ave.

SOIL MITIGATION PLAN

Prepare and submit a Soil Mitigation Plan (SMP) for the excavation, dust control, transportation and disposal of material containing VOCs, petroleum hydrocarbon compounds, and metals. The SMP must be approved by the Engineer and the Air Quality Management District at least 14 days prior to the start of work.

QUALITY CONTROL AND ASSURANCE

Handle soils containing VOCs, petroleum hydrocarbon compounds, and metals in conformance with applicable rules and regulations including all agencies having jurisdiction, but not limited to the following:

- A. California Environmental Protection Agency,
- B. California Department of Public Health,

- C. California Division of Occupational Safety and Health Administration,
- D. Regional Water Quality Control Board, Region 4, Los Angeles,
- E. State Air Resources Control Board, and
- F. South Coast Air Quality Management District (SCAQMD)

Follow SCAQMD Rule 1166 during excavation and handling of soils containing VOCs, petroleum hydrocarbon compounds, and metals. Obtain required permits and SMP to mitigate VOC emissions to SCAQMD prior to start of excavation.

MATERIALS

Not used.

CONSTRUCTION

Prior to performing work in those areas, personnel who have no prior training, including the State personnel, must complete a safety training program provided by you that meets the requirements of Title 8, California Code of Regulations.

Personal protective equipment and washing facilities and other related items required by your Health and Safety Plan must be supplied to the State personnel by you. The number of the State personnel will be 4.

MEASUREMENT AND PAYMENT

Measurement and payment of quantities of soil contaminated with VOCs, petroleum hydrocarbon and metals shall be measured and paid per cubic yard for roadway excavation (volatile organic compounds, petroleum hydrocarbons and metals) and structure excavation (volatile organic compounds, petroleum hydrocarbons and metals) in the same manner for roadway excavation specified in Section 19, "Earthwork," of the Standard Specifications and no additional compensation will be allowed therefor.

The contract price paid per cubic yard for roadway excavation (volatile organic compounds, petroleum hydrocarbons and metals) and structure excavation (volatile organic compounds, petroleum hydrocarbons and metals) includes full compensation for furnishing all labor, materials, tools, equipments and incidentals, and for doing all the work involved as shown on the plans, and as specified in these special provisions including, but not limited to, preparation of the HASP and the Soil Mitigation Plan, supplying the personal protective equipments to the State personnel, permitting excavation, transportation, disposal and other necessary work and no additional compensation will be allowed therefor.

10-1.48 SOIL CONTAINING PETROLEUM HYDROCARBONS AND METAL CONTAMINATION

This work consists of handling soil impacted by petroleum hydrocarbon compounds and metals, such as lead, within the SCRRA railroad right-of-way in conformance with the Standard Specifications and these special provisions.

SITE CONDITIONS

Soil containing hazardous levels of gasoline/diesel/oil based petroleum hydrocarbons and metals is present within the railroad right-of-way at shallow depths. Contaminated soil must be disposed of at an appropriately permitted landfill. Perform necessary sampling and testing of soil according to the requirements of the disposal facility. Obtain signatures required on the required hazardous waste manifest from SCRRA.

HEALTH AND SAFETY PLAN

Prepare a project specific Health and Safety Plan (HASP) to prevent or minimize workers exposure to petroleum hydrocarbon compounds and metals while handling soil containing these materials.

The HASP must contain the elements listed in Title 8, California Code of Regulations. Before submission to the engineer, the HASP must be approved by an Industrial Hygienist certified by the American Board of Industrial Hygiene. The HASP must be submitted to the Engineer at least 7 days prior to beginning of work in the above mentioned areas.

SOIL MITIGATION PLAN

Prepare and submit a Soil Mitigation Plan (SMP) for the excavation, dust control, transportation and disposal of material containing petroleum hydrocarbon compounds and metals. The SMP must be approved by the Engineer and the Air Quality Management District 14 days prior to the start of work.

QUALITY CONTROL AND ASSURANCE

Handling soils containing petroleum hydrocarbon compounds and metals will be in conformance with applicable rules and regulations including all agencies having jurisdiction, but not limited to the following:

- A. California Environmental Protection Agency,
- B. California Department of Public Health,
- C. California Division of Occupational Safety and Health Administration,
- D. Regional Water Quality Control Board, Region 4, Los Angeles,
- E. State Air Resources Control Board, and
- F. South Coast Air Quality Management District (SCAQMD)

Follow SCAQMD Rule 1166 during excavation and handling of soils containing petroleum hydrocarbon compounds and metals. Obtain required permits and provide the SMP to mitigate emissions of petroleum hydrocarbon compounds and metals to the SCAQMD prior to start of excavation.

MATERIALS

Not used.

CONSTRUCTION

Attention is directed to the section "Soil Containing Volatile Organic Compound, Petroleum Hydrocarbon, and Metal," of these special provisions.

MEASUREMENT AND PAYMENT

Measurement and payment of quantities of soil containing petroleum hydrocarbon compounds and metals excavated from railroad corridor shall be measured and paid per cubic yard for trackbed excavation (petroleum hydrocarbon compounds and metals) in the same manner for roadway excavation specified in Section 19, "Earthwork," of the Standard Specifications and no additional compensation will be allowed therefor.

Full compensation for furnishing all labor, materials, tools, equipments and incidentals, and for doing all the work involved as shown on the plans, and as specified in these special provisions including, but not limited to, preparation of the HASP and the Soil Mitigation Plan, supplying the personal protective equipments to the State personnel, permitting and other necessary work is included in the contract price paid per cubic yard for trackbed excavation (petroleum hydrocarbon compounds and metals) and no additional compensation will be allowed therefor.

10-1.49 MATERIAL CONTAINING HAZARDOUS WASTE CONCENTRATIONS OF AERIALY DEPOSITED LEAD

Earthwork involving material containing aerially deposited lead shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Attention is directed to "Aerially Deposited Lead" of these special provisions.

Type Y-1 material contains aerially deposited lead in average concentrations (using the 90 percent Upper Confidence Limit) of 1.5 mg/L or less extractable lead (based on a modified waste extraction test using deionized water as the extractant) and 1411 mg/kg or less total lead. Type Y-1 material exists as shown on the plans. This material shall be placed as shown on the plans, unless otherwise directed by the Engineer, and covered with a minimum 1-foot layer of nonhazardous soil or the pavement structural section. This material is hazardous waste regulated by the State of California that may be reused as permitted under the Variance of the California Department of Toxic Substances Control (DTSC) provided that the lead contaminated soil is placed a minimum of 5 feet above the maximum water table elevation and covered with at least one foot of nonhazardous soil. Temporary surplus material may be generated on this project due to the requirements of stage construction. Temporary surplus material shall not be transported outside the State right of way. In order to conform to the requirements of these provisions it may be necessary to stockpile material for subsequent stages, to construct some embankments out of stage, or to handle temporary surplus material more than once.

Type Y-2 material contains aerially deposited lead in average concentrations (using the 90 percent Upper Confidence Limit) that exceed either 1.5 mg/L extractable lead (based on a modified waste extraction test using deionized water as the extractant) or 1411 mg/kg total lead but are less than 150 mg/L extractable lead (based on a modified waste extraction test using deionized water as the extractant) and less than 3397 mg/kg of total lead. Type Y-2 material exists as shown on the plans. This material shall be placed as shown on the plans, unless otherwise directed by the Engineer, and covered with the pavement structural section. This material is hazardous waste regulated by the State of California that may be reused as permitted under the Variance of DTSC provided that the

lead contaminated soil is placed a minimum of 5 feet above the maximum water table elevation and protected from infiltration by a pavement structure which will be maintained by the Department. Temporary surplus material may be generated on this project due to the requirements of stage construction. Temporary surplus material shall not be transported outside the State right of way. In order to conform to the requirements of these provisions, it may be necessary to stockpile material for subsequent stages, to construct some embankments out of stage, or to handle temporary surplus material more than once.

Type Z-3 material contains aurally deposited lead in average concentrations (using the 95 percent Upper Confidence Limit) greater than 5.0 mg/L soluble lead, as tested using the Toxicity Characteristic Leaching Procedure. Type Z-3 material exists as shown on the plans. This material is Federally regulated hazardous waste and shall be transported to and disposed of at a Class I Disposal Site. Material excavated from these areas shall be transported by a hazardous waste transporter registered with the DTSC using the required procedures for creating a manifest for the material. The transporter of the hazardous material must have a current DTSC registration certificate and be in compliance with the CHP BIT Program.

LEAD COMPLIANCE PLAN

Submit a lead compliance plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

The Lead Compliance Plan shall include perimeter air monitoring incorporating upwind and downwind locations as shown on the plans or as approved by the Engineer. Monitoring shall be by personal air samplers using National Institute of Safety and Health Method 7082. Sampling shall achieve a detection limit of 0.05 $\mu\text{g}/\text{m}^3$ of air per day. Daily monitoring shall take place while the Contractor clears and grubs and performs earthwork operations. A single representative daily sample shall be analyzed for lead. Results shall be analyzed and provided to the Engineer within 24 hours. Average lead concentrations shall not exceed 1.5 $\mu\text{g}/\text{m}^3$ of air per day and 0.15 $\mu\text{g}/\text{m}^3$ per day on a rolling 90-day basis. Average daily concentrations shall be calculated based on monitoring to date, and projection based on those monitoring trends for the next 90 days or to the end of work subject to the Lead Compliance Plan if less than the specified averaging period. If concentrations exceed these levels the Contractor shall stop work and modify the work to prevent release of lead. Monitoring shall be done under the direction of, and the data shall be reviewed by and signed by a Certified Industrial Hygienist.

EXCAVATION AND TRANSPORTATION PLAN

Within 15 days after approval of the contract, the Contractor shall submit 3 copies of an Excavation and Transportation Plan to the Engineer. The Engineer will have 7 days to review the plan. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the plan within 7 days of receipt of the Engineer's comments. The Engineer will have 7 days to review the revisions. Upon the Engineer's approval of the plan, 3 additional copies incorporating the required changes shall be submitted to the Engineer. Minor changes to or clarifications of the initial submittal may be made and attached as amendments to the Excavation and Transportation Plan. In order to allow construction to proceed, the Engineer may conditionally approve the plan while minor revisions or amendments are being completed.

The Contractor shall prepare the written, project specific Excavation and Transportation Plan establishing the procedures the Contractor will use to comply with requirements for excavating, stockpiling, transporting, and placing (or disposing) of material containing aurally deposited lead. The plan shall conform to the regulations of the DTSC and Cal-OSHA. The sampling and analysis portions of the Excavation and Transportation Plan shall meet the requirements for the design and development of the sampling plan, statistical analysis, and reporting of test results contained in USEPA, SW 846, "Test Methods for Evaluating Solid Waste," Volume II: Field Manual Physical/Chemical, Chapter Nine, Section 9.1. The plan shall contain, but not be limited to the following elements:

- A. Excavation schedule (by location and date),
- B. Temporary locations of stockpiled material,
- C. Sampling and analysis plans for areas after removal of a stockpile,
 - 1. Location and number of samples,
 - 2. Analytical laboratory,
- D. Survey methods for Type Y-1 or Y-2 material burial locations,
- E. Dust control measures,
- F. Air monitoring,
 - 1. Location and type of equipment,
 - 2. Sampling frequency,

3. Analytical laboratory,
- G. Transportation equipment and routes,
- H. Method for preventing spills and tracking material onto public roads,
- I. Truck waiting and staging areas,
- J. Site for disposal of hazardous waste,
- K. Example of Bill of Lading to be carried by trucks transporting Type Y-1 or Y-2, material. The Bill of Lading shall contain: US DOT description including shipping name, hazard class, and ID number; handling codes; quantity of material; and volume of material. Copies of the bills of lading shall be provided to the Engineer upon placement of Type Y-1 or Y-2 material in its final location. Trucks carrying Type Y-1 or Y-2 material shall not leave the highway right of way.
- L. Spill Contingency Plan for material containing aurally deposited lead.

DUST CONTROL

Excavation, transportation, placement, and handling of material containing aurally deposited lead shall result in no visible dust migration. The Contractor shall have a water truck or tank on the job site at all times while clearing and grubbing and performing earthwork operations in work areas containing aurally deposited lead. Apply water to prevent visible dust.

STOCKPILING

Stockpiles of material containing aurally deposited lead shall not be placed where affected by surface run-on or run-off. Stockpiles shall be covered with plastic sheeting 13 mils minimum thickness or one foot of nonhazardous material. Stockpiles shall not be placed in environmentally sensitive areas. Stockpiled material shall not enter storm drains, inlets, or waters of the State.

SURVEYING TYPE Y-1 OR Y-2 MATERIAL BURIAL LOCATIONS

Survey the location of the bottom and top perimeters of each area where you bury Type Y-1 or Y-2 material (burial locations). The survey must be performed by or under the direction of either:

- (1) A land surveyor licensed under Chapter 15 of the Business and Professions Code (commencing with Section 8700), or
- (2) A civil engineer licensed prior to January 1, 1982 under Chapter 7 of the Business and Professions Code (commencing with Section 6700).

Survey ten points to determine each burial location horizontally and vertically within the specified accuracies and to create closed polygons of the perimeters of the bottom and top of the burial location. If ten points are not sufficient to define the polygon add additional points until the polygon is defined. Establish the position of the bottom and top perimeters before placing subsequent layers of material that obstruct the location.

Report each burial location in California State Plane Coordinates in US Survey feet within the appropriate zone of the California Coordinate System of 1983 (CCS83) and in latitude and longitude. Horizontal positions shall be referenced to CCS83 (epoch 2007.00 or later NGS or CSRC published epoch) to an accuracy of 3 feet horizontally. The elevation of points identifying the burial location shall locate the bottom and top of Type Y-1 or Y-2 material to an accuracy of 1 foot vertically. Elevations of the bottom and top of Type Y-1 or Y-2 material shall be referenced to North American Vertical Datum of 1988 (NAVD88). Report accuracy of spatial data in US Survey feet under FGDC-STD-007.1-1998.

Within five business days of completing placement of Type Y-1 or Y-2 material at a burial location, submit a report for that burial location, including form CEM 1901 and electronic geospatial vector data shapefiles of the top and bottom perimeters of the burial location to the Engineer and to the following email address:

ADL@dot.ca.gov

The Engineer will notify you of acceptance or rejection of the burial location report within five business days of receipt. If the report is rejected, you have five business days to submit a corrected report.

MATERIAL TRANSPORTATION

Prior to traveling on public roads, loose and extraneous material shall be removed from surfaces outside the cargo areas of the transporting vehicles and the cargo shall be covered with tarpaulins or other cover, as outlined in

the approved Excavation and Transportation Plan. The Contractor shall be responsible for costs due to spillage of material containing lead during transport.

The Department will not consider the Contractor a generator of the hazardous material, and the Contractor will not be obligated for further cleanup, removal, or remedial action for such material handled or disposed of in conformance with the requirements specified in these special provisions and the appropriate State and Federal laws and regulations and county and municipal ordinances and regulations regarding hazardous waste.

DISPOSAL

Surplus material for which the lead content is not known shall be analyzed for aurally deposited lead by the Contractor prior to removing the material from within the project limits. The Contractor shall submit a sampling and analysis plan and the name of the analytical laboratory to the Engineer at least 15 days prior to beginning sampling or analysis. The Contractor shall use a laboratory certified by the California Department of Health Services. Sampling shall be at a minimum rate of one sample for each 200 cubic yards of surplus material and tested for lead using EPA Method 6010 or 7000 series.

Materials containing aurally deposited lead shall be disposed of within California. The disposal site shall be operating under a permit issued by the appropriate California Environmental Protection Agency board or department.

The Engineer will obtain the Environmental Protection Agency Generator Identification Number for hazardous waste disposal. The Engineer will sign all hazardous waste manifests. The Contractor shall notify the Engineer 5 business days before the manifests are to be signed.

Sampling, analyzing, transporting, and disposing of material containing aurally deposited lead excavated outside the pay limits of excavation will be at the Contractor's expense.

MEASUREMENT AND PAYMENT

Quantities of roadway excavation (aurally deposited lead) and structure excavation (aurally deposited lead), of the types shown in the Bid Item List, will be measured and paid for in the same manner specified for roadway excavation and structure excavation, respectively, in Section 19, "Earthwork," of the Standard Specifications.

Full compensation for preparing an approved Excavation and Transportation Plan, transporting material containing aurally deposited lead reused in the work from location to location, and transporting and disposing of material containing aurally deposited lead shall be considered as included in the contract prices paid per cubic yard for the items of roadway excavation (aurally deposited lead) and structure excavation (aurally deposited lead) of the types involved, and no additional compensation will be allowed therefor.

No payment for stockpiling of material containing aurally deposited lead will be made, unless the stockpiling is ordered by the Engineer. No payment for sampling and analysis will be made unless ordered by the Engineer. The Contractor is responsible for all additional sampling and analysis costs required by the receiving landfill.

The contract lump sum price paid for ADL Burial Location Report includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in collecting and reporting the data as specified in these special provisions, and as directed by the Engineer.

10-1.50 TRENCHING, BACKFILLING AND COMPACTING

GENERAL

Summary

This work consists of testing and performance of trench excavation, backfilling and compacting only for pumping station construction in conformance with these special provisions.

Submittals

Shop drawings shall be submitted showing excavation and shoring, bracing, or sloping for worker protection as specified herein.

Six copies of a report from a testing laboratory shall be submitted verifying that backfill material conforms to the specified gradations or characteristics for pea gravel, granular material, imported sand, rock refill for foundation stabilization, and water.

Definition of Zone

The pavement zone shall include the HMA and aggregate base pavement section placed over the street zone. This zone is often referred to as the "structural section" of the street or highway.

The trench zone shall include the portion of the trench from the top of the pipe zone to the bottom of the pavement zone in paved areas or to the existing surface in unpaved areas.

The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level 12 inches above the top of the pipe. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level above the top of the highest or topmost pipe. This zone is also part of the "pipe bedding zone" and as such it shall be filled with bedding material identical to that which is placed in the pipe base.

The pipe base shall be defined as a layer of material immediately below the pipe zone and extending over the full trench width. This is also part of the "pipe bedding zone".

The pipe bedding zone shall include the zones defined as the "pipe base" and the "pipe zone." It shall include the full width of the trench from the bottom of the trench to a point 12 inches above the top of the pipe. Unless specified otherwise the pipe bedding zone shall be from 6 inches under the pipe to 12 inches over the pipe.

Testing for Compaction

The density of soil shall be determined in place by the sand cone method, ASTM D 1556, or by the nuclear method, ASTM D 2922 or D 3017. The laboratory moisture-density relations of soils shall be determined per ASTM D 1557. The relative density of cohesionless materials shall be determined by ASTM D 4253 and D 4254. Backfill materials shall be sampled per ASTM D 75. Relative compaction shall be expressed as the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density. Compaction shall be deemed to comply with the specifications when none of the tests falls below the specified relative compaction. When tests are conducted, the Contractor shall notify the Engineer 24-hours in advance of when backfill lifts are ready for testing, and shall pay the costs of retesting of work not conforming to the specifications. Unless noted otherwise, compaction tests shall be performed at random depths and at 200-foot intervals, and as directed by the Engineer.

The presence of marginal materials, poor soil conditions or a prevalence of failed test results will be cause for increasing the frequency and intervals of required testing.

Safety

All excavations shall be performed, protected, and supported as required for safety and conforming to the operation rules, orders, and regulations prescribed by the Division of Industrial Safety of the State of California.

Barriers shall be placed at each end of all excavations and locations necessary along excavations to warn pedestrians and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until excavation is entirely refilled.

No trench or excavation shall remain open during non working hours. The trench or excavation shall be covered with steel plates, spiked in place, or secured with temporary HMA pavement around the edges, or backfilled.

The Contractor shall notify the Engineer of all work-related accidents which may occur to persons or property at or near the project site, and shall provide the Engineer with a copy of all accident reports. All accident reports shall be signed by the Contractor or its authorized representative and submitted to the Engineer's authorized representative within 24 hours of the accident's occurrence.

MATERIALS

Pavement Zone Materials

Pavement zone materials shall be as specified in the Standard Specifications.

Native or Imported Backfill for Trench Zone

Native or imported backfill shall be excavated, fine-grained non-organic materials free from peat, roots, debris, and rocks larger than 3 inches, and which can be compacted to the specified relative compaction.

Backfill Material for Pipe Bedding Zone

Ductile Iron Pipe: Unless otherwise specified or shown on the plans, the pipe bedding zone backfill material shall be imported sand of a gradation and composition as specified herein.

Reinforced concrete pipe: Unless otherwise specified or shown on the plans, pipe base and pipe zone backfill shall be 1-inch crushed aggregate base rock.

Imported Sand--Pipe Zone and Pipe Base

Imported sand used in the pipe bedding zone shall conform to the Greenbook Standard Specifications for Public Works Construction, Section 200-1.5.1 and shall meet the following gradation:

Sieve Size	Percent Passing by Weight
3/8 - inch	100
No. 4	75 – 100
No. 30	12 – 50
No. 100	5 – 20
No. 200	0 – 11

Minimum sand equivalent shall be 30 for natural imported material and shall be 40 for screened recycled materials per ASTM D 2419.

Crushed Rock--Pipe Zone and Pipe Base

Crushed rock shall be crushed aggregate base material and shall conform to the Greenbook Standard Specifications for Public Works Construction, Section 200-1.2 and shall meet the following gradation:

Designated Material Size Percent Passing by Weight				
Sieve Sizes	1-1/2-inch	1-inch	3/4-inch	3/8-inch
2-inches	100	---	---	---
1-1/2-inches	90-100	100	---	---
1-inch	20-55	90-100	100	---
3/4-inch	0-15	30-60	90-100	---
1/2-inch	---	0-20	30-60	100
3/8-inch	0-5	---	0-20	90-100
No. 4	---	0-5	0-5	30-60
No. 8	---	---	---	0-10

Crushed aggregate base materials used for pipe bedding for reinforced concrete pipe shall be 1 - inch unless otherwise called for by the project plans and specifications.

Sand-Cement Slurry

Sand-cement slurry shall consist of one sack (94 pounds) of Portland cement per cubic yard of sand and sufficient moisture for workability.

Water for Compaction

Water used in compaction shall have a maximum chloride concentration of 500 mg/l, a maximum sulfate concentration of 500 mg/l, and shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali, or organic materials injurious to the pipe coatings.

CONSTRUCTION

Compaction Requirements

Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

1. Pipe base and pipe zone: 90% relative compaction.
2. Backfill in trench zone not beneath paving: 90% relative compaction.
3. Backfill in trench zone in paved areas: 90% relative compaction.
4. Backfill in street zone in paved areas: 95% relative compaction.
5. Rock refill material for foundation stabilization: 90% relative density.
6. Rock refill for over excavation: 90% relative density.

All imported or native materials shall be tested before the start of compaction operations to determine the moisture density relationship for materials with cohesive components, and the maximum density for cohesionless materials. Variations in imported or native earth materials may require a number of base curves of the moisture-density relationship.

Unless noted otherwise, compaction tests shall be performed at random depths and at 200-foot intervals, and as directed by the Engineer.

Material Replacement

Trenching and backfilling material, which does not meet the specifications, shall be removed and replaced at the Contractor's own expense.

Sheeting, Shoring and Bracing of Trenches

Trenches shall have sheeting, shoring and bracing conforming to CAL/OSHA requirements. Lateral pressures for design of trench sheeting, shoring, and bracing shall be based on type of soil exposed in the trench, groundwater conditions, surcharge loads adjacent to the trench, and type of shoring that will be used in the trench.

Trench Widths

Unless shown otherwise on the plans, trench widths in the pipe zone shall be equal to the pipe outside diameter plus 6 inches minimum and 8 inches maximum on each side of the pipe.

Excavation and trenching shall be true to line so that a clear space is provided in the pipe zone on each side of the largest outside diameter of the pipe. The largest outside diameter shall be the outside diameter of the bell on bell and spigot pipe.

Where the trench width in the pipe zone, is wider than the maximum set forth above, the trench area around the pipe shall be backfilled as directed by the Engineer.

Grade

Trenches shall be excavated to the lines and grades shown on the plans with allowance for the thickness of the pipe and for pipe base. If the trench is excavated below the required grade, the portion of the trench excavated below the grade shall be refilled with refill material at the Contractor's own expense. Hard spots that prevent a uniform thickness of pipe base shall be removed. Before laying pipe sections, the grade shall be checked and any irregularities corrected. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point.

Pipe Base Thickness

Thickness of the pipe base shall be as shown on the drawings or as otherwise described in the specifications for the particular type of pipe installed, but the thickness must not be less than 6 inches.

Dewatering

The Contractor shall notify the Engineer 48 hours prior to commencement of dewatering.

Storage of Excavated Material

During trench excavation, excavated material shall be stored only within the working area. Roadways or streets shall not be obstructed. The safe loading of trenches with excavated material shall conform to federal, state, and local codes.

Foundation Stabilization

After the required excavation has been completed, the Engineer shall inspect the exposed trench subgrade to determine the need for any additional excavation. It is the intent that additional excavation shall be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipe base and to the depth required. The presence of unacceptable material may require excavating a wider trench. The width and depth of known areas to be overexcavated shall be shown on the drawings. The over excavated portion of the trench shall be backfilled to the subgrade of the pipe base with refill material for foundation stabilization. Foundation stabilization material shall be placed over the full width of the excavation and compacted in layers not exceeding 6-inches in depth, to the required grade.

Length of Open Trench

The length of open trench shall be limited to 600 feet in advance of pipe laying or length of pipe installed in one working day. Backfilling and temporary or first layer paving shall be completed so that not more than 500 feet of trench is open in the rear of pipe laying. Sidewalks, driveways and other traveled ways shall be backfilled or adequately bridged to provide safe access and egress at the completion of each day's work.

Trench Backfilling and Compaction

Trench backfill shall conform to requirements of the detailed piping specification for the particular type of pipe and following:

1. The specified thickness of pipe base material shall be placed over the full width of trench. The top of the pipe base shall be graded ahead of the pipe laying to provide firm, uniform support along the full length of pipe.
2. Bell holes shall be excavated at each joint to permit proper assembly and inspection of the entire joint.
3. After the pipe has been bedded, pipe zone material shall be placed simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Material shall be carefully placed around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Particular care shall be taken in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling. Material placed within the pipe zone shall be compacted by hand tamping only.
4. Backfill material shall be carefully deposited onto the backfill previously placed in the pipe zone. Free fall of the material shall not be permitted until at least 2 feet of cover is provided over the top of the pipe. Sharp, heavy pieces of material shall not be dropped directly onto the pipe or the tamped material around the pipe.
5. Trench backfill shall be compacted to the specified relative compaction. Compaction shall be performed by using mechanical compaction or hand tamping equipment. Unless specified otherwise, consolidation by jetting or flooding shall not be permitted. High impact hammer-type equipment shall not be used except where the pipe manufacturer warrants in writing that such use will not damage the pipe.
6. Axle-driven or tractor-drawn compaction equipment shall not be used within 5 feet of walls and structures.
7. Street zone backfill shall be done in accordance with the requirements in the Special Provisions in the City's encroachment permit. The Contractor shall procure the encroachment permit from the City of Burbank at no cost to the State.

Import or Export of Backfill Material

Excess excavated soil material shall be removed and disposed of off the project site at the Contractor's own expense. Excess soil material shall be disposed of in accordance with local regulations.

Any additional backfill material necessary to return all grades to plus or minus 0.2 foot from the grade encountered at the beginning of construction or as shown on the contract drawings shall be imported, placed, and compacted at the Contractor's own expense.

Moisture Content of Backfill Material

During the compacting operations, optimum practicable moisture content required for compaction purposes shall be maintained in each lift of the backfill material. Moisture content throughout the lift shall be maintained at a uniform level. If placement is discontinued and proper moisture content not maintained, the upper layer shall be brought back to proper moisture content by sprinkling, cultivating and rolling the backfill material before placing new material. At the time of compaction, the water content of the material shall be at optimum water content plus or minus two percentage points. Material which contains excessive moisture shall not be worked to obtain the required compaction.

Material having excessive moisture content may be dried by blading, discing, or harrowing to hasten the drying process.

MEASUREMENT AND PAYMENT

Full compensation for drying, blending, transporting, importing backfill material, and removing and disposing of unsuitable material and excess excavated material shall be included in the prices paid for various contract items of work involved and no additional cost will be allowed therefor.

Full compensation for protection of utilities or replacement of utilities and street improvements including, but not limited to removal and disposal and reconstruction of existing curb, gutter, spandrels, cross-gutters, sidewalks, driveway aprons, and handicapped ramps shall be included in the contract prices paid for the various sizes of pipe and no additional compensation will be allowed therefor.

10-1.51 IRRIGATION CROSSOVERS

Irrigation crossovers shall conform to the provisions in Section 20-5, "Irrigation Systems," of the Standard Specifications and these special provisions.

Conduits shall be placed in open trenches in conformance with the provisions in Section 20-5.03B, "Conduit for Irrigation Crossovers," of the Standard Specifications.

Conduits shall be corrugated high density polyethylene (CHDPE) pipe. Corrugated high density polyethylene pipe shall conform to the requirements in ASTM Designation: F 405 or F 667, or AASHTO Designation: M 252 or M 294 and shall be Type S. Couplings and fittings shall be as recommended by the pipe manufacturer.

Water line crossovers shall conform to the provisions in Section 20-5.03C, "Water Line Crossovers," of the Standard Specifications.

Fittings for water line crossovers shall be Schedule 80.

Sprinkler control crossovers shall conform to the provisions in Section 20-5.027D, "Sprinkler Control Crossovers," of the Standard Specifications.

Installation of pull boxes shall conform to the provisions in Section 20-5.027I, "Conductors, Electrical Conduit and Pull Boxes," of the Standard Specifications. When no conductors are installed in electrical conduits, pull boxes for irrigation crossovers shall be installed on a foundation of compacted soil.

10-1.52 WATER SUPPLY LINE (BRIDGE)

Water supply lines identified on the plans as supply line (bridge) shall be of the size shown and shall conform to the details shown on the plans, the provisions in Section 20-5, "Irrigation Systems," of the Standard Specifications, and these special provisions.

GENERAL

Unless otherwise shown on the plans, casings shall be installed at each abutment and shall be extended to the greater of: (1) 5 feet beyond the approach slab, (2) 5 feet beyond the end of the adjacent wingwall, or (3) 20 feet beyond the abutment.

Working Drawings

The Contractor shall submit complete working drawings for the temporary support of the casing at the abutments to the Offices of Structure Design (OSD) in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

- A. Expansion assemblies.
- B. Seismic expansion assemblies.
- C. Pipe hanger assemblies and lateral restraint assemblies.

Data for the expansion assemblies for supply lines NPS 4 or greater shall include the preset dimension for each expansion assembly installation.

For initial review, 5 sets of drawings shall be submitted. After review, between 6 and 12 sets, as requested by the Engineer, shall be submitted to the OSD for final approval and use during construction.

MATERIALS

Pipe and Fittings for Supply Lines Less Than NPS 4

Pipe and fittings for supply lines less than NPS 4 shall conform to the provisions in Section 20-2.15A, "Steel Pipe," of the Standard Specifications.

Air Release Valve Assemblies for Supply Lines Less Than NPS 4

Each air release valve assembly for supply lines less than NPS 4 shall consist of a threaded tee of the same diameter as the supply line or pipe saddle, an NPS 1 ball valve, an automatic air release valve, and a tank vent. The air release valve shall have a cast iron body with stainless steel trim and float, an NPS 1 inlet pipe connection, and a 3/16 inch orifice. The tank vent shall be the size of the air release valve outlet and shall have a double opening facing down with screen cover.

Casing Insulators for Supply Lines Less Than NPS 4

Casing insulators for supply lines less than NPS 4 shall be designed for the size of casing and the supply line shown on the plans. Casing insulators for supply lines shall be high density, injection molded polyethylene, 2-piece construction with cadmium plated nuts and bolts and shall have a nonconductive inner liner. Casing insulators shall be factory constructed to ensure the supply line is centered in the casing to avoid any pipe to pipe contact and shall have at least 2 runners seated on the bottom of the casing.

Pipe End Seals for Supply Lines Less Than NPS 4

Pipe end seals for supply lines less than NPS 4 shall cover the space between the supply line and the end of the casing. Pipe end seals shall be made with 2-inch thick construction grade redwood and cut to fit the supply line.

Expansion Assemblies for Supply Lines Less Than NPS 4

Expansion assemblies for supply lines less than NPS 4 shall be the hose type. Hose shall be medium or heavy weight, oil resistant, flexible, reinforced with a minimum of 2-ply synthetic yarn or steel wire, equipped with steel flanges, and shall have rubber or synthetic rubber cover and tube. The hose and flange assembly shall have the same nominal inside diameter as the supply line and shall be rated for a minimum working pressure of 200 psi. Hoses carrying potable water shall meet Food and Drug Administration standards.

Insulated Flange Connections

Each insulated flange connection shall consist of a dielectric flange gasket, insulating washers, and sleeves held in place with steel bolts and nuts. The gasket shall have a minimum dielectric rating of 500 V/mil.

Casings

Casings shall be welded steel pipe and shall conform to the provisions in Section 70-1.02B, "Welded Steel Pipe," of the Standard Specifications and these special provisions. Prior to shipping, exterior surfaces of welded steel pipe shall be cleaned and coated in conformance with the requirements in ANSI/AWWA C213, or at the option of the Contractor, cleaned, primed, and coated in conformance with the requirements in ANSI/AWWA C214.

Pipe Wrapping Tape

Wrapping tape for pipe in contact with the earth shall be a pressure sensitive polyvinyl chloride or polyethylene tape with a minimum thickness of 50 mils.

Pipe Hanger Assemblies

Each pipe hanger assembly shall consist of a concrete clevis plate or embedded steel welded linked eye rods, an adjustable steel yoke, a cast iron pipe roller, a steel roller rod, and hex nuts. Parts shall be galvanized. The pipe hanger assembly shall be suitable for the type and size of pipe installed and shall be as shown on the plans.

Steel hangers, anchor bolts, pipe clamps, nuts and bolts, and other fittings shall be suitable for the type and size of the supply lines or casings and shall conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Pipe Anchorages for Supply Lines Less Than NPS 4

Each pipe anchorage located halfway between the hose assembly shall consist of a fabricated steel I beam, U bolts, concrete expansion anchors or L anchor bolts, and double nuts suitable for the type and size of pipe installed and shall conform to the details shown on the plans and the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Concrete Pipe Supports

Each concrete pipe support shall consist of either a precast or cast-in-place concrete pipe cradle, a galvanized steel pipe clamp, anchor bolts, and where shown on the plans, a stainless steel pipe protection shield.

Concrete pipe supports and pipe stops shall conform to the dimensions shown on the plans and shall be constructed of minor concrete and commercial quality wire mesh. Minor concrete shall conform to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications, except that it shall contain not less than 590 pounds of cementitious material per cubic yard. The concrete for pipe supports and pipe stops shall be moist cured for not less than 3 days.

Steel anchor bolts, nuts, pipe clamps, pipe protection shields, and other fittings shall be suitable for the type and size of the supply line or casing and shall conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Epoxy Adhesive

Epoxy adhesive shall conform to the provisions in Section 95, "Epoxy," of the Standard Specifications and one of the following:

- A. Section 95-2.01, "Binder (Adhesive), Epoxy Resin Base," for load bearing applications.
- B. Section 95-2.04, "Rapid Set Epoxy Adhesive for Pavement Markers."

C. Section 95-2.05, "Standard Set Epoxy Adhesive for Pavement Markers."

INSTALLATION

Water supply lines in bridge structures shall be supported as shown on the plans and in conformance with these special provisions.

If a blackout is provided in the bridge abutment wall for casing, the space between the casing and bridge abutment wall shall be filled with mortar conforming to the provisions in Section 51-1.135, "Mortar," of the Standard Specifications.

When the bridge superstructure is to be prestressed, the space around supply lines through abutments shall not be filled until the prestressing has been completed.

Openings for supply lines through bridge superstructure concrete shall either be formed or shall consist of pipe sleeves.

Expansion joints for supply lines NPS 4 or greater shall be factory adjusted and set at half the expansion capacity and shall be approved by the Engineer prior to installation. Expansion joints shall be connected to the supply line with insulated flange connections.

Cleaning and Closing of Pipe

The interior of the pipe shall be cleaned before installation. Openings shall be capped or plugged as soon as the pipe is installed to prevent the entrance of foreign material. The caps or plugs shall remain in place until the adjacent pipe sections are to be installed.

Wrapping and Coating Pipe

Damaged coating on supply line pipe in contact with the earth shall be wrapped with tape as follows:

- A. Pipe to be wrapped shall be thoroughly cleaned and primed as recommended by the tape manufacturer.
- B. Tape shall be tightly applied with one-half uniform lap, free from wrinkles and voids to provide not less than a 100-mil thickness.
- C. Field joints and fittings for wrapped pipe shall be covered by double wrapping 50-mil thick tape. Wrapping at joints shall extend a minimum of 6 inches over adjacent pipe coverings. Width of tape for wrapping fittings shall not exceed 2 inches. Adequate tension shall be applied so that the tape will conform closely to the contours of the joint.

TESTING

Water supply lines less than NPS 4 shall be tested in conformance with the provisions in Section 20-5.03H(1), "Method A," of the Standard Specifications, except that the testing period shall be 4 hours minimum with no leakage or pressure drop.

The Contractor shall furnish pipe anchorages to resist thrust forces occurring during testing. Leaks shall be repaired and defective materials shall be replaced by the Contractor at the Contractor's expense.

Pressure testing and necessary repairing of water lines shall be completed prior to backfilling, placing deck slabs over supply lines in box girder cells, or otherwise covering the supply lines.

Each end of the supply line shall be capped prior to and after the testing.

The supply line shall be tested as one unit. The limits of the unit shall be 5 feet beyond the casing at each end of the bridge.

MEASUREMENT AND PAYMENT

Measurement and payment for supply line (bridge) for each size listed in the Bid Item List shall be made in the same manner as galvanized steel pipe and plastic pipe supply lines in Section 20-5.04, "Measurement," and Section 20-5.05, "Payment," of the Standard Specifications.

Full compensation for furnishing and installing air release valve assemblies, steel hangers, steel brackets and other fittings, casings and casing insulators, pipe end seals, concrete supports, pipe anchorages, concrete pipe stops, pipe wrapping tape, epoxy adhesives, and expansion assemblies; for cleaning, closing, wrapping, and coating pipe; and for pressure testing shall be considered as included in the contract prices paid per linear foot for the sizes of water supply line (bridge) involved, and no additional compensation will be allowed therefor.

10-1.53 AGGREGATE BASE

Aggregate base must comply with Section 26, "Aggregate Bases," of the Standard Specifications and these special provisions.

Aggregate base must be Class 3.

Do not store reclaimed asphalt concrete or aggregate base with reclaimed asphalt concrete within 100 feet measured horizontally of any culvert, watercourse, or bridge.

Class 3 aggregate base must comply with:

Grading (Percentage Passing)

Sieve Sizes	1 1/2" _Maximum	
	Operating Range	Contract Compliance
2"	100	100
1-1/2"	90 – 100	87 – 100
1"	---	---
3/4"	50 – 90	45 – 95
No. 4	25 – 60	20 – 65
No. 30	10 – 35	6 – 39
No. 200	3 – 15	0 – 19

Grading (Percentage Passing)

Sieve Sizes	3/4" _Maximum	
	Operating Range	Contract Compliance
2"	---	---
1-1/2"	---	---
1"	100	100
3/4"	90 – 100	87 – 100
No. 4	40 – 70	35 – 75
No. 30	12 – 40	7 – 45
No. 200	3 – 15	0 – 19

Quality

Tests	Operating Range	Contract Compliance
Sand Equivalent	21 min.	18 min.
Resistance (R-value)	---	50 min.
Durability Index	---	35 min.

Do not treat aggregate with lime, cement, or other chemical material before the Department performs the Durability Index test. The Engineer does not consider any untreated reclaimed asphalt concrete and Portland cement concrete to be treated with lime, cement, or other chemical material for purposes of performing the Durability Index test.

If tests show grading or sand equivalent does not comply with the "Operating Range" specifications but complies with the "Contract Compliance" specifications, you may place aggregate base for the remainder of that day. Do not start another day's work until tests or other information indicate the next day's material complies with the "Operating Range" specifications.

If tests show grading or sand equivalent does not comply with the "Contract Compliance" specifications, remove the aggregate base represented by the tests. If you request and the Engineer approves, that aggregate base may remain in place and the Department reduces payment by \$2.25 per cubic yard for that aggregate base. If both the grading and sand equivalent do not comply with "Contract Compliance" specifications and the base remains in place, the Department only makes one payment reduction.

No single grading or sand equivalent test may represent more than the smaller of 500 cubic yards or one day's production.

If lean concrete base is placed over Class 3 aggregate base, the aggregate base finished surface must not project above the grade established by the Engineer at any point. At locations where the aggregate base planned thickness, less allowable tolerance, is not obtained and is not compensated for by an equivalent thickness of lean concrete base, take corrective measures to obtain the thickness. If you request and the Engineer approves, aggregate base at these locations may remain in place and the Department reduces payment for that aggregate base. The Department deducts the product of:

1. The deficient thickness less allowable tolerance
2. The planned width
3. The longitudinal distance between locations showing specified thickness
4. The higher of \$20.00 per cubic yard or the aggregate base contract bid price

10-1.54 AGGREGATE BASE CEMENT SLURRY (ABCS)

Aggregate base cement slurry (ABCS) must comply with Section 26, "Aggregate Bases," of the Standard Specifications and these special provisions.

Portland cement used in ABCS shall conform to the provisions in Section 90, "Portland Cement Concrete," except that testing will not be required.

Do not store reclaimed asphalt concrete or aggregate base with reclaimed asphalt concrete within 100 feet measured horizontally of any culvert, watercourse, or bridge.

Prior to adding cement and water, aggregate for ABCS must comply with:

Grading (Percentage Passing)

Sieve Sizes	1 1/2" Maximum	
	Operating Range	Contract Compliance
2"	100	100
1-1/2"	90-100	87-100
1"	-----	-----
3/4"	50-90	45-95
No. 4	25-60	20-65
No. 30	10-35	6-39
No. 200	3-15	0-19

Quality

Tests	Operating Range	Contract Compliance
Sand Equivalent	21 min	18 min
Resistance (R-value)	-----	50 min
Durability Index	-----	35 min

Do not treat aggregate with lime, cement, or other chemical material before the Department performs the Durability Index test. The Engineer does not consider any untreated reclaimed asphalt concrete and portland cement concrete to be treated with lime, cement, or other chemical material for purposes of performing the Durability Index test.

If tests show grading or sand equivalent does not comply with the "Operating Range" specifications but complies with the "Contract Compliance" specifications, you may place aggregate base for the remainder of that day. Do not start another day's work until tests or other information indicate the next day's material complies with the "Operating Range" specifications.

If tests show grading or sand equivalent does not comply with the "Contract Compliance" specifications, remove the aggregate base represented by the tests. If you request and the Engineer approves, that aggregate base may remain in place and the Department reduces payment by \$2.25 per cubic yard for that aggregate base. If both the grading and sand equivalent do not comply with "Contract Compliance" specifications and the base remains in place, the Department only makes one payment reduction.

No single grading or sand equivalent test may represent more than the smaller of 500 cubic yards or one day's production.

Water used for ABCS must be free from oil, salts and other impurities which would have an adverse effect on the quality of the slurry material.

Aggregate for ABCS must be either material selected from the excavation, imported material, or a combination thereof, be free of organic material and other deleterious substances.

Proportion the aggregate, cement and water either by weight or by volume. Use 50 pounds of cement for each cubic yard of material produced. The water content must be sufficient to produce a workable mix that will flow and can be vibrated without segregation of the aggregate while being placed.

Materials for ABCS must be thoroughly machine-mixed in a pugmill, rotary drum or other approved mixer. Continue mixing until the cement and water are thoroughly dispersed throughout the material. Place ABCS in the work within one hour after mixing.

Place ABCS in a uniform manner that will prevent voids in, or segregation of, the slurry, and will not float or shift the excavation. Immediately remove foreign material which falls into the excavation prior to or during placing of the ABCS.

Construct successive pavement layers over ABCS when maximum indentation diameter of 2 inches in conformance with ASTM D6024 is achieved.

10-1.55 LEAN CONCRETE BASE

Lean concrete base shall conform to the provisions in Section 28, "Lean Concrete Base," of the Standard Specifications and these special provisions.

The finished surface of lean concrete base shall not be above the grade established by the Engineer, or more than 0.05-foot below the grade established by the Engineer.

BOND BREAKER

Bond breaker to be placed under LCB or Class 3 Aggregate Base as shown on the plans, must be one of the following:

1. White curing paper under ASTM C 171
2. White opaque polyethylene film under ASTM C 171, except that the minimum thickness must be 6 mils.

MEASUREMENT AND PAYMENT

The contract price paid per cubic yard for lean concrete base shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the base, including bond breaker, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.56 LEAN CONCRETE BASE RAPID SETTING

GENERAL

Summary

Lean concrete base rapid setting (LCBRS) must comply with Section 28, "Lean Concrete Base," of the Standard Specifications and these special provisions.

Definitions

final set time: Time a specific penetration resistance of 4,000 psi is achieved, determined under ASTM C 403.

opening age: Time the concrete achieves the specified strength for opening to traffic.

Submittals

Mix Design

Determine the mix proportions for LCBRS and submit mix designs. At least 10 days before use, submit a mix design for LCBRS that includes:

1. Opening age
2. Proposed aggregate gradation
3. Proportions of hydraulic cement and aggregate
4. Types and amounts of chemical admixtures
5. Maximum time allowed between batching and placing
6. Range of ambient temperatures over which the mix design is effective
7. Final set time
8. Test result from California Test 548 testing, if required

Submit more than 1 mix design to plan for ambient temperature variations anticipated during LCBRS placement. Each mix design must have a maximum ambient temperature range of 18 °F.

LCBRS Field Qualification

Submit field qualification data and test reports including:

1. Mixing date
2. Mixing equipment and procedures used
3. Batch volume in cubic yards
4. Type and source of ingredients used
5. Age and strength at time of cylinder testing

Field qualification test reports must be certified with a signature by an official in responsible charge of the laboratory performing the tests.

Submit strength development data for each mix design. You may use strength development data from laboratory-prepared samples. The testing ages for strength development data must include 1 hour before opening age, opening age, 1 hour after opening age, 24 hours, and 7 days.

Quality Control

Prepare compressive strength test specimens under California Test 540. Test compressive strength specimens under California Test 521 or ASTM C 1231. Perform at least 1 test at opening age for each 130 cubic yards placed. One test is two cylinders.

MATERIALS

Cement

Cement for LCBRS must comply with one of the following:

1. Cement for portland cement concrete specified in Section 90, "Portland Cement Concrete," of the Standard Specifications except Type III cement may be used.
2. A proprietary cementitious material in compliance with the specifications for cement in Section 90, "Portland Cement Concrete," of the Standard Specifications, except:
 - 2.1. Cementitious material must meet the definition of hydraulic cement in ASTM C 219, and the following:

Proprietary Cementitious Material

Test Description	Test Method	Requirement
Contraction in Air	California Test 527, w/c ratio = 0.39±0.010	0.053%, max.
Mortar Expansion in Water	ASTM C 1038	0.04%, max.
Soluble Chloride*	California Test 422	0.05%, max.
Soluble Sulfate*	California Test 417	0.30%, max.
Thermal Stability	California Test 553	90%, min.
Compressive Strength @ 3 days	ASTM C 109	2500 psi

*Test is to be done on a cube specimen fabricated in conformance with the requirements in ASTM C 109, cured at least 14 days, and then pulverized so that 100% passes the No. 50 sieve.

- 2.2. Citric acid or borax may be used if requested in writing by the cement manufacturer and a sample is submitted to the Engineer. Chemical admixtures, if used, must be included when testing for requirements listed in the table above.

Aggregates

Aggregate for LCBRS must comply with either of the following:

1. Section 90-2.02, "Aggregates," and 90-3, "Aggregate Gradings," of the Standard Specifications
2. Section 28-1.02, "Materials," of the Standard Specifications and the following:
 - 2.1. The fifth paragraph of Section 28-1.02 does not apply
 - 2.2. Perform California Test 548 except part H.

Field Qualification

Proposed mix proportions must be field qualified before you place concrete pavement. Use an American Concrete Institute (ACI) certified "Concrete Laboratory Technician, Grade I" to perform field qualification tests and calculations.

The Engineer accepts field qualification if five cylinders, for each age, made under California Test 540 and tested under California Test 521 or under ASTM C 1231 comply with the following:

1. At a minimum, cylinders are tested at opening age, and 7 days of age
2. At opening age no single cylinder is less than 700 psi and the average strength is at least 700 psi
3. At 7 days age no single cylinder is less than 725 psi and the average strength is at least 725 psi

CONSTRUCTION

General

LCBRS must have a compressive strength of 700 psi at opening age of and 725 psi at 7 days age. LCBRS must have a compressive strength of 700 psi before placing HMA, base, or operating equipment on it. Concrete paving activities may commence after final set time of LCBRS. The pavement may be opened to traffic after opening age of LCBRS.

Proportioning

Weighing, measuring, and metering devices used for proportioning materials must comply with Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

For central batch plants, indicators for weighing and measuring systems such as over and under dials must be grouped so that each indicator's smallest increment can be accurately read from the control point of the proportioning operation. In addition, indicators for weighing and measuring cement batched from a remote weighing system must be placed so that each indicator can be accurately read from the control point of the proportioning operation.

Weighing equipment must be insulated from other equipment's vibration or movement. When the plant is operating, each draft's material weight must not vary from the designated weight by more than the specified tolerances. Each scale graduation must be 0.001 of the usable scale capacity.

Aggregate must be weighed cumulatively. Equipment for weighing aggregate must have a zero tolerance of ± 0.5 percent of the aggregate's designated total batch weight. Equipment for the separate weighing of the cement must have a zero tolerance of ± 0.5 percent of the cement's designated individual batch draft. Equipment for measuring water must have a zero tolerance of ± 0.5 percent of the water's designated weight or volume.

The weight indicated for any individual batch of material must not vary from the preselected scale setting by more than:

Batch Weight Tolerances	
Material	Tolerance
Aggregate	± 1.0 percent of designated batch weight
Cement	± 0.5 percent of designated batch weight
Water	± 1.5 percent of designated batch weight or volume

If you choose aggregate that complies with Section 90-2.02, "Aggregates," and 90-3, "Aggregate Gradings," of the Standard Specifications, proportioning consists of dividing the aggregate into the specified sizes and storing them in separate bins, and then combining the aggregate with cement and water. Control the aggregate discharged from several bins with gates or mechanical conveyors. The means of discharge from the bins and from the weigh hopper must be interlocked so that no more than 1 bin can discharge at a time, and the weigh hopper cannot be discharged until the required quantity from each of the bins has been deposited in the weigh hopper.

Proportion dry ingredients by weight. Proportion liquid ingredients by weight or volume.

Handle and store aggregates under Section 90-5.01, "Storage of Aggregates," of the Standard Specifications. Proportion liquid admixtures under Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures," of the Standard Specifications.

At the time of batching, dry and drain aggregates to a stable moisture content. Do not proportion aggregates with visible separation of water from the aggregate during proportioning. At the time of batching, the free moisture content of fine aggregate must not exceed 8 percent of its saturated, surface-dry weight.

If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust 1 supply before using another supply.

Keep cement separated from the aggregate until discharged into the mixer. When discharged into the mixer, cement must be free of lumps and clods. Before reuse, clean fabric containers used for transportation or proportioning of cement.

Weigh systems for proportioning aggregate and cement must be individual and distinct from other weigh systems. Each weigh system must have a hopper, a lever system, and an indicator.

For batches with a volume of 1 cubic yard or more, proportioning must comply with one of the following methods:

1. Batch the ingredients at a central batch plant and charge them into a mixer truck for transportation to the pour site. Proportion ingredients under Section 90-5, "Proportioning," of the Standard Specifications.
2. Batch the ingredients except the cement at a central batch plant and charge them into a mixer truck for transportation to a cement silo and weigh system, which must proportion cement for charging into the mixer truck.
3. Batch ingredients except the cement at a central batch plant and charge them into a mixer truck for transportation to a location where pre-weighed containerized cement is added to the mixer truck. The cement pre-weighing operation must utilize a platform scale. The platform scale must have a maximum capacity of 2.75 tons with a maximum graduation size of 1 pound. Pre-weigh cement into a fabric container. The minimum amount of cement to be proportioned into any single container must be 1/2 of the total amount required for the load of LCBRS being produced.
4. Cement, water, and aggregate are proportioned volumetrically.

When ordered by the Engineer, determine the gross weight and tare weight of truck mixers on scales designated by the Engineer.

Install and maintain in operating condition an electrically actuated moisture meter. The meter must indicate on a readily visible scale the changes in the fine aggregate moisture content as it is batched. The meter must have a sensitivity of 0.5 percent by weight of the fine aggregate.

Obtain the Engineer's acceptance before mixing water into the concrete during hauling or after arrival at the delivery point. If the Engineer accepts additional water be incorporated into the concrete, the drum must revolve not less than 30 revolutions at mixing speed after the water is added and before starting discharge. Measure water added to the truck mixer at the job site through a meter in compliance with Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

Volumetric Proportioning

You may choose to proportion LCBRS by volume. Comply with proportioning requirements under, "Jointed Plain Concrete Pavement (RSC)," of these special provisions.

Handle and store aggregates under Section 90-5.01, "Storage of Aggregates," of the Standard Specifications. Proportion liquid admixtures under Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures," of the Standard Specifications.

Batch-mixer trucks must proportion cement, water, aggregate, and additives by volume. Aggregate feeders must be connected directly to the drive on the cement vane feeder. The cement feed rate must be tied directly to the feed rate for the aggregate and other ingredients. Only change the ratio of cement to aggregate by changing the gate opening for the aggregate feed. The drive shaft of the aggregate feeder must have a revolution counter reading to the nearest full or partial revolution of the aggregate delivery belt.

Proportion aggregate with a belt feeder operated with an adjustable cutoff gate delineated to the nearest quarter increment. The gate opening height must be readily determinable. Proportion cement by any method that complies with the accuracy tolerance specifications. Proportion water with a meter under Section 9-1.01, "Measurement and Payment," of the Standard Specifications.

Calibrate the cutoff gate for each batch-mixer truck used and for each aggregate source. Calibrate batch-mixer trucks at 3 different aggregate gate settings that are commensurate with production needs. Perform at least 2 calibration runs for each aggregate gate.

Individual aggregate delivery rate check-runs must not deviate more than 1.0 percent from the mathematical average of all runs for the same gate and aggregate type. Each test run must be at least 1,000 pounds.

At the time of batching, dry and drain aggregates to a stable moisture content. Do not proportion aggregates with visible separation of water from the aggregate during proportioning. At the time of batching, the free moisture content of fine aggregate must not exceed 8 percent of its saturated, surface-dry weight.

If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust 1 supply before using another supply.

Cover rotating and reciprocating equipment on batch-mixer trucks with metal guards.

Individual cement delivery rate check-runs must not deviate more than 1.0 percent of the mathematical average of 3 runs of at least 1,000 pounds each.

When the water meter operates from 50 to 100 percent of production capacity, the indicated weight of water delivered must not differ from the actual weight delivered by more than 1.5 percent for each of 2 runs of 300 gallons. Calibrate the water meter under California Test 109. The water meter must be equipped with a resettable totalizer and display the operating rate.

Conduct calibration tests for aggregate, cement, and water proportioning devices with a platform scale located at the calibration site. Platform scales for weighing test-run calibration material must have a maximum capacity of 2.75 tons with maximum graduations of 1 pound. Error test the platform scale within 8 hours of calibrating the batch-mixer truck proportioning devices. Perform error-testing with test weights under California Test 109. Furnish a witness scale that is within 2 graduations of the test weight load. The witness scale must be available for use at the production site throughout the production period. Equipment needed for the calibration of proportioning systems must remain available at the production site throughout the production period.

The batch-mixer truck must be equipped so that accuracy checks can be made. Recalibrate proportioning devices every 30 days after production starts or when you change the source or type of any ingredient.

A spot calibration is calibration of the cement proportioning system only. Perform a 2-run spot calibration each time 55 tons of cement passes through the batch-mixer truck. If the spot calibration shows the cement proportioning system does not comply with the specifications, complete a full calibration of the cement proportioning system before you resume production.

Proportion liquid admixtures with a meter.

Locate cement storage immediately before the cement feeder. Equip the system with a device that automatically shuts down power to the cement feeder and aggregate belt feeder when the cement storage level is less than 20 percent of the total volume.

Submit aggregate moisture determinations, made under California Test 223, at least every 2 hours during proportioning and mixing operations. Record moisture determinations and submit them at the end of each production shift.

Equip each aggregate bin with a device that automatically shuts down the power to the cement feeder and the aggregate belt feeder when the aggregate discharge rate is less than 95 percent of the scheduled discharge rate.

Proportioning device indicators must be in working order before starting proportioning and mixing operations and must be visible when standing near the batch-mixer truck.

Identifying numbers of batch-mixer trucks must be at least 3 inches in height, and be located on the front and rear of the vehicles.

Mix volumetric proportioned LCBRS in a mechanically operated mixer. You may use auger-type mixers. Operate mixers uniformly at the mixing speed recommended by the manufacturer. Do not use mixers that have an accumulation of hard concrete or mortar.

Do not mix more material than will permit complete mixing. Reduce the volume of material in the mixer if complete mixing is not achieved. Continue mixing until a homogeneous mixture is produced at discharge. Do not add water to the LCBRS after discharge.

Do not use equipment with components made of aluminum or magnesium alloys that may have contact with plastic concrete during mixing or transporting of LCBRS.

The Engineer determines uniformity of concrete mixtures by differences in penetration measurements made under California Test 533. Differences in penetration are determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load. The differences must not exceed 5/8 inch. Submit samples of freshly mixed concrete. Sampling facilities must be safe, accessible, clean, and produce a sample that is representative of production. Sampling devices and sampling methods must comply with California Test 125.

Do not use ice to cool LCBRS directly. If ice is used to cool water used in the mix, it must be melted before entering the mixer.

When proportioning and charging cement into the mixer, prevent variance of the required quantity by conditions such as wind or accumulation on equipment.

Each mixer must have metal plates that provide the following information:

1. Designed usage
2. Manufacturer's guaranteed mixed concrete volumetric capacity
3. Rotation speed

The device controlling the proportioning of cement, aggregate, and water must produce production data. The production data must be captured at 15-minute intervals throughout daily production. Each capture of production data represents production activity at that time and is not a summation of data. The amount of material represented by each production capture is the amount produced in the period from 7.5 minutes before to 7.5 minutes after the capture time. The daily production data must be submitted in electronic or printed media at the end of each production shift. The reported data must be in the order including data titles as follows:

1. Weight of cement per revolution count
2. Weight of each aggregate size per revolution count
3. Gate openings for each used aggregate size
4. Weight of water added to the concrete per revolution count
5. Moisture content of each used aggregate size
6. Individual volume of other admixtures per revolution count
7. Time of day
8. Day of week
9. Production start and stop times
10. Batch-mixer truck identification
11. Name of supplier
12. Specific type of concrete being produced
13. Source of the individual aggregate sizes
14. Source, brand, and type of cement
15. Source, brand and type of individual admixtures
16. Name and signature of operator

You may input production data by hand into a pre-printed form or it may be captured and printed by the proportioning device. Present electronic media containing recorded production data in a tab delimited format on a CD or DVD. Each capture of production data must be followed by a line-feed carriage-return with sufficient fields for the specified data.

Placing LCBRS

You may use metal or wood side forms. Wood side forms must not be less than 1-1/2 inches thick.

Side forms must remain in place until the LCBRS edge no longer requires the protection of forms.

After you deposit the LCBRS on the subgrade, consolidate it with high-frequency internal vibrators. Consolidate adjacent to forms and across the full placement width. Place LCBRS as nearly as possible to its final position. Do not use vibrators for extensive shifting of LCBRS.

Spread and shape LCBRS with powered finishing machines supplemented by hand finishing.

After you mix and place LCBRS, do not add water to the surface to facilitate finishing. Use surface finishing additives as recommended by the manufacturer of the cement after their use is approved by the Engineer.

Final Finishing

The finished surface of LCBRS must not be above the grade established by the Engineer, or more than 0.05-foot below the grade established by the Engineer.

PAYMENT

Lean concrete base rapid setting is measured and paid for by the cubic yard in the same manner specified for lean concrete base in Sections 28-1.09, "Measurement," and Section 28-1.10, "Payment," of the Standard Specifications.

10-1.57 HOT MIX ASPHALT

GENERAL

Summary

This work includes producing and placing hot mix asphalt (HMA) Type A using the QC/QA process. Comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

Submittals

Quality Control / Quality Assurance Projects

With the job mix formula (JMF) submittal, submit:

1. California Test 204 plasticity index results
2. California Test 371 tensile strength ratio results for untreated HMA
3. California Test 371 tensile strength ratio results for treated HMA if untreated HMA tensile strength ratio is below 70

At project start-up and once during production, submit samples split from your HMA production sample for California Test 371 to the Engineer and the Transportation Laboratory, Attention: Moisture Test.

With the JMF submittal, at project start-up, and each 5,000 tons, submit the California Test 371 test results for mix design and production to the Engineer and electronically to:

Moisture_Tests@dot.ca.gov

Data Cores

Three business days before starting coring, submit proposed methods and materials for backfilling data core holes.

Submit to the Engineer and electronically to Coring@dot.ca.gov:

1. A summary of data cores taken
2. A photograph of each data core

For each data core, the summary must include:

1. Project identification number
2. Date cored
3. Core identification number
4. Type of materials recovered
5. Type and approximate thickness of unstabilized material not recovered
6. Total core thickness
7. Thickness of each individual material to within:
 - 7.1. For recovered material, 1/2 inch
 - 7.2. For unstabilized material, 1.0 inch
8. Location including:
 - 8.1. County
 - 8.2. Route
 - 8.3. Post mile
 - 8.4. Lane number
 - 8.5. Lane direction
 - 8.6. Station

Each data core digital photograph must include a ruler laid next to the data core. Each photograph must include:

1. The core
2. Project identification number
3. Core identification number
4. Date cored
5. County
6. Route
7. Post mile
8. Lane number
9. Lane direction

After data core summary and photograph submittal, dispose of cores under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Quality Control and Assurance

Quality Control / Quality Assurance Projects

For the mix design, determine the plasticity index of the aggregate blend under California Test 204. Choose an antistrip treatment and use the corresponding laboratory procedure for the mix design in compliance with:

Antistrip Treatment Lab Procedures for Mix Design

Antistrip Treatment	Lab Procedure
Plasticity index from 4 to 10 ^a	
Dry hydrated lime with marination	LP-6
Lime slurry with marination	LP-7
Plasticity index less than 4	
Liquid	LP-5
Dry hydrated lime without marination	LP-6
Dry hydrated lime with marination	LP-6
Lime slurry with marination	LP-7

Notes:

^a If the plasticity index is greater than 10, do not use that aggregate blend.

For the mix design, determine tensile strength ratio under California Test 371 on untreated HMA. If the tensile strength ratio is less than 70:

1. Choose from the antistrip treatments specified based on plasticity index.
2. Test treated HMA under California Test 371.
3. Treat to a minimum tensile strength ratio of 70.

On the first production day and at least every 5,000 tons, sample HMA and test under California Test 371.

The Department does not use California Test 371 test results for JMF verification and production to determine specification compliance.

MATERIALS

Asphalt Binder

The grade of asphalt binder mixed with aggregate for HMA Type A must be PG 64-10.

Aggregate

The aggregate for HMA Type A must comply with the 3/4-inch grading.

CONSTRUCTION

Vertical Joints

Before opening the lane to public traffic, pave shoulders and median borders adjacent to a lane being paved.

Do not leave a vertical joint more than 0.15 foot high between adjacent lanes open to public traffic.

Place HMA on adjacent traveled way lanes so that at the end of each work shift, the distance between the ends of HMA layers on adjacent lanes is between 5 feet and 10 feet. Place additional HMA along the transverse edge at each lane's end and along the exposed longitudinal edges between adjacent lanes. Hand rake and compact the additional HMA to form temporary conforms. You may place Kraft paper or another approved bond breaker under the conform tapers to facilitate the taper removal when paving operations resume.

Widening

If widening existing pavement, construct new structural section on both sides of the existing pavement to match the elevation of the existing pavement's edge at each location before placing HMA over the existing pavement.

Conform Tapers

Place shoulder conform tapers concurrently with the adjacent lane's paving.

Place additional HMA along the pavement's edge to conform to road connections and private drives. Hand rake, if necessary, and compact the additional HMA to form a smooth conform taper.

Data Cores

Take data cores that include the completed HMA pavement, underlying base, and subbase material. Protect data cores and surrounding pavement from damage.

Take 4-inch or 6-inch diameter data cores:

1. At the beginning, end, and every 1/2 mile within the paving limits of each route on the project
2. After all paving is complete
3. From the center of the specified lane

On a 2-lane roadway, take data cores from either lane. On a 4-lane roadway, take data cores from each direction in the outermost lane. On a roadway with more than 4 lanes, take data cores from the median lane and the outermost lane in each direction.

Each core must include the stabilized materials encountered. You may choose not to recover unstabilized material but you must identify the material. Unstabilized material includes:

1. Granular material
2. Crumbled or cracked stabilized material
3. Sandy or clayey soil

PAYMENT

The contract lump sum price paid for data core includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in data coring, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.58 RUBBERIZED HOT MIX ASPHALT (GAP GRADED)

GENERAL

Summary

This work includes producing and placing rubberized hot mix asphalt (gap graded) (RHMA-G) using the standard process.

Comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

MATERIALS

Asphalt Binder

Asphalt binder mixed with asphalt modifier and crumb rubber modifier (CRM) for asphalt rubber binder must be PG 64-16.

Aggregate

The aggregate for RHMA-G must comply with the 1/2-inch grading.

Asphalt Rubber Binder Content

Determine the amount of asphalt rubber binder to be mixed with the aggregate for RHMA-G under California Test 367 except:

1. Determine the specific gravity used in California Test 367, Section B, "Void Content of Specimen," using California Test 308, Method A.
2. California Test 367, Section C, "Optimum Bitumen Content," is revised as follows:
 - 2.1. Base the calculations on the average of 3 briquettes produced at each asphalt rubber binder content.
 - 2.2. Use California Test 309 to determine theoretical maximum specific gravity and density of the RHMA-G.

- 2.3. Plot asphalt rubber binder content versus average air voids content based on California Test 309 for each set of three specimens on Form TL-306 (Figure 3), and connect adjacent points with a best-fit curve.
 - 2.4. Plot asphalt rubber binder content versus average Hveem stability for each set of three specimens and connect adjacent points with a best-fit curve.
 - 2.5. Calculate voids in mineral aggregate (VMA) and voids filled with asphalt (VFA) for each specimen, average each set, and plot the average versus asphalt rubber binder content.
 - 2.6. Calculate the dust proportion and plot versus asphalt rubber binder content.
 - 2.7. From the curve plotted in Step 2.3, select the theoretical asphalt rubber binder content that has 4.0 percent air voids.
 - 2.8. At the selected asphalt rubber binder content, evaluate corresponding voids in mineral aggregate, voids filled with asphalt, and dust proportion to verify compliance with requirements. If necessary, develop an alternate composite aggregate gradation to conform to the RHMA-G requirements.
 - 2.9. Record the asphalt rubber binder content in Step 2.7 as the Optimum Bitumen Content (OBC).
 - 2.10. To establish a recommended range, use the OBC as the high value and 0.3 percent less as the low value. Notwithstanding, the recommended range must not extend below 7.0 percent. If the OBC is 7.0 percent, then there is no recommended range, and 7.0 percent is the recommended value.
3. Laboratory mixing and compaction must comply with California Test 304, except the mixing temperature of the aggregate must be between 300 °F and 325 °F. The mixing temperature of the asphalt-rubber binder must be between 375 °F and 425 °F. The compaction temperature of the combined mixture must be between 290 °F and 300 °F.

10-1.59 HOT MIX ASPHALT (CHANNEL)

GENERAL

Summary

This work includes producing hot mix asphalt (HMA) and placing it on the Burbank Western channel. Comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

MEASUREMENT AND PAYMENT

If there is a contract item for place hot mix asphalt (channel) paid for by the square yard, this item is limited to the areas listed on the plans.

Full compensation for tack coat for hot mix asphalt (channel) is considered as included in the contract price paid per ton for furnish hot mix asphalt (channel) and no separate payment will be made therefor.

10-1.60 HOT MIX ASPHALT AGGREGATE LIME TREATMENT - SLURRY METHOD

GENERAL

Summary

This work includes treating hot mix asphalt (HMA) aggregate with lime using the slurry method and placing it in stockpiles to marinate.

Treat aggregate for HMA Type A with lime slurry.

Submittals

Determine the exact lime proportions for fine and coarse virgin aggregate and submit them as part of the proposed job mix formula (JMF) under Section 39, "Hot Mix Asphalt," of the Standard Specifications.

Submit the averaged aggregate quality test results to the Engineer within 24 hours of sampling.

Submit a treatment data log from the slurry proportioning device in the following order:

1. Treatment date
2. Time of day the data is captured
3. Aggregate size being treated
4. Wet aggregate flow rate collected directly from the aggregate weigh belt
5. Moisture content of the aggregate just before treatment, expressed as a percent of the dry aggregate weight
6. Dry aggregate flow rate calculated from the wet aggregate flow rate
7. Lime slurry flow rate measured by the slurry meter
8. Dry lime flow rate calculated from the slurry meter output
9. Approved lime ratio for each aggregate size being treated

10. Actual lime ratio calculated from the aggregate weigh belt and the slurry meter output, expressed as a percent of the dry aggregate weight
11. Calculated difference between the approved lime ratio and the actual lime ratio
12. Dry lime and water proportions at the slurry treatment time

Every day during lime treatment, submit the treatment data log on electronic media in tab delimited format on a removable CD-ROM storage disk. Each continuous treatment data set must be a separate record using a line feed carriage return to present the specified data on one line. The reported data must include data titles at least once per report.

Quality Control and Assurance

Your quality control plan (QCP) must include aggregate quality control sampling and testing during aggregate lime treatment. Perform sampling and testing in compliance with:

Aggregate Quality Control During Lime Treatment

Quality Characteristic	Test Method	Minimum sampling and testing frequency
Sand Equivalent	CT 217	Once per 1,000 tons of aggregate treated with lime
Percent of crushed particles	CT 205	As necessary and as designated in the QCP
Los Angeles Rattler	CT 211	
Fine aggregate angularity	CT 234	
Flat and elongated particles	CT 235	

Note: During lime treatment, sample coarse and fine aggregate from individual stockpiles. Combine aggregate in the JMF proportions. Run tests for aggregate quality in triplicate and report test results as the average of 3 tests.

The Engineer orders proportioning operations stopped for any of the following if you:

1. Do not submit the treatment data log.
2. Do not submit the aggregate quality control data.
3. Submit incomplete, untimely, or incorrectly formatted data.
4. Do not take corrective actions.
5. Take late or unsuccessful corrective actions.
6. Do not stop treatment when proportioning tolerances are exceeded.
7. Use malfunctioning or failed proportioning devices.

If you stop treatment, notify the Engineer of any corrective actions taken and conduct a successful 20-minute test run before resuming treatment.

For the aggregate to be treated, determine the moisture content at least once during each 2 hours of treatment. Calculate moisture content under California Test 226 or California Test 370 and report it as a percent of dry aggregate weight. Use the moisture content calculations as a set point for the proportioning process controller.

MATERIALS

High-calcium hydrated lime and water must comply with Section 24-1.02, "Materials," of the Standard Specifications.

Before virgin aggregate is treated, it must comply with the aggregate quality specifications. Do not test treated aggregate for quality control except for gradation. The Engineer does not test treated aggregate for acceptance except for gradation.

The Engineer determines the combined aggregate gradation during HMA production after you have treated aggregate. If reclaimed asphalt pavement (RAP) is used, the Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

Treated aggregate must not have lime balls or clods.

CONSTRUCTION

General

Notify the Engineer at least 24 hours before the start of aggregate treatment.

Treat aggregate separate from HMA production.

Do not treat RAP.

Add lime to the aggregate as slurry consisting of mixed dry lime and water at a ratio of 1 part lime to between 2 parts and 3 parts water by weight. The slurry must completely coat the aggregate.

Lime treat and marinate coarse and fine aggregates separately.

Immediately before mixing lime slurry with aggregate, water must not visibly separate from aggregate.

Treat aggregate and stockpile for marination only once.

The lime ratio is the pounds of dry hydrated lime per 100 pounds of dry virgin aggregate expressed as a percent. Water content of slurry or untreated aggregate must not affect the lime ratio.

Lime ratio ranges are:

Aggregate Gradation	Lime Ratio
Coarse	0.4 to 1.0
Fine	1.5 to 2.0
Combined virgin aggregate	0.8 to 1.5

The lime ratio for fine and coarse aggregate must be within ± 0.2 percent of the lime ratio in the accepted JMF. The lime ratio must be within ± 0.2 percent of the approved lime ratio when you combine the individual aggregate sizes in the JMF proportions. The lime ratio must be determined before the addition of RAP.

If 3 consecutive sets of recorded treatment data indicate deviation more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment.

If a set of recorded treatment data indicates a deviation of more than 0.4 percent above or below the lime ratio in the accepted JMF, stop treatment and do not use the material represented by that set of data in HMA.

If 20 percent or more of the total daily treatment indicates deviation of more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment and do not use the day's total treatment in HMA.

If you stop treatment for noncompliance, you must implement corrective action and successfully treat aggregate for a 20-minute period. Notify the Engineer before beginning the 20-minute treatment period.

Lime Slurry Proportioning

Proportion lime and water with a continuous or batch operation.

The device controlling slurry proportioning must produce a treatment data log. The log consists of a series of data sets captured at 10-minute intervals throughout daily treatment. The data must be a treatment activity register and not a summation. The material represented by the data set is the amount produced 5 minutes before and 5 minutes after the capture time. For the contract's duration, collected data must be stored by the controller.

Proportioning and Mixing Lime Slurry Treated Aggregate

Treat HMA aggregate by proportioning lime slurry and aggregate by weight in a continuous operation.

Marinate treated aggregate in stockpiles from 24 hours to 60 days before using in HMA. Do not use aggregate marinated longer than 60 days.

MEASUREMENT AND PAYMENT

Full compensation for treating aggregates with lime slurry shall be considered as included in the contract price paid per ton for HMA as designated in the Bid Item List and no separate payment will be made therefor.

10-1.61 HOT MIX ASPHALT AGGREGATE LIME TREATMENT - DRY LIME METHOD

GENERAL

Summary

This work includes treating hot mix asphalt (HMA) aggregate with lime using the dry lime method either with marination or without.

Treat aggregate for HMA Type A with dry lime.

Marinate aggregate if the plasticity index determined under California Test 204 is from 4 to 10.

Submittals

Determine the exact lime proportions for fine and coarse virgin aggregate and submit them as part of the proposed job mix formula (JMF) under Section 39, "Hot Mix Asphalt," of the Standard Specifications.

If marination is required, submit in writing the averaged aggregate quality test results to the Engineer within 24 hours of sampling.

Submit in writing a treatment data log from the dry lime and aggregate proportioning device in the following order:

1. Treatment date
2. Time of day the data is captured
3. Aggregate size being treated
4. HMA type and mix aggregate size
5. Wet aggregate flow rate collected directly from the aggregate weigh belt
6. Aggregate moisture content, expressed as a percent of the dry aggregate weight
7. Flow rate of dry aggregate calculated from the flow rate of wet aggregate
8. Dry lime flow rate
9. Lime ratio from the accepted JMF for each aggregate size being treated
10. Lime ratio from the accepted JMF for the combined aggregate
11. Actual lime ratio calculated from the aggregate weigh belt output, the aggregate moisture input, and the dry lime meter output, expressed as a percent of the dry aggregate weight
12. Calculated difference between the approved lime ratio and the actual lime ratio

Every day during lime treatment, submit the treatment data log on electronic media in tab delimited format on a removable CD-ROM storage disk. Each continuous treatment data set must be a separate record using a line feed carriage return to present the specified data on one line. The reported data must include data titles at least once per report.

Quality Control and Assurance

If marination is required, the quality control plan (QCP) specified in Section 39-4, "Quality Control / Quality Assurance," must include aggregate quality control sampling and testing during lime treatment. Perform sampling and testing in compliance with:

Quality Characteristic	Test Method	Minimum sampling and testing frequency
Sand Equivalent	CT 217	Once per 1,000 tons of aggregate treated with lime
Percent of crushed particles	CT 205	As necessary and as designated in the QCP
Los Angeles Rattler	CT 211	
Fine aggregate angularity	CT 234	
Flat and elongated particles	CT 235	

Note: During lime treatment, sample coarse and fine aggregate from individual stockpiles. Combine aggregate in the JMF proportions. Run tests for aggregate quality in triplicate and report test results as the average of 3 tests.

The Engineer orders proportioning operations stopped for any of the following if you:

1. Do not submit the treatment data log
2. Do not submit the aggregate quality control data for marinated aggregate
3. Submit incomplete, untimely, or incorrectly formatted data
4. Do not take corrective actions
5. Take late or unsuccessful corrective actions
6. Do not stop treatment when proportioning tolerances are exceeded
7. Use malfunctioning or failed proportioning devices

If you stop treatment, notify the Engineer of any corrective actions taken and conduct a successful 20-minute test run before resuming treatment.

MATERIALS

Lime must be high-calcium hydrated lime. Lime and water must comply with Section 24-1.02, "Materials," of the Standard Specifications.

Before virgin aggregate is treated, it must comply with the aggregate quality specifications. Do not test treated aggregate for quality control except for gradation. The Engineer does not test treated aggregate for acceptance except for gradation.

The Engineer determines the combined aggregate gradation during HMA production after you have treated aggregate. If reclaimed asphalt pavement (RAP) is used, the Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

Treated aggregate must not have lime balls or clods.

CONSTRUCTION

General

Notify the Engineer in writing at least 24 hours before the start of aggregate treatment.

Do not treat RAP.

If marination is required:

1. Treat and marinate coarse and fine aggregates separately.
2. Treat aggregate and stockpile for marination only once.
3. Treat aggregate separate from HMA production.

The lime ratio is the pounds of dry hydrated lime per 100 pounds of dry virgin aggregate expressed as a percent. Water content of untreated aggregate must not affect the lime ratio.

Lime ratio ranges are:

Aggregate Gradation	Lime Ratio
Coarse	0.4 to 1.0
Fine	1.5 to 2.0
Combined virgin aggregate	0.8 to 1.5

The lime ratio for fine and coarse aggregate must be within ± 0.2 percent of the lime ratio in the accepted JMF. The lime ratio must be within ± 0.2 percent of the approved lime ratio when you combine the individual aggregate sizes in the JMF proportions. Determine the lime ratio before you add RAP.

Proportion dry lime by weight with a continuous operation.

The device controlling dry lime and aggregate proportioning must produce a treatment data log. The log consists of a series of data sets captured at 10-minute intervals throughout daily treatment. The data must be a treatment activity register and not a summation. The material represented by a data set is the amount produced 5 minutes before and 5 minutes after the capture time. For the duration of the contract, collected data must be stored by the controller.

If 3 consecutive sets of recorded treatment data indicate deviation more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment of lime treated aggregates.

If a set of recorded treatment data indicates a deviation of more than 0.4 percent above or below the lime ratio in the accepted JMF, stop treatment of lime treated aggregates and do not use the material represented by that set of data in HMA.

If 20 percent or more of the total daily treatment indicates deviation of more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment and do not use the day's treated aggregate in HMA.

If you stop treatment for noncompliance, you must implement corrective action and successfully treat aggregate for a 20-minute period. Notify the Engineer before beginning the 20-minute treatment period.

If you use a batch-type proportioning operation for HMA production, control proportioning in compliance with the specifications for continuous mixing plants. Use a separate dry lime aggregate treatment operation from HMA batching operations including:

1. Pugmill mixer
2. Controller
3. Weigh belt for the lime
4. Weigh belt for the aggregate

If using a continuous mixing operation for HMA without lime marinated aggregates, use a controller that measures the blended aggregate weight after any additional water is added to the mixture. The controller must determine the amount of lime added to the aggregate from the aggregate weigh belt input in connection with the manually input total aggregate moisture, the manually input target lime content, and the lime proportioning system output. Use a continuous aggregate weigh belt and pugmill mixer for the lime treatment operation in addition to the weigh belt for the aggregate proportioning to asphalt binder in the HMA plant. If you use a water meter for moisture control for lime treatment, the meter must comply with California Test 109.

At the time of mixing dry lime with aggregate, the aggregate moisture content must ensure complete lime coating. The aggregate moisture content must not cause aggregate to be lost between the point of weighing the combined aggregate continuous stream and the dryer. Add water for mixing and coating aggregate to the aggregate before dry lime addition. Immediately before mixing lime with aggregate, water must not visibly separate from aggregate.

The HMA plant must be equipped with a bag house dust system. Material collected in the dust system must be returned to the mix.

Mixing Dry Lime and Aggregate

Mix aggregate, water, and dry lime with a continuous pugmill mixer with twin shafts. Immediately before mixing lime with aggregate, water must not visibly separate from aggregate. Store dry lime in a uniform and free flowing condition. Introduce dry lime to the pugmill in a continuous operation. The introduction must occur after the aggregate cold feed and before the point of proportioning across a weigh belt and the aggregate dryer. Prevent loss of dry lime.

If marination is required, marinate treated aggregate in stockpiles between 24 hours and 60 days before using in HMA. Do not use aggregate marinated more than 60 days.

The pugmill must be equipped with paddles arranged to provide sufficient mixing action and mixture movement. The pugmill must produce a homogeneous mixture of uniformly coated aggregates at mixer discharge.

If the aggregate treatment operation is stopped longer than 1 hour, clean the equipment of partially treated aggregate and lime.

Aggregate must be completely treated before introduction into the mixing drum.

MEASUREMENT AND PAYMENT

Full compensation for dry lime treating HMA aggregate including marination shall be considered as included in the contract price paid per ton for HMA as designated in the Bid Item List and no separate payment will be made therefor.

10-1.62 LIQUID ANTISTRIP TREATMENT

GENERAL

Summary

This work includes treating asphalt binder with liquid antistrip (LAS) treatment to bond the asphalt binder to aggregate in hot mix asphalt (HMA).

Submittals

For LAS, submit with the proposed job mix formula (JMF) submittal under Section 39, "Hot Mix Asphalt," of the Standard Specifications:

1. Materials Safety Data Sheet (MSDS)
2. One 1-pint sample
3. Infrared analysis including copy of absorption spectra

Submit a certified copy of test results and a MSDS for each LAS lot.

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each LAS shipment. With each certificate also submit:

1. Your signature and printed name
2. Shipment number
3. Material type
4. Material specific gravity
5. Refinery

6. Consignee
7. Destination
8. Quantity
9. Contact or purchase order number
10. Shipment Date

Submit proportions for LAS as part of the JMF submittal specified in Section 39-1.03, "Hot Mix Asphalt Mix Design Requirements," of the Standard Specifications. If you change the brand or type of LAS, submit a new JMF.

For each job site delivery of LAS, submit one 1/2-pint sample to the Transportation Laboratory. Submit shipping documents to the Engineer. Label each LAS sampling container with:

1. LAS type
2. Application rate
3. Sample date
4. Contract number

At the end of each day's production shift, submit production data in electronic and printed media. Present data on electronic media in tab delimited format. Use line feed carriage return with one separate record per line for each production data set. Allow sufficient fields for the specified data. Include data titles at least once per report. For each mixing operation type, submit in order:

1. Batch Mixing:

- 1.1. Production date
- 1.2. Time of batch completion
- 1.3. Mix size and type
- 1.4. Each ingredient's weight
- 1.5. Asphalt binder content as percentage of dry aggregate weight
- 1.6. LAS content as percentage of asphalt binder weight

2. Continuous Mixing:

- 2.1. Production date
- 2.2. Data capture time
- 2.3. Mix size and type
- 2.4. Flow rate of wet aggregate collected directly from the aggregate weigh belt
- 2.5. Aggregate moisture content as percentage of dry aggregate weight
- 2.6. Flow rate of asphalt binder collected from the asphalt binder meter
- 2.7. Flow rate of LAS collected from the LAS meter
- 2.8. Asphalt binder content as percentage of dry aggregate weight calculated from:
 - 2.8.1. Aggregate weigh belt output
 - 2.8.2. Aggregate moisture input
 - 2.8.3. Asphalt binder meter output
- 2.9. LAS content as percentage of asphalt binder weight calculated from:
 - 2.9.1. Asphalt binder meter output
 - 2.9.2. LAS meter output

Quality Control and Assurance

For continuous mixing and batch mixing operations, sample asphalt binder before adding LAS. For continuous mixing operations, sample combined asphalt binder and LAS after the static mixer.

The Engineer orders proportioning operations stopped for any of the following if you:

1. Do not submit data
2. Submit incomplete, untimely, or incorrectly formatted data
3. Do not take corrective actions
4. Take late or unsuccessful corrective actions

5. Do not stop production when proportioning tolerances are exceeded
6. Use malfunctioning or failed proportioning devices

If you stop production, notify the Engineer of any corrective actions taken before resuming.

MATERIALS

LAS-treated asphalt binder must comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications. LAS does not substitute for asphalt binder.

LAS total amine value must be 325 minimum when tested under ASTM D 2074.

Use only 1 LAS type or brand at a time. Do not mix LAS types or brands.

Store and mix LAS under the manufacturer's recommendations.

CONSTRUCTION

LAS must be between 0.5 and 1.0 percent by weight of asphalt binder.

If 3 consecutive sets of recorded production data show actual delivered LAS weight is more than ± 1 percent of the approved mix design LAS weight, stop production and take corrective action.

If a set of recorded production data shows actual delivered LAS weight is more than ± 2 percent of the approved mix design LAS weight, stop production. If the LAS weight exceeds 1.2 percent of the asphalt binder weight, do not use the HMA represented by that data.

The continuous mixing plant controller proportioning the HMA must produce a production data log. The log consists of a series of data sets captured at 10-minute intervals throughout daily production. The data must be a production activity register and not a summation. The material represented by the data is the amount produced 5 minutes before and 5 minutes after the capture time. For the duration of the contract, collected data must be stored by the plant controller or a computer's memory at the plant.

MEASUREMENT AND PAYMENT

Full compensation for LAS is included in the contract price paid per ton for HMA as designated in the Bid Item List and no separate payment will be made therefor.

10-1.63 JOINTED PLAIN CONCRETE PAVEMENT

GENERAL

Summary

This work includes constructing jointed plain concrete pavement.

Comply with Section 40, "Concrete Pavement," of the Standard Specifications.

Submittals

Fabricate test specimens from a single sample of concrete for coefficient of thermal expansion testing under AASHTO T 336. Submit 4 test specimens for assurance testing.

Submit all your coefficient of thermal expansion data at the Web site:

<http://169.237.179.13/cte/>

For rejected test strips, submit a plan for changed materials, methods, or equipment before constructing additional test strips.

Quality Control and Assurance

General

Perform coefficient of thermal expansion testing under AASHTO T 336 at a frequency of 1 test for each 5,000 cubic yards of paving but not less than 1 test for projects with less than 5,000 cubic yards of JCPC. This test is not going to be used for acceptance.

Perform profilograph testing on concrete shoulders. Testing and test results must comply with the specifications for concrete pavement smoothness, profilograph test procedure, and corrective action for traffic lanes.

Prepaving Conference

Meet with the Engineer at a prepaving conference at a mutually agreed time and place. Discuss methods of performing the production and paving work.

Prepaving conference attendees must sign an attendance sheet provided by the Engineer. The prepaving conference must be attended by your:

1. Project superintendent
2. Quality control manager
3. Paving construction foreman
4. Subcontractor's workers including:
 - 4.1. Foremen
 - 4.2. Concrete plant manager
 - 4.3. Concrete plant operator
 - 4.4. Personnel performing saw cutting and joint sealing

Do not start paving activities including test strips until the listed personnel have attended a prepaving conference.

Test Strips

The first paving activity must be to construct a test strip:

1. 700 to 1,000 feet long
2. Same width as the planned paving
3. With the same equipment used for the planned paving

The Engineer evaluates the test strip for compliance with the specifications for Engineer's acceptance.

The Engineer selects from 6 to 12 core locations for dowel bars and up to 6 locations for tie bars per test strip.

If you use mechanical dowel bar inserters, the test strip must demonstrate they do not leave voids, segregations, or surface irregularities such as depressions, dips, or high areas.

Allow the Engineer 3 days to evaluate the test strip for:

1. Smoothness
2. Dowel bar and tie bar alignment
3. Thickness
4. Final finishing except coefficient of friction

During the 3-day evaluation, the Engineer rejects a test strip if:

1. Surface varies more than 0.02 foot from a 12-foot straightedge's lower edge
2. Wheel path's individual high points are greater than 0.025 foot in 25 feet
3. Dowel bars do not comply with specified placement tolerances
4. Concrete pavement thickness deficiency is greater than 0.05 foot
5. Final finishing does not comply with the specifications except coefficient of friction

Remove the test strip if the Engineer rejects it for noncompliance with the specifications for dowel bar alignment or thickness. Dispose of rejected test strip material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

If the Engineer rejects the test strip for noncompliance with the smoothness or final finishing specifications except coefficient of friction, you may grind the test strip into compliance if you intend to leave it as part of the paving.

If the Engineer does not reject the test strip during the 3-day evaluation, you may begin production paving while the Engineer continues to evaluate the test strip for compliance with the other specifications. If the Engineer rejects the test strip for noncompliance with the other specifications, stop production paving until you construct a test strip the Engineer accepts.

Construct additional test strips until the Engineer accepts one.

Construct additional test strips if you:

1. Propose different paving equipment including:
 - 1.1. Paver
 - 1.2. Dowel bar inserter

- 1.3. Tie bar inserter
- 1.4. Tining
- 1.5. Curing equipment

2. Change concrete mix proportions

You may request authorization to eliminate the test strip if you use paving equipment and personnel from a Department project (1) for the same type of pavement and (2) completed within the past 12 months. Submit supporting documents and previous project information with your request.

MATERIALS

Concrete

For field qualification, perform coefficient of thermal expansion testing under AASHTO T 336.

Add enough air-entraining admixture in compliance with Section 90-4, "Admixtures," of the Standard Specifications to attain an air content of 4 ± 1.5 percent in the freshly mixed concrete.

Joint Seal

Use compression seal for transverse and longitudinal contraction joints. Install preformed compression seals in isolation joints.

Joint Filler for Isolation Joints

Joint filler for isolation joints must be bituminous expansion joint filler.

Tack Coat

Tack coat must comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

CONSTRUCTION

Tie Bar Spacing On Curves

If the curvature of a concrete pavement slab prevents equal spacing of tie bars to maintain the minimum clearance from transverse joints, space them from 15 to 18 inches.

Transverse Contraction Joints

Transverse contraction joints must be Type A1. If widening existing concrete pavement, do not construct transverse contraction joints to match the existing pavement's joint spacing or skew unless specified. Transverse joints in concrete pavement on a curve must be on a single straight line through the curve's radius point.

Longitudinal Contraction Joints

Longitudinal contraction joints must be Type A2.

Transition Joints With Hot Mix Asphalt

If a joint between concrete pavement and hot mix asphalt is specified, apply tack coat between the concrete pavement and hot mix asphalt.

Concrete Pavement Removal

When removing and replacing concrete, remove it to full depth and width.

Crack Treatment

If cracks form that do not extend to the full depth of a slab, treat the cracks with a high molecular weight methacrylate resin under "Concrete Pavement Crack Treatment."

Removal and Replacement of Slabs Without Bar Reinforcement

For full depth and partial length slab removal, saw cut the full depth and width.

Saw cut full slabs at the longitudinal and transverse joints. Saw cut partial slabs at joints and where the Engineer orders. You may make additional saw cuts within the removal area to facilitate slab removal or to prevent binding of the saw cut at the removal area's edge. Saw cut perpendicular to the slab surface.

Use slab lifting equipment with lifting devices that attach to the slab. After lifting the slab, paint the cut ends of dowels and tie bars.

Construct transverse and longitudinal construction joints between the new slab and existing concrete using dowel bars. For longitudinal joints, offset dowel bar holes from original tie bars by 3 inches. For transverse joints, offset dowel bars holes from the original dowel bars by 3 inches.

Drill holes and use chemical adhesive to bond the dowel bars to the existing concrete. Use an automated dowel bar drilling machine. Holes must be at least 1/8-inch greater than the dowel bar diameter. Clean the holes in compliance with the chemical adhesive manufacturer's instructions. Holes must be dry when you place chemical adhesive.

Immediately after inserting dowel bars into the chemical adhesive-filled holes, support the dowel bars and leave them undisturbed for the minimum cure time recommended by the chemical adhesive manufacturer.

Clean the faces of joints and underlying base from loose material and contaminants. Coat the faces with a double application of pigmented curing compound under Section 28-1.07, "Curing," of the Standard Specifications. For partial slab replacements, place preformed sponge rubber expansion joint filler at new transverse joints in compliance with ASTM D 1752.

MEASUREMENT AND PAYMENT

If the Engineer accepts a test strip and it remains as part of the paving surface, the test strip is measured and paid for as jointed plain concrete pavement, seal pavement joint, and seal isolation joint as the case may be.

Full compensation for providing a facility for and attending the prepaving conference is included in the contract price paid per cubic yard for jointed plain concrete pavement and no additional compensation is allowed therefor.

Full compensation for applying tack coat at transverse transition joints and end anchors is included in the contract price paid per cubic yard for jointed plain concrete pavement and no separate payment is made therefor.

If the curvature of a slab affects tie bar spacing and additional tie bars are required, they are included in the contract price paid per cubic yard for jointed plain concrete pavement and no additional compensation is allowed therefor.

The contract unit price paid for dowel bar (drill and bond) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in drilling holes, placing epoxy-coated dowel bars, and bonding the dowel bars with chemical adhesive, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.64 JOINTED PLAIN CONCRETE PAVEMENT (RAPID STRENGTH CONCRETE)

GENERAL

Summary

This work includes constructing jointed plain concrete pavement (JPCP) with rapid strength concrete (RSC). Comply with Section 40, "Concrete Pavement," of the Standard Specifications.

Definitions

early age: Time less than 10 times the concrete's final set time.

final set time: Time a specific penetration resistance of 4,000 psi is achieved, determined under ASTM C 403.

opening age: Time the concrete achieves the specified strength for opening to traffic.

transverse crack: A crack running from one longitudinal edge of the panel to the other.

Submittals

Submit AASHTO T 336 coefficient of thermal expansion test results to the Engineer and at the website <http://169.237.179.13/cte/>.

Quality Control and Assurance

Prepaving Conference

Meet with the Engineer at a prepaving conference at a mutually agreed time and place. Discuss methods of performing the production and paving work.

Prepaving conference attendees must sign an attendance sheet provided by the Engineer. The prepaving conference must be attended by your:

1. Project superintendent
2. Quality control manager
3. Paving construction foreman

4. Subcontractor's workers including:
 - 4.1. Foremen
 - 4.2. Concrete plant manager
 - 4.3. Concrete plant operator
 - 4.4. Personnel performing saw cutting and joint sealing

Do not start paving activities until the listed personnel have attended a prepaving conference.

Mix Design

At least 10 days before use in a trial slab, submit a mix design for RSC that includes:

1. Opening age
2. Proposed aggregate gradation
3. Proportions of hydraulic cement and aggregate
4. Types and amounts of chemical admixtures
5. Maximum time allowed between batching and placing
6. Range of ambient temperatures over which the mix design is effective
7. Final set time
8. Any special instructions or conditions such as water temperature requirements

Submit more than 1 mix design to plan for ambient temperature variations anticipated during RSC placement. Each mix design must have a maximum ambient temperature range of 18 °F.

Submit modulus of rupture development data for each mix design. You may use modulus of rupture development data from laboratory-prepared samples. The testing ages for modulus of rupture development data must include 1 hour before opening age, opening age, one hour after opening age, 24 hours, 7 days, and 28 days.

During concrete mix design, perform coefficient of thermal expansion testing under AASHTO T 336 from trial mixture samples. Provide a split test sample to METS. If changing an aggregate supply source or the mix properties or proportions, perform coefficient of thermal expansion testing for the new concrete mix.

Calibration Testing Certificates of Compliance

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications with each delivery of aggregate, cement, and admixtures to be used for calibration tests. Submit certified copies of the weight of each delivery. The Certificate of Compliance must state the source of materials used for the calibration tests is from the same source to be used in the work. The Certificate of Compliance must be signed by your authorized representative.

Cement and Admixtures

At least 45 days before intended use, submit a sample of cement from each proposed lot and samples of proposed admixtures in the quantities ordered by the Engineer.

During RSC pavement operations, submit uniformity reports for hydraulic cement at least once every 30 days to the Transportation Laboratory, Attention: Cement Laboratory. Uniformity reports must comply with ASTM C 917, except testing age and water content may be modified to suit the particular material.

Quality Control Program

General

Establish a quality control program. The quality control program assures the Engineer that methods and procedures are in place to produce and place RSC in compliance with the specifications.

If the quality control program is not implemented and followed, the Engineer orders RSC work stopped.

Quality Control Managers

For the project, designate a lead QCM and assistant QCMs.

The lead QCM administers the quality control plan (QCP). The lead QCM must hold current American Concrete Institute (ACI) certification as "Concrete Field Testing Technician-Grade I" and "Concrete Laboratory Testing Technician-Grade II." Assistant QCMs must hold current ACI certification as "Concrete Field Testing Technician-Grade I" and either "Concrete Laboratory Testing Technician-Grade I" or "Concrete Laboratory Testing Technician-Grade II."

The QCM responsible for the production period involved must review and sign the sampling, inspection, and test reports before submittal to the Engineer. At least 1 QCM must be present for:

1. Each stage of mix design
2. Trial slab construction
3. Production and construction of RSC
4. Meetings with the Engineer relating to production, placement, or testing.

A QCM must not be a member of this project's production or paving crews, an inspector, or a tester. A QCM must have no duties during the production and placement of RSC except those specified.

Quality Control Plan

The QCP describes the procedures you will use to control the production process including:

1. Determining if changes to the production process are needed
2. Procedures for proposing changes
3. Procedures for implementing changes

Do not start RSC work until the QCP has been accepted by the Engineer. The Engineer accepts the QCP based the inclusion and adequacy of:

1. The names and qualifications of the lead Quality Control Manager (QCM) and assistant QCMs.
2. An outline procedure for the placement and testing of trial slabs
3. An outline procedure for the production, transportation, and placement of RSC
4. An outline procedure for sampling and testing to be performed during and after RSC construction
5. A contingency plan for correcting problems in production, transportation, or placement. Include the quantity and location of standby material in your contingency plan.
6. Provisions for determining if RSC placement must be suspended and temporary roadway pavement structure constructed
7. Forms to report inspection, sampling, and testing
8. The location of your quality control testing laboratory and testing equipment during and after paving operations
9. A list of the testing equipment to be used including date of last calibration
10. The names and certifications of quality control personnel including those performing sampling and testing

At the time of QCP submission, the Department qualifies the quality control samplers and testers through the Independent Assurance Program (IAP) for the sampling and testing they perform.

Quality Control Inspection, Sampling, and Testing

Perform quality control sampling, testing, and inspection throughout RSC production and placement. Before any sampling and testing, give the Engineer at least 2 business days notice. Give the Engineer unrestricted access to your quality control inspectors, samplers, testers, and laboratories. Submit testing results within 15 minutes of testing completion. Record inspection, sampling, and testing on the forms accepted with the QCP and submit them within 48 hours of completion of each paving shift and within 24 hours of 7-day modulus of rupture tests.

Provide a testing laboratory to perform quality control tests. Maintain sampling and testing equipment in proper working condition. Perform sampling under California Test 125.

Testing laboratories and testing equipment must comply with the Department's Independent Assurance Program.

Trial Slabs

Before starting work on RSC, complete one trial slab for each rapid strength concrete mix design. Trial slabs demonstrate that you are capable of producing replacement concrete pavement in compliance with the specifications within the specified time periods including delivery, placement, finishing, and curing times, and under similar atmospheric and temperature conditions expected during replacement operations.

The trial slab must be at least 10' x 20'. The trial slab thickness must be at least 10 inches. Place trial slabs near the job site at a mutually-agreed location that is neither on the roadway nor within the project limits.

During trial slab construction, sample and split the aggregate for gradings, cleanness value, and sand equivalent testing.

Trial slab must comply with the QCP for RSC production and placement. The QCP must detail your intended:

1. Locations and times
2. Production procedures
3. Placement and finishing methods
4. Sampling methods, sample curing, and sample transportation
5. Testing and test result reporting

Within 20 minutes after rapid strength concrete delivery for test strips, fabricate test beams under California Test 524. Use beams to determine early age and 7-day modulus of rupture values.

Cure beams fabricated for early age testing so that the monitored temperatures in the beams and the test strip are always within 5 °F. Monitor and record the internal temperatures of trial slab and early age beams at intervals of at least 5 minutes. Install thermocouples or thermistors connected to strip-chart recorders or digital data loggers to monitor the temperatures. Temperature recording devices must be accurate to within ± 2 °F. Measure internal temperatures at 1 inch from the top, 1 inch from the bottom, and no closer than 3 inches from any edge until early age testing is completed.

Cure beams fabricated for 7-day testing under California Test 524 except place them into sand at a time that is from 5 to 10 times the final set time, or 24 hours, whichever is earlier.

Trial slab must have an early age modulus of rupture of not less than 400 psi and a 7-day modulus of rupture of not less than 600 psi.

Dispose of trial slab and test specimens for test strip under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Production Process Control and Quality Control Testing

Contingency plan equipment and personnel must be present at the job site.

Provide continuous process control and quality control sampling and testing throughout RSC production and placement.

During production of RSC, sample and test aggregates at least once for every 650 cubic yards of RSC produced, but not less than once per placement shift. Test aggregates for compliance with gradations, cleanness value, and sand equivalent specifications.

At least once for every 650 cubic yards of RSC produced, but not less than twice per placement shift, sample and test for:

1. Yield
2. Penetration
3. Air content
4. Unit weight

During placement of RSC, fabricate beams and test for modulus of rupture within the first 30 cubic yards, at least once every 130 cubic yards, and within the final truckload.

If the Engineer requests, submit split samples and fabricate test beams for the Engineer's testing.

For determining early age modulus of rupture, cure beams under the same conditions as the pavement until 1 hour before testing. Cure beams fabricated for the 7-day test under California Test 524. The Engineer uses modulus of rupture test results for accepting or rejecting the replacement pavement and pay factor adjustment for low modulus of rupture.

Dispose of materials resulting from the construction of the test beams, temporary roadway pavement structure, and rejected replacement pavement under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Weighmaster Certificates

Weighmaster certificates for RSC, regardless of the proportioning method used, must include the information necessary to trace the manufacturer and the manufacturer's lot number for the cement being used. If proportioned into fabric containers, the weighmaster certificates for the cement must contain date of proportioning, location of proportioning, and actual net draft cement weight. If proportioned at the pour site from a storage silo, the weighmaster certificates must contain date of proportioning, location of proportioning, and the net draft cement weight used in the load.

Engineer's Acceptance for Modulus of Rupture

RSC pavement must develop a minimum modulus of rupture of 400 psi before opening to traffic. RSC pavement must develop a minimum modulus of rupture of 600 psi 7 days after placement. The Engineer may accept RSC pavement that does not attain the specified moduli of rupture as specified in "Pay Factor Adjustment for Low Modulus of Rupture." You must determine the modulus of rupture by testing 3 beam specimens under California Test 524 and averaging the results in the presence of the Engineer. You may fabricate beam specimens using an internal vibrator under ASTM C 31. No single test represents more than that day's production or 130 cubic yards, whichever is less.

Beam specimens for early age must be cured so the temperature in the specimens is within 5 °F of the temperature in the pavement. You must determine the modulus of rupture at other ages using beams cured and tested under California Test 524 except place them in sand from 5 to 10 times the final set time or 24 hours, whichever is earlier. You must perform the testing to determine modulus of rupture values of the RSC pavement in the presence of the Engineer.

Pay Factor Adjustment for Low Modulus of Rupture

The Engineer adjusts payment for RSC for modulus of rupture as follows:

1. Payment for RSC with a modulus of rupture of 400 psi or greater before opening to traffic and 7-day modulus of rupture of 600 psi or greater is not adjusted.
2. Payment for RSC with a 7-day modulus of rupture less than 500 psi is not adjusted and no payment is made. Remove this RSC and replace it at your expense with RSC that complies with the specifications.
3. Payment for RSC with a modulus of rupture less than 350 psi before opening to traffic is not adjusted and no payment is made. Remove this RSC and replace it at your expense with RSC that complies with the specifications.
4. Payment for RSC with a modulus of rupture of 350 psi or greater before opening to traffic and a 7-day modulus of rupture greater than or equal to 500 psi is reduced by the percentage in the pay table for the quantity represented by the tests.

Percentage Pay Table

Modulus of Rupture (psi) at opening to traffic	7-Day Modulus of Rupture (psi)		
	Greater than or equal to 600	Less than 600 and greater than or equal to 550	Less than 550 and greater than or equal to 500
Greater than or equal to 400	100%	95%	90%
Less than 400 and greater than or equal to 350	95%	95%	90%
Less than 350	0%	0%	0%

The Engineer rejects any RSC area that develops 1 or more transverse full depth random cracks within 64 days after placement. Remove this RSC at your expense and replace it with RSC that complies with the specifications.

MATERIALS

Temporary Roadway Pavement Structure

Aggregate Base

Aggregate base for temporary roadway pavement structure must be produced from any combination of broken stone, crushed gravel, natural rough-surfaced gravel, reclaimed concrete and sand. Grading of aggregate base must comply with the 3/4-inch maximum grading specified in Section 26-1.02A, "Class 2 Aggregate Base," of the Standard Specifications.

Hot Mix Asphalt

For hot mix asphalt:

1. Choose the 3/8-inch or 1/2-inch HMA Type A or Type B aggregate gradation under Section 39-1.02E, "Aggregate," of the Standard Specifications.
2. Minimum asphalt binder content must be 6.8 percent for 3/8-inch aggregate gradation and 6.0 percent for 1/2-inch aggregate gradation.

- Choose asphalt binder Grade PG 64-10, PG 64-16, or PG 70-10 under Section 92, "Asphalts," of the Standard Specifications.

Rapid Strength Concrete

RSC that fails to meet opening strength but has a modulus of rupture of at least 200 psi may serve as temporary roadway and must be replaced prior to acceptance of the contract.

Bond Breaker

Bond breaker must be one of the following:

- White curing paper under ASTM C 171
- White opaque polyethylene film under ASTM C 171, except that the minimum thickness must be 6 mils
- Paving asphalt, Grade PG 64-10, under Section 92, "Asphalts," of the Standard Specifications
- Curing compound (5) under Section 90-7.01b, "Curing Compound Method," of the Standard Specifications

Rapid Strength Concrete

RSC must be one of the following:

- Concrete complying with section 90 "Portland Cement Concrete", except you may use Type III portland cement.
- Concrete complying with section 90 "Portland Cement Concrete", except:

2.1. You may use any cement that complies with the definition of hydraulic cement or blended hydraulic cement in ASTM C 219 and the requirements shown in the following table:

Hydraulic Cement^c

Test Description	Test Method	Requirement ^b
Contraction in air	California Test 527, W/C Ratio = 0.39 ±0.010	0.053 %, max.
Mortar expansion in water	ASTM C 1038	0.04 %, max.
Soluble chloride ^a	California Test 422	0.05 %, max.
Soluble sulfates ^a	California Test 417	0.30 %, max.
Thermal stability	California Test 553	90 %, min.
Compressive strength @ 3 days	ASTM C 109	2,500 psi

Note:

^a Perform test on a cube specimen fabricated under ASTM C 109. Cure the specimen at least 14 days and then pulverized to 100 percent passing the No. 50 sieve.

^b If you use chemical admixtures, include them when testing.

^c The requirements of this table does not apply to portland cement.

- 2.2. You may use citric acid or borax if you submit a written request from the cement manufacturer and a test sample.

Section 40-2.01C does not apply.

Supplementary cementitious material is not required in RSC.

Choose the combined aggregate grading for RSC from either the 1-1/2 inch maximum or the 1-inch maximum combined grading under Section 90-3.04, "Combined Aggregate Gradings," of the Standard Specifications.

Aggregate for RSC must be either:

- Innocuous in conformance with the provisions in Section 90-2.02, "Aggregates."
- When tested under ASTM C 1567 using the proposed aggregate and cementitious materials, the expansion is less than 0.10 percent. Submit test data with each mix design. Test data authorized by the Department no more than 3 years before the 1st day of the Contract is authorized for the entire Contract. The test data must be for the same concrete mix and must use the same materials and material sources to be used on the Contract.

You may use Type C accelerating and Type E accelerating and water reducing chemical admixtures as specified in Section 90-4, "Admixtures," of the Standard Specifications. The requirement for air entrainment of concrete in freeze-thaw areas only applies when portland cement is used.

During concrete mix design, perform coefficient of thermal expansion testing under AASHTO T 336 from trial mixture samples. If changing an aggregate supply source or the mix properties or proportions, perform coefficient of thermal expansion testing for the new concrete mix. This test will not be used for acceptance.

Joint Seal

Use compression seal for seal existing pavement transverse and longitudinal joints.

Joint Seal for Isolation Joints

Joint seal for isolation joints must be compression seal.

Joint Filler for Isolation Joints

Joint filler for isolation joints must be bituminous expansion joint filler.

Tack Coat

Tack coat must comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

CONSTRUCTION

Tie Bar Spacing On Curves

If the curvature of a concrete pavement slab prevents equal spacing of tie bars to maintain the minimum clearance from transverse joints, space them from 15 to 18 inches.

Transverse Contraction Joints

Transverse contraction joints must be Type A-1. If widening existing concrete pavement, do not construct transverse contraction joints to match the existing pavement's joint spacing or skew unless specified. Transverse joints in concrete pavement on a curve must be on a single straight line through the curve's radius point.

Longitudinal Contraction Joints

Longitudinal contraction joints must be Type A-2.

Transition Joints With Hot Mix Asphalt

If a joint between concrete pavement and hot mix asphalt is specified, apply tack coat between the concrete pavement and hot mix asphalt.

Temporary Roadway Pavement Structure

Place hot mix asphalt and aggregate base where existing pavement is replaced for construction of a temporary roadway pavement structure. The quantity must be equal to the quantity of pavement removed during the work shift. If you place temporary roadway pavement structure, it must be maintained and later removed as the first order of work when JPCP (RSC) activities resume. The temporary roadway pavement structure must consist of 3-1/2 inch thick hot mix asphalt over aggregate base. RSC not conforming to the specifications may be used for temporary roadway pavement structure with the Engineer's approval.

Spread and compact aggregate base and hot mix asphalt by methods that produce a well-compacted, uniform base, with a surface of uniform smoothness, texture and density. Surfaces must be free from pockets of coarse or fine material. You may spread aggregate base and hot mix asphalt each in one layer. The finished surface of hot mix asphalt must not vary more than 0.05 foot from the lower edge of a 12-foot long straightedge placed parallel with the centerline and must match the elevation of existing concrete pavement along the joints between the existing pavement and temporary surfacing.

After removing temporary roadway pavement structure, you may stockpile removed aggregate base at the project site and reuse it for temporary roadway pavement structures. When no longer required, dispose of standby material or stockpiled material for temporary roadway pavement structures under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Rapid Strength Concrete

General

Concrete pavement penetration specified in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications does not apply to RSC.

RSC must develop the specified opening age and 7-day modulus of rupture strengths.

Proportioning

Weighing, measuring, and metering devices used for proportioning materials must comply with Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

For batches with a volume of 1 cubic yard or more, proportioning must comply with one of the following methods:

1. Batch the ingredients at a central batch plant and charge them into a mixer truck for transportation to the pour site. Proportion ingredients under Section 90-5, "Proportioning," of the Standard Specifications.
2. Batch the ingredients except the cement at a central batch plant and charge them into a mixer truck for transportation to a cement silo and weigh system, which must proportion cement for charging into the mixer truck.
3. Batch ingredients except the cement at a central batch plant and charge them into a mixer truck for transportation to a location where pre-weighed containerized cement is added to the mixer truck. The cement pre-weighing operation must utilize a platform scale. The platform scale must have a maximum capacity of 2.75 tons with a maximum graduation size of 1 pound. Pre-weigh cement into a fabric container. The minimum amount of cement to be proportioned into any single container must be 1/2 of the total amount required for the load of RSC being produced.
4. Cement, water, and aggregate are proportioned volumetrically.

For central batch plants, indicators for weighing and measuring systems such as over and under dials must be grouped so that each indicator's smallest increment can be accurately read from the control point of the proportioning operation. In addition, indicators for weighing and measuring cement batched from a remote weighing system must be placed so that each indicator can be accurately read from the control point of the proportioning operation.

Weighing equipment must be insulated from other equipment's vibration or movement. When the plant is operating, each draft's material weight must not vary from the designated weight by more than the specified tolerances. Each scale graduation must be 0.001 of the usable scale capacity.

Aggregate must be weighed cumulatively. Equipment for weighing aggregate must have a zero tolerance of ± 0.5 percent of the aggregate's designated total batch weight. Equipment for the separate weighing of the cement must have a zero tolerance of ± 0.5 percent of the cement's designated individual batch draft. Equipment for measuring water must have a zero tolerance of ± 0.5 percent of the water's designated weight or volume.

The weight indicated for any individual batch of material must not vary from the preselected scale setting by more than:

Batch Weight Tolerances

Material	Tolerance
Aggregate	± 1.0 percent of designated batch weight
Cement	± 0.5 percent of designated batch weight
Water	± 1.5 percent of designated batch weight or volume

Proportioning consists of dividing the aggregate into the specified sizes and storing them in separate bins, and then combining the aggregate with cement and water. Proportion dry ingredients by weight. Proportion liquid ingredients by weight or volume.

Handle and store aggregates under Section 90-5.01, "Storage of Aggregates," of the Standard Specifications. Proportion liquid admixtures under Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures," of the Standard Specifications.

Control aggregate discharged from several bins with gates or mechanical conveyors. The means of discharge from the bins and from the weigh hopper must be interlocked so that no more than 1 bin can discharge at a time, and the weigh hopper cannot be discharged until the required quantity from each of the bins has been deposited in the weigh hopper.

At the time of batching, dry and drain aggregates to a stable moisture content. Do not proportion aggregates with visible separation of water from the aggregate during proportioning. At the time of batching, the free moisture content of fine aggregate must not exceed 8 percent of its saturated, surface-dry weight.

If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust 1 supply before using another supply.

Keep cement separated from the aggregate until discharged into the mixer. When discharged into the mixer, cement must be free of lumps and clods. Before reuse, clean fabric containers used for transportation or proportioning of cement.

Weigh systems for proportioning aggregate and cement must be individual and distinct from other weigh systems. Each weigh system must have a hopper, a lever system, and an indicator.

When ordered by the Engineer, determine the gross weight and tare weight of truck mixers on scales designated by the Engineer.

Install and maintain in operating condition an electrically actuated moisture meter. The meter must indicate on a readily visible scale the changes in the fine aggregate moisture content as it is batched. The meter must have a sensitivity of 0.5 percent by weight of the fine aggregate.

Obtain the Engineer's acceptance before mixing water into the concrete during hauling or after arrival at the delivery point. If the Engineer accepts additional water be incorporated into the concrete, the drum must revolve not less than 30 revolutions at mixing speed after the water is added and before starting discharge. Measure water added to the truck mixer at the job site through a meter in compliance with Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

Volumetric Proportioning

You may choose to proportion RSC by volume.

Handle and store aggregates under Section 90-5.01, "Storage of Aggregates," of the Standard Specifications. Proportion liquid admixtures under Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures," of the Standard Specifications.

Batch-mixer trucks must proportion cement, water, aggregate, and additives by volume. Aggregate feeders must be connected directly to the drive on the cement vane feeder. The cement feed rate must be tied directly to the feed rate for the aggregate and other ingredients. Only change the ratio of cement to aggregate by changing the gate opening for the aggregate feed. The drive shaft of the aggregate feeder must have a revolution counter reading to the nearest full or partial revolution of the aggregate delivery belt.

Proportion aggregate with a belt feeder operated with an adjustable cutoff gate delineated to the nearest quarter increment. The gate opening height must be readily determinable. Proportion cement by any method that complies with the accuracy tolerance specifications. Proportion water with a meter under Section 9-1.01, "Measurement and Payment," of the Standard Specifications.

Calibrate the cutoff gate for each batch-mixer truck used and for each aggregate source. Calibrate batch-mixer trucks at 3 different aggregate gate settings that are commensurate with production needs. Perform at least 2 calibration runs for each aggregate gate.

Individual aggregate delivery rate check-runs must not deviate more than 1.0 percent from the mathematical average of all runs for the same gate and aggregate type. Each test run must be at least 1,000 pounds.

At the time of batching, dry and drain aggregates to a stable moisture content. Do not proportion aggregates with visible separation of water from the aggregate during proportioning. At the time of batching, the free moisture content of fine aggregate must not exceed 8 percent of its saturated, surface-dry weight.

If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust 1 supply before using another supply.

Cover rotating and reciprocating equipment on batch-mixer trucks with metal guards.

Individual cement delivery rate check-runs must not deviate more than 1.0 percent of the mathematical average of 3 runs of at least 1,000 pounds each.

When the water meter operates from 50 to 100 percent of production capacity, the indicated weight of water delivered must not differ from the actual weight delivered by more than 1.5 percent for each of 2 runs of 300 gallons. Calibrate the water meter under California Test 109. The water meter must be equipped with a resettable totalizer and display the operating rate.

Conduct calibration tests for aggregate, cement, and water proportioning devices with a platform scale located at the calibration site. Platform scales for weighing test-run calibration material must have a maximum capacity of 2.75 tons with maximum graduations of 1 pound. Error test the platform scale within 8 hours of calibrating the batch-mixer truck proportioning devices. Perform error-testing with test weights under California Test 109. Furnish a witness scale that is within 2 graduations of the test weight load. The witness scale must be available for use at the production site throughout the production period. Equipment needed for the calibration of proportioning systems must remain available at the production site throughout the production period.

The batch-mixer truck must be equipped so that accuracy checks can be made. Recalibrate proportioning devices every 30 days after production starts or when you change the source or type of any ingredient.

A spot calibration is calibration of the cement proportioning system only. Perform a 2-run spot calibration each time 55 tons of cement passes through the batch-mixer truck. If the spot calibration shows the cement proportioning

system does not comply with the specifications, complete a full calibration of the cement proportioning system before you resume production.

Proportion liquid admixtures with a meter.

Locate cement storage immediately before the cement feeder. Equip the system with a device that automatically shuts down power to the cement feeder and aggregate belt feeder when the cement storage level is less than 20 percent of the total volume.

Submit aggregate moisture determinations, made under California Test 223, at least every 2 hours during proportioning and mixing operations. Record moisture determinations and submit them at the end of each production shift.

Equip each aggregate bin with a device that automatically shuts down the power to the cement feeder and the aggregate belt feeder when the aggregate discharge rate is less than 95 percent of the scheduled discharge rate.

Proportioning device indicators must be in working order before starting proportioning and mixing operations and must be visible when standing near the batch-mixer truck.

Identifying numbers of batch-mixer trucks must be at least 3 inches in height, and be located on the front and rear of the vehicles.

Mix volumetric proportioned RSC in a mechanically operated mixer. You may use auger-type mixers. Operate mixers uniformly at the mixing speed recommended by the manufacturer. Do not use mixers that have an accumulation of hard concrete or mortar.

Do not mix more material than will permit complete mixing. Reduce the volume of material in the mixer if complete mixing is not achieved. Continue mixing until a homogeneous mixture is produced at discharge. Do not add water to the RSC after discharge.

Do not use equipment with components made of aluminum or magnesium alloys that may have contact with plastic concrete during mixing or transporting of RSC.

The Engineer determines uniformity of concrete mixtures by differences in penetration measurements made under California Test 533. Differences in penetration are determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load. The differences must not exceed 5/8 inch. Submit samples of freshly mixed concrete. Sampling facilities must be safe, accessible, clean, and produce a sample that is representative of production. Sampling devices and sampling methods must comply with California Test 125.

Do not use ice to cool RSC directly. If ice is used to cool water used in the mix, it must be melted before entering the mixer.

When proportioning and charging cement into the mixer, prevent variance of the required quantity by conditions such as wind or accumulation on equipment.

Each mixer must have metal plates that provide the following information:

1. Designed usage
2. Manufacturer's guaranteed mixed concrete volumetric capacity
3. Rotation speed

The device controlling the proportioning of cement, aggregate, and water must produce production data. The production data must be captured at 15-minute intervals throughout daily production. Each capture of production data represents production activity at that time and is not a summation of data. The amount of material represented by each production capture is the amount produced in the period from 7.5 minutes before to 7.5 minutes after the capture time. The daily production data must be submitted in electronic or printed media at the end of each production shift. The reported data must be in the order including data titles as follows:

1. Weight of cement per revolution count
2. Weight of each aggregate size per revolution count
3. Gate openings for each used aggregate size
4. Weight of water added to the concrete per revolution count
5. Moisture content of each used aggregate size
6. Individual volume of other admixtures per revolution count
7. Time of day
8. Day of week
9. Production start and stop times
10. Batch-mixer truck identification
11. Name of supplier
12. Specific type of concrete being produced
13. Source of the individual aggregate sizes

14. Source, brand, and type of cement
15. Source, brand and type of individual admixtures
16. Name and signature of operator

You may input production data by hand into a pre-printed form or it may be captured and printed by the proportioning device. Present electronic media containing recorded production data in a tab delimited format on a CD or DVD. Each capture of production data must be followed by a line-feed carriage-return with sufficient fields for the specified data.

Bond Breaker

Place bond breaker between JPCP (RSC) and LCBRS layer.

If you use curing paper or polyethylene film, place it in a wrinkle free manner. Overlap adjacent sheets a minimum of 6 inches in the same direction as the concrete pour.

If you use curing compound or paving asphalt, before application remove foreign and loose materials remaining from slab removal.

If you use paving asphalt, do not add water before applying asphalt to the base surface. Apply the paving asphalt in one even application at a rate from 0.02 to 0.10 gallon per square yard over the entire base surface area. Do not place concrete pavement until the paving asphalt has cured.

If you use curing compound, apply it in 2 separate applications. Apply each application evenly at a rate from 0.07 to 0.11 gallon per square yard over the entire base surface area.

Spreading, Compacting, and Shaping

You may use metal or wood side forms. Wood side forms must not be less than 1-1/2 inches thick. Side forms must be of sufficient rigidity, both in the form and in the connection with adjoining forms, that movement will not occur under forces from subgrading and paving equipment or from the pressure of concrete.

Side forms must remain in place until the pavement edge no longer requires the protection of forms. Clean and oil side forms before each use.

After you deposit the RSC on the subgrade, consolidate RSC with high-frequency internal vibrators. Consolidate adjacent to forms and across the full paving width. Place RSC as nearly as possible to its final position. Do not use vibrators for extensive shifting of RSC.

Spread and shape RSC with powered finishing machines supplemented by hand finishing.

After you mix and place RSC, do not add water to the surface to facilitate finishing. Use surface finishing additives as recommended by the manufacturer of the cement after their use is approved by the Engineer.

Joints

Before placing RSC against existing concrete, place 1/4-inch thick commercial quality polyethylene flexible foam expansion joint filler across the original transverse and longitudinal joint faces and extend the excavation's full depth. Place the top of the joint filler flush with the top of the pavement. Secure joint filler to the joint face of the existing pavement to prevent the joint filler from moving during the placement of RSC.

Final Finishing

If the Engineer determines by visual inspection the final texturing may not comply with the specifications for coefficient of friction, the Engineer tests to determine coefficient of friction. Open the pavement to traffic and allow 5 days after concrete placement for the Department to test for coefficient of friction. If pavement does not comply with the specifications for coefficient of friction, grind the pavement under Section 42-2, "Grinding," of the Standard Specifications. Perform grinding before sealing joints.

On ramp termini, use heavy brooming normal to the ramp centerline to produce a coefficient of friction of at least 0.35 determined on the hardened surface under California Test 342.

Curing Method

Use the curing method recommended by the manufacturer of the cement for JPCP (RSC).

Concrete Pavement Removal

When removing and replacing concrete, remove it to full depth and width.

Crack Treatment

If cracks form that do not extend to the full depth of a slab, treat the cracks with a high molecular weight methacrylate resin under "Concrete Pavement Crack Treatment."

Removal and Replacement of Slabs Without Bar Reinforcement

For full depth and partial length slab removal, saw cut the full depth and width.

Saw cut full slabs at the longitudinal and transverse joints. Saw cut partial slabs at joints and where the Engineer orders. You may make additional saw cuts within the removal area to facilitate slab removal or to prevent binding of the saw cut at the removal area's edge. Saw cut perpendicular to the slab surface.

Use slab lifting equipment with lifting devices that attach to the slab. After lifting the slab, paint the cut ends of dowels and tie bars.

Construct transverse and longitudinal construction joints between the new slab and existing concrete using dowel bars. For longitudinal joints, offset dowel bar holes from original tie bars by 3 inches. For transverse joints, offset dowel bars holes from the original dowel bars by 3 inches.

Drill holes and use chemical adhesive to bond the dowel bars to the existing concrete. Use an automated dowel bar drilling machine. Holes must be at least 1/8-inch greater than the dowel bar diameter. Clean the holes in compliance with the chemical adhesive manufacturer's instructions. Holes must be dry when you place chemical adhesive.

Immediately after inserting dowel bars into the chemical adhesive-filled holes, support the dowel bars and leave them undisturbed for the minimum cure time recommended by the chemical adhesive manufacturer.

Clean the faces of joints and underlying base from loose material and contaminants. Coat the faces with a double application of pigmented curing compound under Section 28-1.07, "Curing," of the Standard Specifications. For partial slab replacements, place preformed sponge rubber expansion joint filler at new transverse joints in compliance with ASTM D 1752.

MEASUREMENT AND PAYMENT

The contract price paid per cubic yard for jointed plain concrete pavement (rapid strength concrete) as designated in the Verified Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the concrete pavement, complete in place including trial slabs, bond breaker, bar reinforcement, tie bars, dowel bars, anchors, and fasteners, as shown on the plans and as specified in these specifications and the special provisions, and as directed by the Engineer.

The Engineer adjusts payment for jointed plain concrete pavement (rapid strength concrete) in compliance with "Pay Factor Adjustment for Low Modulus of Rupture."

Repair, or removal and replacement of damaged pavement and base is at your expense and will not be measured or paid for.

Full compensation for providing a facility for and attending the prepaving conference is included in the contract price paid per cubic yard for jointed plain concrete pavement (rapid strength concrete) and no additional compensation is allowed therefor.

Full compensation for applying tack coat at transverse transition joints and end anchors is included in the contract price paid per cubic yard for jointed plain concrete pavement (rapid strength concrete) and no separate payment is made therefor.

If the curvature of a slab affects tie bar spacing and additional tie bars are required, they are included in the contract price paid per cubic yard for jointed plain concrete pavement (rapid strength concrete) and no additional compensation is allowed therefor.

If calibration of volumetric batch-trucks is performed more than 100 miles from the project limits, payment for individual slab replacement is reduced by \$1,000 per calibration session.

10-1.65 CONCRETE PAVEMENT JUST-IN-TIME-TRAINING

GENERAL

Summary

Your personnel required to attend the prepaving conference must also complete Just-In-Time-Training (JITT). JITT is a formal training class for the following pavement types:

Pavement Types for JITT
Jointed Plain Concrete Pavement
Lean Concrete Base Rapid Setting

Submittals

At least 7 business days before JITT, submit the instructor's name and listed experience, the JITT facility's location, and 1 copy each of the course syllabus, handouts, and presentation materials.

The Engineer provides training evaluation forms and each attendee must complete them. 5 business days after JITT, submit completed training evaluation forms to the Engineer and to:

Construction_Engineering_HQ@dot.ca.gov

Just-In-Time-Training

JITT must be:

1. At least 4 hours long
2. At your option, an extension of the prepaving conference
3. Conducted within 3 miles of the job site
4. Completed at least 20 days before you start paving activities
5. Conducted during normal working hours

Provide a JITT instructor who is experienced with the specified pavement construction methods, materials, and tests. The instructor must be neither your employee nor a Department field staff member. Upon JITT completion, the instructor must issue a certificate of completion to each participant.

The Engineer may waive training for personnel who have completed equivalent training within the 12 months preceding JITT. Submit certificates of completion for the equivalent training.

MEASUREMENT AND PAYMENT

The Engineer determines the costs for providing JITT under Section 9-1.03, "Force Account Payment," of the Standard Specifications, except no markups are added and you are paid for one half of the JITT cost. Costs for providing JITT include training materials, class site, and the JITT instructor including the JITT instructor's travel, lodging, meals and presentation materials. The Engineer does not pay your costs for attending JITT.

10-1.66 CONCRETE PAVEMENT CRACK TREATMENT

GENERAL

Summary

This work includes applying a high molecular weight methacrylate (HMWM) resin system to concrete pavement surface cracks that do not extend the full slab depth. HMWM resin system consists of:

1. HMWM resin
2. Promoter
3. Initiator

Submittals

Before starting crack treatment, submit the following plans under the specifications for working drawings in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications:

1. Public safety plan for HMWM resin system
2. Placement plan for the construction activity
3. Material Safety Data Sheet for each component of the HMWM resin system

The public safety plan and the placement plan must identify materials, equipment, and methods to be used. The public safety plan must include details for:

1. Shipping
2. Storage

3. Handling
4. Disposal of residual HMWM and the containers

The public safety plan must also include an airborne emissions monitoring plan prepared by a industrial hygienist with current certification in Comprehensive Practice by the American Board of Industrial Hygiene. Submit a copy of the hygienist's certification. The hygienist must monitor the emissions at a minimum of 4 points including the mixing point, the application point, and the point of nearest public contact. At work completion, submit a report by the industrial hygienist with results of the airborne emissions monitoring plan.

The placement plan must include:

1. Crack treatment schedule including coefficient of friction testing
2. Methods and materials including:
 - 2.1. Equipment description for HMWM resin system application
 - 2.2. Equipment description for sand application
 - 2.3. Manufacturer's gel time range and final cure time for resin

Revise rejected plans and resubmit. With each plan rejection, the Engineer gives revision directions including detailed comments in writing. The Engineer notifies you of a plan's acceptance or rejection within 2 weeks of receiving that plan.

Submit HMWM samples 20 days before use.

Quality Control and Assurance

Before starting crack treatment, treat a 500-square foot test area within the project limits and at a location accepted by the Engineer. Use test areas outside the traveled way if available. Weather and pavement conditions during the test crack treatment must be similar to those expected during production crack treatment. Use equipment during testing similar to those to be used during crack treatment.

For the test area and during crack treatment, use test tiles for evaluating the HMWM resin system cure time. Coat at least one 4" x 4" smooth glazed tile for each batch of HMWM resin system. Place the coated tile adjacent to the area being treated. Do not apply sand to the test tiles.

Do not start crack treatment until the Engineer accepts the test area.

The Engineer accepts a treated area if:

1. The corresponding test tiles are dry to the touch
2. The treated surface is tack-free and non-oily
3. The sand cover adheres enough to resist hand brushing
4. You remove excess sand
5. The coefficient of friction is at least 0.30 determined under California Test 342

MATERIALS

Promoter and initiator in the HMWM resin system must be compatible. The HMWM resin may be a prepromoted resin consisting of promoter and resin mixed together before filling containers. Identify prepromoted resin on the container label.

Adjust the gel time to compensate for temperature changes throughout the application.

HMWM resin must comply with:

High Molecular Weight Methacrylate Resin

Property	Requirement	Test Method
Viscosity ^a	25 cP, maximum, (Brookfield RVT with UL adapter, 50 RPM at 77 °F	ASTM D 2196
Specific Gravity ^a	0.90 minimum, at 77 °F	ASTM D 1475
Flash Point ^a	180 °F, minimum	ASTM D 3278
Vapor Pressure ^a	1.0 mm Hg, maximum, at 77 °F	ASTM D 323
Tack-free Time	400 minutes, maximum, at 77 °F	Specimen prepared under California Test 551
Volatile Content ^a	30 percent, maximum	ASTM D 2369
PCC Saturated Surface-Dry Bond Strength	500 psi, minimum at 24 hours and 77 °F±2 °F	California Test 551

Note:

^aTest must be performed before adding initiator.

Sand must be commercial quality dry blast sand. At least 95 percent of the sand must pass the No. 8 sieve and at least 95 percent must be retained on the No. 20 sieve.

CONSTRUCTION

Apply HMWM resin system after any grinding.

Prevent deleterious material such as oil from being deposited on the pavement by equipment with devices such as traps, filters, and drip pans.

Before applying HMWM resin system, clean the pavement surface by abrasive blasting and blow loose material from visible cracks with high-pressure air. Remove concrete curing seals from the pavement to be treated. The pavement must be dry when blast cleaning is performed. If the pavement surface becomes contaminated before applying the HMWM resin system, clean the pavement surface by abrasive blasting.

If performing abrasive blasting within 10 feet of a lane occupied by traffic, operate abrasive blasting equipment with a concurrently operating vacuum attachment.

During pavement treatment, protect pavement joints, working cracks, and surfaces not to be treated. Block drains and openings that convey water to water ways.

The machine applying HMWM resin system must combine the components by either static in-line mixers or by external intersecting spray fans. The pump pressure at the spray bars must not cause atomization. Do not use compressed air to produce the spray. Use a shroud to enclose the spray bar apparatus.

You may apply HMWM resin system manually to prevent overspray onto adjacent traffic. If applying resin manually, limit the batch quantity of HMWM resin system to 5 gallons.

Do not apply HMWM resin system in more than 90 percent relative humidity. The prepared area must be dry and the surface temperature must be from 50 to 100 °F when the HMWM resin system is applied. Apply HMWM resin system at a rate of 90 square feet per gallon.

Protect existing facilities from the HMWM resin system application. Repair or replace existing facilities contaminated with HMWM resin system at your expense.

Flood the treatment area with HMWM resin system, penetrating the pavement and cracks. Apply HMWM resin system within 5 minutes after complete mixing. Mixed HMWM resin system viscosity must not increase. Redistribute excess material with squeegees or brooms within 10 minutes of application. Remove excess material from tined grooves.

Wait at least 20 minutes after applying HMWM resin system before applying sand. Apply sand at a rate of approximately 2 pounds per square yard or until refusal. Remove excess sand by vacuuming or sweeping.

Do not allow traffic on the treated surface until:

1. Treated surface is tack-free and non-oily
2. Sand cover adheres enough to resist hand brushing

3. Excess sand is removed
4. Coefficient of friction is at least 0.30 under California Test 342

PAYMENT

Full compensation for concrete pavement crack treatment is included in the contract price paid per cubic yard for jointed plain concrete pavement and jointed plain concrete pavement (rapid strength concrete) as designated in the Bid Item List and no separate payment will be made therefor.

10-1.67 INDIVIDUAL SLAB REPLACEMENT (RAPID STRENGTH CONCRETE)

GENERAL

Summary

This work includes removing existing concrete pavement and constructing new pavement.

Definitions

early age: Time less than 10 times the concrete's final set time.

final set time: Time a specific penetration resistance of 4,000 psi is achieved, determined under ASTM C 403.

opening age: Time the concrete achieves the specified strength for opening to traffic.

Submittals

Quality Control Plan

At least 20 days before placing trial slabs, submit a written Quality Control Plan (QCP). The QCP must detail the methods used to ensure the quality of the work. You or the Engineer may request a meeting with you, the Quality Control Managers (QCMs), and the Engineer to discuss the QCP. Allow the Engineer 15 days to accept the QCP.

Mix Design

At least 10 days before use in a trial slab, submit a mix design for RSC that includes:

1. Opening age
2. Proposed aggregate gradation
3. Proportions of hydraulic cement and aggregate
4. Types and amounts of chemical admixtures
5. Maximum time allowed between batching and placing
6. Range of ambient temperatures over which the mix design is effective
7. Final set time
8. Any special instructions or conditions such as water temperature requirements

Submit more than 1 mix design to plan for ambient temperature variations anticipated during RSC placement. Each mix design must have a maximum ambient temperature range of 18 °F.

Submit modulus of rupture development data for each mix design. You may use modulus of rupture development data from laboratory-prepared samples. The testing ages for modulus of rupture development data must include 1 hour before opening age, opening age, one hour after opening age, 24 hours, 7 days, and 28 days.

Trial Slab

Submit split aggregate samples taken during trial slab construction.

Calibration Testing Certificates of Compliance

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications with each delivery of aggregate, cement, and admixtures to be used for calibration tests. Submit certified copies of the weight of each delivery. The Certificate of Compliance must state the source of materials used for the calibration tests is from the same source to be used in the work. The Certificate of Compliance must be signed by your authorized representative.

Cement and Admixtures

Except for portland cement concrete, at least 45 days before intended use, submit a sample of cement from each proposed lot and samples of proposed admixtures in the quantities ordered by the Engineer.

During RSC pavement operations, submit uniformity reports for hydraulic cement at least once every 30 days to the Transportation Laboratory, Attention: Cement Laboratory. Uniformity reports must comply with ASTM C 917, except testing age and water content may be modified to suit the particular material.

Quality Control and Assurance

Pre-operation Conference

Meet with the Engineer at a pre-operation conference at a mutually agreed time and place. Make the arrangements for the conference facility. Discuss methods of performing the work.

Pre-operation conference attendees must sign an attendance sheet provided by the Engineer. The pre-operation conference must be attended by your:

1. Project superintendent
2. Project manager
3. Quality control manager
4. Paving foreman
5. Concrete plant manager
6. Concrete plant operator
7. Personnel performing saw cutting and joint sealing
8. Plant inspector
9. Paving machine operators
10. Inspectors
11. Samplers
12. Testers
13. Subcontractor's workers

Do not start paving activities including trial slabs until the listed personnel have attended a pre-operation conference.

The purpose of the pre-operation conference is to familiarize personnel with the project's requirements. Items to be discussed include the processes for:

1. Production
2. Transportation
3. Placement
4. Replacing pavement
5. Contingency plan
6. Sampling
7. Testing

Quality Control Program

General

Establish a quality control program. The quality control program assures the Engineer that methods and procedures are in place to produce and place RSC in compliance with the specifications.

If the quality control program is not implemented and followed, the Engineer orders individual slab replacement work stopped.

Quality Control Managers

For the project, designate a lead QCM and assistant QCMs.

The lead QCM administers the quality control plan (QCP). The lead QCM must hold current American Concrete Institute (ACI) certification as "Concrete Field Testing Technician-Grade I" and "Concrete Laboratory Testing Technician-Grade II." Assistant QCMs must hold current ACI certification as "Concrete Field Testing Technician-Grade I" and either "Concrete Laboratory Testing Technician-Grade I" or "Concrete Laboratory Testing Technician-Grade II."

The QCM responsible for the production period involved must review and sign the sampling, inspection, and test reports before submittal to the Engineer. At least 1 QCM must be present for:

1. Each stage of mix design
2. Trial slab construction

3. Production and construction of RSC
4. Meetings with the Engineer relating to production, placement, or testing.

A QCM must not be a member of this project's production or paving crews, an inspector, or a tester. A QCM must have no duties during the production and placement of RSC except those specified.

Quality Control Plan

The QCP describes the procedures you will use to control the production process including:

1. Determining if changes to the production process are needed
2. Procedures for proposing changes
3. Procedures for implementing changes

Do not start individual slab replacement work until the QCP has been accepted by the Engineer. The Engineer accepts the QCP based the inclusion and adequacy of:

1. The names and qualifications of the lead Quality Control Manager (QCM) and assistant QCMs.
2. An outline procedure for the placement and testing of trial slabs
3. An outline procedure for the production, transportation, and placement of RSC
4. An outline procedure for sampling and testing to be performed during and after individual slab replacement construction
5. A contingency plan for correcting problems in production, transportation, or placement. Include the quantity and location of standby material in your contingency plan.
6. Provisions for determining if RSC placement must be suspended and temporary roadway pavement structure constructed
7. Forms to report inspection, sampling, and testing
8. The location of your quality control testing laboratory and testing equipment during and after paving operations
9. A list of the testing equipment to be used including date of last calibration
10. The names and certifications of quality control personnel including those performing sampling and testing

At the time of QCP submission, the Department qualifies the quality control samplers and testers through the Independent Assurance Program (IAP) for the sampling and testing they perform.

Quality Control Inspection, Sampling, and Testing

Perform quality control sampling, testing, and inspection throughout RSC production and placement. Before any sampling and testing, give the Engineer at least 2 business days notice. Give the Engineer unrestricted access to your quality control inspectors, samplers, testers, and laboratories. Submit testing results within 15 minutes of testing completion. Record inspection, sampling, and testing on the forms accepted with the QCP and submit them within 48 hours of completion of each paving shift and within 24 hours of 7-day modulus of rupture tests.

Provide a testing laboratory to perform quality control tests. Maintain sampling and testing equipment in proper working condition. Perform sampling under California Test 125.

Testing laboratories and testing equipment must comply with the Department's Independent Assurance Program.

Trial Slabs

Before starting work on individual slab replacement, complete one trial slab for each mix design. Trial slabs demonstrate that you are capable of constructing individual slab replacement in compliance with the specifications within the specified time periods including delivery, placement, finishing, and curing times, and under similar atmospheric and temperature conditions expected during replacement operations.

During trial slab construction, sample and split the aggregate for gradings, cleanness value, and sand equivalent testing.

Trial slabs must comply with the QCP for RSC production and placement. The QCP must detail your intended:

1. Locations and times
2. Production procedures
3. Placement and finishing methods

4. Sampling methods, sample curing, and sample transportation
5. Testing and test result reporting

The trial slab must be at least 10' x 20'. The trial slab thickness must be at least 10 inches. Place trial slabs near the job site at a mutually-agreed location that is neither on the roadway nor within the project limits.

Within 20 minutes after RSC delivery for trial slabs, fabricate test beams under California Test 524. Use beams to determine early age and 7-day modulus of rupture values.

Cure beams fabricated for early age testing so that the monitored temperatures in the beams and the trial slab are always within 5 °F. Monitor and record the internal temperatures of trial slabs and early age beams at intervals of at least 5 minutes. Install thermocouples or thermistors connected to strip-chart recorders or digital data loggers to monitor the temperatures. Temperature recording devices must be accurate to within ± 2 °F. Measure internal temperatures at 1 inch from the top, 1 inch from the bottom, and no closer than 3 inches from any edge until early age testing is completed.

Cure beams fabricated for 7-day testing under California Test 524 except place them into sand at a time that is from 5 to 10 times the final set time, or 24 hours, whichever is earlier.

Trial slabs must have an early age modulus of rupture of not less than 400 psi and a 7-day modulus of rupture of not less than 600 psi.

You may request to use ASTM C 805 or ASTM C 900 to estimate the modulus of rupture of the pavement. If the Engineer accepts these test methods, but either you or the Engineer later withdraw the request or acceptance, you must use the selected test method until 7 days after you notify the Engineer of withdrawal of the request or 7 days after the Engineer notifies you of withdrawal of acceptance. During trial slab curing, perform correlation testing to determine the relationship between the modulus of rupture and ASTM C 805 or ASTM C 900 test results that were performed. Establish the correlation by testing at 4 or more time intervals. At a minimum, perform tests 1 hour before and 1 hour after the opening age and 2 others within 15 minutes of the opening age. Calculate modulus of rupture estimates with either a linear, exponential, or logarithmic least squares best-fit equation, whichever provides the best correlation coefficient.

Dispose of trial slabs and test specimens for trial slabs under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Production Process Control and Quality Control Testing

Contingency plan equipment and personnel must be present at the job site.

Provide continuous process control and quality control sampling and testing throughout RSC production and placement.

During production of RSC, sample and test aggregates at least once for every 650 cubic yards of RSC produced, but not less than once per placement shift. Test aggregates for compliance with gradations, cleanness value, and sand equivalent specifications.

At least once for every 650 cubic yards of RSC produced, but not less than twice per placement shift, sample and test for:

1. Yield
2. Penetration
3. Air content
4. Unit weight

During placement of RSC, fabricate beams and test for modulus of rupture within the first 30 cubic yards, at least once every 130 cubic yards, and within the final truckload.

If the Engineer requests, submit split samples and fabricate test beams for the Engineer's testing.

For determining early age modulus of rupture, cure beams under the same conditions as the pavement until 1 hour before testing. Cure beams fabricated for the 7-day test under California Test 524. The Engineer uses modulus of rupture test results for accepting or rejecting the replacement pavement and pay factor adjustment for low modulus of rupture.

Dispose of materials resulting from the construction of the test beams, temporary roadway pavement structure, and rejected replacement pavement under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Weighmaster Certificates

Weighmaster certificates for RSC, regardless of the proportioning method used, must include the information necessary to trace the manufacturer and the manufacturer's lot number for the cement being used. If proportioned

into fabric containers, the weighmaster certificates for the cement must contain date of proportioning, location of proportioning, and actual net draft cement weight. If proportioned at the pour site from a storage silo, the weighmaster certificates must contain date of proportioning, location of proportioning, and the net draft cement weight used in the load.

Engineer's Acceptance for Modulus of Rupture

RSC pavement must develop a minimum modulus of rupture of 400 psi before opening to traffic. RSC pavement must develop a minimum modulus of rupture of 600 psi 7 days after placement. The Engineer may accept RSC pavement that does not attain the specified moduli of rupture as specified in "Pay Factor Adjustment for Low Modulus of Rupture." The modulus of rupture will be determined based on testing of 3 beam specimens under California Test 524 and averaging the results. You may fabricate beam specimens using an internal vibrator under ASTM C 31. No single test represents more than that day's production or 130 cubic yards, whichever is less.

Beam specimens for early age must be cured so the temperature in the specimens is within 5 °F of the temperature in the pavement. You must determine the modulus of rupture at other ages using beams cured and tested under California Test 524 except place them in sand from 5 to 10 times the final set time or 24 hours, whichever is earlier. You must perform the sampling and testing to determine modulus of rupture values of the RSC pavement in the presence of the Engineer.

Pay Factor Adjustment for Low Modulus of Rupture

The Engineer adjusts payment for RSC for modulus of rupture as follows:

1. Payment for RSC with a modulus of rupture of 400 psi or greater before opening to traffic and 7-day modulus of rupture of 600 psi or greater is not adjusted.
2. Payment for RSC with a 7-day modulus of rupture less than 500 psi is not adjusted and no payment is made. Remove this RSC and replace it at your expense with RSC that complies with the specifications.
3. Payment for RSC with a modulus of rupture less than 350 psi before opening to traffic is not adjusted and no payment is made. Remove this RSC and replace it at your expense with RSC that complies with the specifications.
4. Payment for RSC with a modulus of rupture of 350 psi or greater before opening to traffic and a 7-day modulus of rupture greater than or equal to 500 psi is reduced by the percentage in the pay table for the quantity represented by the tests.

Percentage Pay Table

Modulus of Rupture (psi) at opening to traffic	7-Day Modulus of Rupture (psi)		
	Greater than or equal to 600	Less than 600 and greater than or equal to 550	Less than 550 and greater than or equal to 500
Greater than or equal to 400	100%	95%	90%
Less than 400 and greater than or equal to 350	95%	95%	90%
Less than 350	0%	0%	0%

The Engineer rejects any RSC area that develops 1 or more transverse full depth random cracks within 64 days after placement. Remove this RSC at your expense and replace it with RSC that complies with the specifications. A transverse crack is a crack running from one longitudinal edge of the panel to the other.

Treat partial depth cracks with a high molecular weight methacrylate resin under "Concrete Pavement Crack Treatment" at your expense.

MATERIALS

Temporary Roadway Pavement Structure

Aggregate Base

Aggregate base for temporary roadway pavement structure must be produced from any combination of broken stone, crushed gravel, natural rough-surfaced gravel, reclaimed concrete and sand. Grading of aggregate base must comply with the 3/4-inch maximum grading specified in Section 26-1.02A, "Class 2 Aggregate Base," of the Standard Specifications.

Hot Mix Asphalt

For hot mix asphalt:

1. Choose the 3/8-inch or 1/2-inch HMA Type A or Type B aggregate gradation under Section 39-1.02E, "Aggregate," of the Standard Specifications.
2. Minimum asphalt binder content must be 6.8 percent for 3/8-inch aggregate gradation and 6.0 percent for 1/2-inch aggregate gradation.
3. Choose asphalt binder Grade PG 64-10, PG 64-16, or PG 70-10 under Section 92, "Asphalts," of the Standard Specifications.

Rapid Strength Concrete

RSC that fails to meet opening strength but has a modulus of rupture of at least 200 psi may serve as temporary roadway and must be replaced during the next paving shift.

Bond Breaker

Bond breaker must be one of the following:

1. White curing paper under ASTM C 171
2. White opaque polyethylene film under ASTM C 171, except that the minimum thickness must be 6 mils
3. Paving asphalt, Grade PG 64-10, under Section 92, "Asphalts," of the Standard Specifications
4. Curing compound (5) under Section 90-7.01b, "Curing Compound Method," of the Standard Specifications

Rapid Strength Concrete

RSC must be one of the following:

1. Concrete complying with section 90 "Portland Cement Concrete," except you may use Type III portland cement.
2. Concrete complying with section 90 "Portland Cement Concrete," except:
 - 2.1. You may use any cement that complies with the definition of hydraulic cement or blended hydraulic cement in ASTM C 219 and the requirements shown in the following table:

Hydraulic Cement^c

Test Description	Test Method	Requirement ^b
Contraction in air	California Test 527, W/C Ratio = 0.39 ±0.010	0.053 %, max.
Mortar expansion in water	ASTM C 1038	0.04 %, max.
Soluble chloride ^a	California Test 422	0.05 %, max.
Soluble sulfates ^a	California Test 417	0.30 %, max.
Thermal stability	California Test 553	90 %, min.
Compressive strength @ 3 days	ASTM C 109	2,500 psi

Note:

^a Perform test on a cube specimen fabricated under ASTM C 109. Cure the specimen at least 14 days and then pulverized to 100 percent passing the No. 50 sieve.

^b If you use chemical admixtures, include them when testing.

^c The requirements of this table does not apply to portland cement.

- 2.2. You may use citric acid or borax if you submit a written request from the cement manufacturer and a test sample.

Supplementary cementitious material is not required in RSC.

Choose the combined aggregate grading for RSC from either the 1-1/2 inch maximum or the 1-inch maximum combined grading under Section 90-3.04, "Combined Aggregate Gradings," of the Standard Specifications.

Aggregate for RSC must be either:

1. Innocuous in conformance with the provisions in Section 90-2.02, "Aggregates."
2. When tested under ASTM C 1567 using the proposed aggregate and cementitious materials, the expansion is less than 0.10 percent. Submit test data with each mix design. Test data authorized by the Department

no more than 3 years before the 1st day of the Contract is authorized for the entire Contract. The test data must be for the same concrete mix and must use the same materials and material sources to be used on the Contract.

You may use Type C accelerating and Type E accelerating and water reducing chemical admixtures as specified in Section 90-4, "Admixtures," of the Standard Specifications.

The requirement for air entrainment of concrete in freeze-thaw areas only applies when portland cement is used.

CONSTRUCTION

Removing Existing Pavement

The Engineer determines the exact limits of individual slab replacement.

Remove existing concrete pavement and replace it with RSC within the same work period. If you remove existing pavement or base materials and you are unable to construct, finish, and cure RSC before the specified traffic opening time, construct a temporary roadway pavement structure.

Saw cut the outline of concrete pavement to be removed with a power-driven saw except where adjacent to an asphalt concrete shoulder. Do not saw cut within concrete pavement slabs more than 2 days before concrete pavement slab removal. If you saw cut in work shifts that are before the actual removal work shift, do not make saw cuts parallel or diagonal to the traveled way. Saw cut so that traffic will not dislodge any pieces or segments.

Remove concrete pavement by non-impacting methods. Remove each pavement panel in 1 or more pieces without disturbing or damaging the underlying base. Remove pavement and base without damage to pavement or base remaining in place.

Dispose of removed materials under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

After removing pavement to the required depth, grade existing base to a uniform plane. Water and compact the material remaining in place to a firm and stable base. The finished surface of the remaining material must not extend above the grade established by the Engineer. At your expense, fill areas that were over-excavated during removal with replacement material in the same operation as the base replacement.

Temporary Roadway Pavement Structure

Place hot mix asphalt and aggregate base where existing pavement is replaced for construction of a temporary roadway pavement structure. The quantity must be equal to the quantity of pavement removed during the work shift. If you place temporary roadway pavement structure, it must be maintained and later removed as the first order of work when individual slab replacement activities resume.

The temporary roadway pavement structure must consist of 3-1/2 inch thick hot mix asphalt over aggregate base. RSC not conforming to the specifications may be used for temporary roadway pavement structure with the Engineer's approval.

Spread and compact aggregate base and hot mix asphalt by methods that produce a well-compacted, uniform base, with a surface of uniform smoothness, texture and density. Surfaces must be free from pockets of coarse or fine material. You may spread aggregate base and hot mix asphalt each in one layer. The finished surface of hot mix asphalt must not vary more than 0.05 foot from the lower edge of a 12-foot long straightedge placed parallel with the centerline and must match the elevation of existing concrete pavement along the joints between the existing pavement and temporary surfacing.

After removing temporary roadway pavement structure, you may stockpile removed aggregate base at the project site and reuse it for temporary roadway pavement structures. When no longer required, dispose of standby material or stockpiled material for temporary roadway pavement structures under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Rapid Strength Concrete

General

Concrete pavement penetration specified in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications does not apply to RSC.

RSC must develop the specified opening age and 7-day modulus of rupture strengths.

Proportioning

Weighing, measuring, and metering devices used for proportioning materials must comply with Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

For batches with a volume of 1 cubic yard or more, proportioning must comply with one of the following methods:

1. Batch the ingredients at a central batch plant and charge them into a mixer truck for transportation to the pour site. Proportion ingredients under Section 90-5, "Proportioning," of the Standard Specifications.
2. Batch the ingredients except the cement at a central batch plant and charge them into a mixer truck for transportation to a cement silo and weigh system, which must proportion cement for charging into the mixer truck.
3. Batch ingredients except the cement at a central batch plant and charge them into a mixer truck for transportation to a location where pre-weighed containerized cement is added to the mixer truck. The cement pre-weighing operation must utilize a platform scale. The platform scale must have a maximum capacity of 2.75 tons with a maximum graduation size of 1 pound. Pre-weigh cement into a fabric container. The minimum amount of cement to be proportioned into any single container must be 1/2 of the total amount required for the load of RSC being produced.
4. Cement, water, and aggregate are proportioned volumetrically.

For central batch plants, indicators for weighing and measuring systems such as over and under dials must be grouped so that each indicator's smallest increment can be accurately read from the control point of the proportioning operation. In addition, indicators for weighing and measuring cement batched from a remote weighing system must be placed so that each indicator can be accurately read from the control point of the proportioning operation.

Weighing equipment must be insulated from other equipment's vibration or movement. When the plant is operating, each draft's material weight must not vary from the designated weight by more than the specified tolerances. Each scale graduation must be 0.001 of the usable scale capacity.

Aggregate must be weighed cumulatively. Equipment for weighing aggregate must have a zero tolerance of ± 0.5 percent of the aggregate's designated total batch weight. Equipment for the separate weighing of the cement must have a zero tolerance of ± 0.5 percent of the cement's designated individual batch draft. Equipment for measuring water must have a zero tolerance of ± 0.5 percent of the water's designated weight or volume.

The weight indicated for any individual batch of material must not vary from the preselected scale setting by more than:

Batch Weight Tolerances

Material	Tolerance
Aggregate	± 1.0 percent of designated batch weight
Cement	± 0.5 percent of designated batch weight
Water	± 1.5 percent of designated batch weight or volume

Proportioning consists of dividing the aggregate into the specified sizes and storing them in separate bins, and then combining the aggregate with cement and water. Proportion dry ingredients by weight. Proportion liquid ingredients by weight or volume.

Handle and store aggregates under Section 90-5.01, "Storage of Aggregates," of the Standard Specifications. Proportion liquid admixtures under Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures," of the Standard Specifications.

Control aggregate discharged from several bins with gates or mechanical conveyors. The means of discharge from the bins and from the weigh hopper must be interlocked so that no more than 1 bin can discharge at a time, and the weigh hopper cannot be discharged until the required quantity from each of the bins has been deposited in the weigh hopper.

At the time of batching, dry and drain aggregates to a stable moisture content. Do not proportion aggregates with visible separation of water from the aggregate during proportioning. At the time of batching, the free moisture content of fine aggregate must not exceed 8 percent of its saturated, surface-dry weight.

If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust 1 supply before using another supply.

Keep cement separated from the aggregate until discharged into the mixer. When discharged into the mixer, cement must be free of lumps and clods. Before reuse, clean fabric containers used for transportation or proportioning of cement.

Weigh systems for proportioning aggregate and cement must be individual and distinct from other weigh systems. Each weigh system must have a hopper, a lever system, and an indicator.

When ordered by the Engineer, determine the gross weight and tare weight of truck mixers on scales designated by the Engineer.

Install and maintain in operating condition an electrically actuated moisture meter. The meter must indicate on a readily visible scale the changes in the fine aggregate moisture content as it is batched. The meter must have a sensitivity of 0.5 percent by weight of the fine aggregate.

Obtain the Engineer's acceptance before mixing water into the concrete during hauling or after arrival at the delivery point. If the Engineer accepts additional water be incorporated into the concrete, the drum must revolve not less than 30 revolutions at mixing speed after the water is added and before starting discharge. Measure water added to the truck mixer at the job site through a meter in compliance with Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

Volumetric Proportioning

You may choose to proportion RSC by volume.

Handle and store aggregates under Section 90-5.01, "Storage of Aggregates," of the Standard Specifications. Proportion liquid admixtures under Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures," of the Standard Specifications.

Batch-mixer trucks must proportion cement, water, aggregate, and additives by volume. Aggregate feeders must be connected directly to the drive on the cement vane feeder. The cement feed rate must be tied directly to the feed rate for the aggregate and other ingredients. Only change the ratio of cement to aggregate by changing the gate opening for the aggregate feed. The drive shaft of the aggregate feeder must have a revolution counter reading to the nearest full or partial revolution of the aggregate delivery belt.

Proportion aggregate with a belt feeder operated with an adjustable cutoff gate delineated to the nearest quarter increment. The gate opening height must be readily determinable. Proportion cement by any method that complies with the accuracy tolerance specifications in Section 90-5.02, "Proportioning Devices," of the Standard Specifications. Proportion water with a meter under Section 9-1.01, "Measurement and Payment," of the Standard Specifications.

Calibrate the cutoff gate for each batch-mixer truck used and for each aggregate source. Calibrate batch-mixer trucks at 3 different aggregate gate settings that are commensurate with production needs. Perform at least 2 calibration runs for each aggregate gate.

Individual aggregate delivery rate check-runs must not deviate more than 1.0 percent from the mathematical average of all runs for the same gate and aggregate type. Each test run must be at least 1,000 pounds.

At the time of batching, dry and drain aggregates to a stable moisture content. Do not proportion aggregates with visible separation of water from the aggregate during proportioning. At the time of batching, the free moisture content of fine aggregate must not exceed 8 percent of its saturated, surface-dry weight.

If the proportioning plant has separate supplies of the same size group of aggregate with different moisture content, specific gravity, or surface characteristics affecting workability, exhaust 1 supply before using another supply.

Cover rotating and reciprocating equipment on batch-mixer trucks with metal guards.

Individual cement delivery rate check-runs must not deviate more than 1.0 percent of the mathematical average of 3 runs of at least 1,000 pounds each.

When the water meter operates from 50 to 100 percent of production capacity, the indicated weight of water delivered must not differ from the actual weight delivered by more than 1.5 percent for each of 2 runs of 300 gallons. Calibrate the water meter under California Test 109. The water meter must be equipped with a resettable totalizer and display the operating rate.

Conduct calibration tests for aggregate, cement, and water proportioning devices with a platform scale located at the calibration site. Platform scales for weighing test-run calibration material must have a maximum capacity of 2.75 tons with maximum graduations of 1 pound. Error test the platform scale within 8 hours of calibrating the batch-mixer truck proportioning devices. Perform error-testing with test weights under California Test 109. Furnish a witness scale that is within 2 graduations of the test weight load. The witness scale must be available for use at the production site throughout the production period. Equipment needed for the calibration of proportioning systems must remain available at the production site throughout the production period.

The batch-mixer truck must be equipped so that accuracy checks can be made. Recalibrate proportioning devices every 30 days after production starts or when you change the source or type of any ingredient.

A spot calibration is calibration of the cement proportioning system only. Perform a 2-run spot calibration each time 55 tons of cement passes through the batch-mixer truck. If the spot calibration shows the cement proportioning system does not comply with the specifications, complete a full calibration of the cement proportioning system before you resume production.

Proportion liquid admixtures with a meter.

Locate cement storage immediately before the cement feeder. Equip the system with a device that automatically shuts down power to the cement feeder and aggregate belt feeder when the cement storage level is less than 20 percent of the total volume.

Submit aggregate moisture determinations, made under California Test 223, at least every 2 hours during proportioning and mixing operations. Record moisture determinations and submit them at the end of each production shift.

Equip each aggregate bin with a device that automatically shuts down the power to the cement feeder and the aggregate belt feeder when the aggregate discharge rate is less than 95 percent of the scheduled discharge rate.

Proportioning device indicators must be in working order before starting proportioning and mixing operations and must be visible when standing near the batch-mixer truck.

Identifying numbers of batch-mixer trucks must be at least 3 inches in height, and be located on the front and rear of the vehicles.

Mix volumetric proportioned RSC in a mechanically operated mixer. You may use auger-type mixers. Operate mixers uniformly at the mixing speed recommended by the manufacturer. Do not use mixers that have an accumulation of hard concrete or mortar.

Do not mix more material than will permit complete mixing. Reduce the volume of material in the mixer if complete mixing is not achieved. Continue mixing until a homogeneous mixture is produced at discharge. Do not add water to the RSC after discharge.

Do not use equipment with components made of aluminum or magnesium alloys that may have contact with plastic concrete during mixing or transporting of RSC.

The Engineer determines uniformity of concrete mixtures by differences in penetration measurements made under California Test 533. Differences in penetration are determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load. The differences must not exceed 5/8 inch. Submit samples of freshly mixed concrete. Sampling facilities must be safe, accessible, clean, and produce a sample that is representative of production. Sampling devices and sampling methods must comply with California Test 125.

Do not use ice to cool RSC directly. If ice is used to cool water used in the mix, it must be melted before entering the mixer.

When proportioning and charging cement into the mixer, prevent variance of the required quantity by conditions such as wind or accumulation on equipment.

Each mixer must have metal plates that provide the following information:

1. Designed usage
2. Manufacturer's guaranteed mixed concrete volumetric capacity
3. Rotation speed

The device controlling the proportioning of cement, aggregate, and water must produce production data. The production data must be captured at 15-minute intervals throughout daily production. Each capture of production data represents production activity at that time and is not a summation of data. The amount of material represented by each production capture is the amount produced in the period from 7.5 minutes before to 7.5 minutes after the capture time. The daily production data must be submitted in electronic or printed media at the end of each production shift. The reported data must be in the order including data titles as follows:

1. Weight of cement per revolution count
2. Weight of each aggregate size per revolution count
3. Gate openings for each used aggregate size
4. Weight of water added to the concrete per revolution count
5. Moisture content of each used aggregate size
6. Individual volume of other admixtures per revolution count
7. Time of day
8. Day of week
9. Production start and stop times
10. Batch-mixer truck identification
11. Name of supplier
12. Specific type of concrete being produced
13. Source of the individual aggregate sizes
14. Source, brand, and type of cement
15. Source, brand and type of individual admixtures
16. Name and signature of operator

You may input production data by hand into a pre-printed form or it may be captured and printed by the proportioning device. Present electronic media containing recorded production data in a tab delimited format on a CD or DVD. Each capture of production data must be followed by a line-feed carriage-return with sufficient fields for the specified data.

Base Replacement Layer

Replace removed base materials with RSC in a separate and distinct operation from individual slab replacement.

Finish the replacement base layer to the grade of the original base layer. Do not texture the surface. Finish to a smooth surface, free of projections such as mortar ridges, voids, and porous areas.

Bond Breaker

Place bond breaker between replacement pavement and existing lean concrete base, cement treated base, or new base replacement layer.

If you use curing paper or polyethylene film, place it in a wrinkle free manner. Overlap adjacent sheets a minimum of 6 inches in the same direction as the concrete pour.

If you use curing compound or paving asphalt, before application remove foreign and loose materials remaining from slab removal.

If you use paving asphalt, do not add water before applying asphalt to the base surface. Apply the paving asphalt in one even application at a rate from 0.02 to 0.10 gallon per square yard over the entire base surface area. Do not place individual slab replacement until the paving asphalt has cured.

If you use curing compound, apply it in 2 separate applications. Apply each application evenly at a rate from 0.07 to 0.11 gallon per square yard over the entire base surface area.

Spreading, Compacting, and Shaping

The specifications for pavement thickness in Section 40, "Concrete Pavement," of the Standard Specifications do not apply.

You may use metal or wood side forms. Wood side forms must not be less than 1-1/2 inches thick. Side forms must be of sufficient rigidity, both in the form and in the connection with adjoining forms, that movement will not occur under forces from subgrading and paving equipment or from the pressure of concrete.

Side forms must remain in place until the pavement edge no longer requires the protection of forms. Clean and oil side forms before each use.

After you deposit the RSC on the subgrade, consolidate RSC with high-frequency internal vibrators. Consolidate adjacent to forms and across the full paving width. Place RSC as nearly as possible to its final position. Do not use vibrators for extensive shifting of RSC.

Spread and shape RSC with powered finishing machines supplemented by hand finishing.

After you mix and place RSC, do not add water to the surface to facilitate finishing. Use surface finishing additives as recommended by the manufacturer of the cement after their use is approved by the Engineer.

Joints

Before placing RSC against existing concrete, place 1/4-inch thick commercial quality polyethylene flexible foam expansion joint filler across the original transverse and longitudinal joint faces and extend the excavation's full depth. Place the top of the joint filler flush with the top of the pavement. Secure joint filler to the joint face of the existing pavement to prevent the joint filler from moving during the placement of RSC.

Construct transverse contraction joints in pavement widenings to match the spacing and skew of the contraction joints in the adjacent existing pavement. Where the existing transverse joint spacing in an adjacent lane exceeds 15 feet, construct an additional transverse contraction joint midway between the existing joints. Complete sawing of contraction joints within 2 hours of completion of final finishing. Cut contraction joints a minimum 1/3 the depth of the slab.

Final Finishing

If the Engineer determines by visual inspection the final texturing may not comply with the specifications for coefficient of friction, the Engineer tests to determine coefficient of friction. Open the pavement to traffic and allow 5 days after concrete placement for the Department to test for coefficient of friction. If pavement does not comply with the specifications for coefficient of friction, groove or grind the pavement under Section 42 "Groove and Grind Pavement," of the Standard Specifications. Perform grooving or grinding before sealing joints the installation of any required joint seal or edge drains adjacent to the areas to be grooved or ground.

You must stamp your company name, the date placed and the contract number on the replaced concrete slabs. If the concrete slabs are successively replaced on the same working day, only first and last concrete slabs must be stamped. Level the location of the stamp with a steel trowel below the pavement texture before affixing the stamp.

The Engineer measures smoothness with a straightedge.

Test pavement smoothness in the longitudinal direction with the straightedge placed along the right and left wheel paths of the new pavement. Do not test pavement within one foot transversely of pavement not constructed in this contract. Grind pavement not in compliance with smoothness specifications within 48 hours by grinding.

Curing Method

Use the curing method recommended by the manufacturer of the cement for replacement pavement.

Replace Existing Pavement Delineation

Replace any existing pavement delineation removed, obliterated, or damaged by the work involved in individual slab replacement. Install replacement delineation at existing or new locations. Replacement delineation must comply with the design of the existing delineation and be equal to the best portions of the existing delineation. Comply with the specifications for new delineation.

MEASUREMENT AND PAYMENT

Individual slab replacement is measured and paid for in the same manner specified for concrete pavement in Sections 40-4.01, "Measurement," and 40-4.02, "Payment," of the Standard Specifications.

The Engineer adjusts payment for individual slab replacement in compliance with "Pay Factor Adjustment for Low Modulus of Rupture."

Full compensation for the pre-operation conference and the prepaving meeting is included in the contract price paid per cubic yard for individual slab replacement and no additional compensation will be allowed therefor.

Full compensation for removing and disposing of existing pavement, constructing trial slabs, furnishing and placing bond breaker and joint filler, as shown on the plans, furnishing and disposing of standby materials for temporary roadway pavement structure, constructing, maintaining, removing, and disposing of temporary roadway pavement structure, work involved in determining the modulus of rupture of RSC pavement and quality control program, are included in the contract price paid per cubic yard for individual slab replacement and no additional compensation will be allowed therefor.

Repair, or removal and replacement of damaged pavement and base, and partial depth cracks is at your expense and will not be measured or paid for.

If calibration of volumetric batch-trucks is performed more than 100 miles from the project limits, payment for individual slab replacement is reduced by \$1,000 per calibration session.

If RSC does not conform to the mix design requirements or the specifications, the Engineer orders you to provide extra samples and testing. The Engineer determines the costs for sampling, fabricating, transporting, and testing extra samples under Section 4-1.03D, "Extra Work," of the Standard Specifications. If the extra samples do not comply with the specifications, these costs are at your expense. If the extra samples comply with the specifications, the Engineer pays you for these costs.

10-1.68 DRILL AND BOND DOWEL BAR

GENERAL

Summary

This work includes drilling, bonding, and installing dowel bars in construction joints for individual slab replacements and concrete pavement.

Comply with dowel bar requirements for submittals and quality control in Section 40, "Concrete Pavement," of the Standard Specifications and these special provisions.

At least 7 days before the start of dowel bar (drill and bond) work, submit a copy of the chemical adhesive manufacturer's recommended installation procedure.

MATERIALS

Dowel Bar (Drill and Bond)

Comply with Section 40-2.03 "Dowel Bars" of the Standard Specifications.

Chemical Adhesive (Drill and Bond)

Comply with Section 40-2.05 "Chemical Adhesive" of the Standard Specifications.

CONSTRUCTION

Drill dowel bars and bond with chemical adhesive.

Clean drilled holes in compliance with the chemical adhesive manufacturer's instructions. Holes must be dry at the time of placing the chemical adhesive and dowel bars. Immediately after inserting the dowel bars into the chemical adhesive, support the dowel bars to prevent movement during curing. Leave the supported dowel bars undisturbed until chemical adhesive has cured a minimum time instructed by the manufacturer. If the Engineer rejects dowel bars, drill new holes adjacent to the rejected holes, place new dowel bars, and securely bond to the concrete.

MEASUREMENT AND PAYMENT

Unless specified otherwise, drill and bond dowel bar is measured and paid for by each installation. Drill and bond dowel bars installed at contractor's option in construction joints are included in the contract price for the type of concrete pavement being constructed and is not paid for separately.

Drill and bond dowel bars installed in longitudinal construction joints are included in the contract price paid for type of concrete pavement being constructed.

The contract unit price paid for dowel bar (drill and bond) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in drilling holes, placing epoxy coated dowel bars, bonding the dowel bars with chemical adhesive, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.69 REPAIR SPALLED JOINTS (POLYESTER GROUT)

This work shall consist of removing unsound or damaged concrete from spalled areas at transverse and longitudinal joints in new and existing concrete pavement and filling the area with polyester grout in conformance with these special provisions.

MATERIALS

Polyester Grout

Polyester grout shall consist of polyester resin binder and dry aggregate. The resin shall be an unsaturated isophthalic polyester-styrene copolymer conforming to the following:

POLYESTER RESIN BINDER

Property	Test Method	Requirement
*Viscosity	ASTM Designation: D 2196	0.075 Pa·s to 0.200 Pa·s (RVT, No. 1 Spindle, 20 RPM at 77° F)
*Specific Gravity	ASTM Designation: D 1475	1.05 to 1.10 at 77° F
Elongation	ASTM Designation: D 638	35 percent, minimum Type I at 15/32 inch/min Thickness = 1/4 inch ±1/32 inch
	ASTM Designation: D 618	Sample Conditioning: 18/25/50 + 5/70
Tensile Strength	ASTM Designation: D 638	2,500 psi, minimum Type I at 0.45 inch/min Thickness = 0.25 ±0.05 inch
	ASTM Designation: D 618	Sample Conditioning: 18/25/50 + 5/70
* Styrene Content	ASTM Designation: D 2369	40 percent to 50 percent (by weight)
Silane Coupler		1.0 percent, minimum (by weight of polyester styrene resin)
PCC Saturated Surface Dry Bond Strength	California Test 551	500 psi, minimum at 24 hours and 70° F ±2° F
*Static Volatile Emission	South Coast Air Quality Management District, Standard Method	2 ounces per square yard, loss, maximum

* Test shall be performed prior to adding initiator.

The silane coupler shall be an organosilane ester, gammamethacryloxypropyltrimethoxysilane. The promoter shall be compatible with suitable methyl ethyl ketone peroxide (MEKP) and cumene hydroperoxide (CHP) initiators.

Aggregate for polyester grout shall conform to the provisions in Section 90-2.02, "Aggregates," of the Standard Specifications and either of the following combined aggregate gradings:

COMBINED AGGREGATE GRADING

Sieve Size	Percentage Passing	
	3/8" Maximum	No. 4 Maximum
1/2"	100	100
3/8"	83 - 100	100
No. 4	65 - 82	62 - 85
No. 8	45 - 64	45 - 67
No. 16	27 - 48	29 - 50
No. 30	12 - 30	16 - 36
No. 50	6 - 17	5 - 20
No. 100	0 - 7	0 - 7
No. 200	0 - 3	0 - 3

Aggregate retained on the No. 8 sieve shall have a maximum of 45 percent crushed particles when tested in conformance with the requirements in California Test 205. Fine aggregate shall consist of natural sand.

The polyester resin binder in the grout shall be approximately 12 percent by weight of the dry aggregate; the exact percentage will be determined by the Engineer.

The average of coarse and fine aggregate absorption shall not exceed one percent when tested in conformance with the requirements in California Tests 206 and 207.

At the time of mixing with the resin, the moisture content of the combined aggregate, when tested in conformance with the requirements in California Test 226, shall not exceed one half of the average aggregate absorption.

A Material Safety Data Sheet shall be furnished prior to use for each shipment of polyester resin binder.

The Contractor shall allow 14 days for sampling and testing of the polyester resin binder prior to proposed use.

If bulk resin is to be used, the Contractor shall notify the Engineer in writing 10 days prior to the delivery of the bulk resin to the jobsite. Bulk resin is defined as resin that is stored in containers in excess of 55 gallons.

Preformed Compression Seal

Preformed compression seal shall be placed as shown on the plans and specified in these special provisions. A Certificate of Compliance for compression seal shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate shall be accompanied with a certified test report of the results for the required tests performed on the sealant material within the previous 12 months prior to proposed use. The Certificate and accompanying test report shall be provided for each lot of compression seals in the project.

Joint Insert Installation

Joint inserts shall be either corrugated cardboard with a 6-mil polyethylene covering or expanded polystyrene material.

Bonding Agent

Bonding agent shall be as recommended by the polyester grout manufacturer.

SPALL REPAIR PROCEDURE

Concrete Removal

Outlines of rectangular areas, as marked by the Engineer, shall be cut with a diamond bladed saw to a minimum depth of 1-1/2 inch but not greater than one third the depth of the pavement. Unsound and damaged concrete between the saw cut and the joint, and to the depth of the saw cut, shall be removed by methods that will not damage the concrete pavement that is to remain in place. Damage to the concrete pavement beyond the limits to be removed shall be repaired by the Contractor at his expense. A pneumatic hammer greater than 15 pounds shall not be used for removal of unsound concrete.

Concrete pavement removed to repair spalled joints shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Cleaning

After the repair area has been cleared of unsound concrete, the exposed faces of the concrete shall be thoroughly cleaned. Cleaning shall be by abrasive blasting, either sand blasting or high pressure water blasting.

Water blasting equipment for concrete cleaning shall be capable of producing a blast pressure of 3,000 pounds per square inch to 6,000 pounds per square inch.

After abrasive blasting, the exposed concrete area shall be cleaned with moisture-free, oil-free compressed air to remove debris. Air compressors shall deliver air at a minimum of 120 cubic feet per minute and develop 90 pounds per square inch of nozzle pressure.

Joint Insert Installation

Joint inserts shall be placed full depth along the joint and extend one inch beyond the ends of the patch. Joint insert shall be the same width as the existing joint.

Bonding Agent Application

Bonding agent shall be applied to the surface prior to placing polyester grout. Bonding agents shall be mixed on site in small quantities and in conformance with the requirements of the manufacturer's instructions. Bonding agent shall be applied in a thin even coat by using a stiff bristle brush scrubbing the entire area including the patch walls.

Mixing Polyester Grout

Fast setting polyester grout shall be mixed in conformance with the requirements in the manufacturer's instructions.

Placement of Grout

Polyester grout shall be placed on a dry surface. The grout shall air cure with no curing medium applied. The repaired area shall be protected from public traffic for at least one hour after the grout sets.

Resealing Joints

Existing joints where sealant was removed shall be cleaned, resealed and recessed below the final surface as shown on the plans in conformance with the joint sealant manufacturer's instructions and these special provisions.

MEASUREMENT AND PAYMENT

Repairing spalled joints in existing concrete pavement will be measured by the square yard of the pavement surface area repaired.

Full compensation for all costs involved in installing performed compression joint seals is included in the unit price paid per linear foot for seal joint (existing concrete pavement) and no additional compensation will be allowed therefor.

The contract price paid per square yard for repair spalled joints, polyester grout in existing concrete pavement shall include full compensation for furnishing all labor, materials, tools, equipment, including removal and disposal of portions of concrete pavement involved in repairing spalled joints with polyester grout, and incidentals, and for doing all the work involved in repairing spalled joints with polyester grout, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Repairing spalled joints, polyester grout in new concrete pavement is at your own expense and will not be measured or paid for.

10-1.70 SEAL EXISTING CONCRETE PAVEMENT JOINT

This work shall consist of constructing joint seal reservoirs at existing transverse and longitudinal contraction joints and placing joint sealant as shown on the plans and as specified in these special provisions.

MATERIALS

Silicone Joint Sealant

Silicone joint sealant shall conform to the provisions in Section 40-2.11B, "Silicone Joint Sealant," of the Standard Specifications.

A Certificate of Compliance for silicone joint sealant shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate shall be accompanied with a certified test report of the results for the required tests performed on the sealant material within the previous 12 months prior to proposed use. The Certificate and accompanying test report shall be provided for each lot of silicone joint sealant prior to use on the project.

Backer Rods

Backer rods shall conform to the provisions in Section 40-2.07, "Backer Rods," of the Standard Specifications.

Pavement joint seals shall be liquid sealant and shall be Type R as shown on the plans.

Minor spalling along joint faces shall be repaired in conformance with "Repair Spalled Joints" of these special provisions.

Construct Joint Sealant Reservoir

Joint sealant reservoirs shall be constructed in existing concrete pavement at transverse contraction joints by the sawing method. The size and shape of the sealant reservoir shall conform to the details shown on the plans. Residue from sawing operations to construct reservoirs in existing concrete pavement shall be picked up by means of a vacuum attachment to the sawing machine and shall not be allowed to flow across the pavement nor be left on the surface of the pavement.

Removed concrete pavement and residue from sawing involved in constructing reservoirs in existing concrete pavement shall become the property of the Contractor and shall be disposed of in conformance with the requirements in Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way," of the Standard Specifications. In addition, if the Contractor elects to dispose of residue at a location other than those where arrangements have been made by the Department, the Contractor shall obtain approval from the California Regional Water Quality Control Board having jurisdiction over the location. A copy of the approval shall be provided to the Engineer before disposing of material at the location.

Cleaning the Joint

The joint shall be cleaned of dust, dirt, or visible traces of old sealant. Chemical solvents shall not be used to wash the joint. Immediately after sawing, plowing or cutting, or manual removal, slurry or remaining debris from the removal operations shall be removed. The cleaning operation shall be performed in one direction to minimize contamination of surrounding areas. Surface moisture shall be removed at the sealant reservoir by means of compressed air or moderate hot compressed air or other means approved by the Engineer. Drying procedures that leave a residue or film on the reservoir wall shall not be used. After reservoir drying, the reservoir shall be sandblasted to remove remaining residue. Sandblasting straight into the reservoir will not be allowed. The sandblast nozzle shall be pointed close to the surface at an angle to clean each reservoir face. A minimum of one pass along each reservoir face shall be made. The reservoir shall then be air blasted to remove sand, dirt, and dust, no more than one hour before placement of sealant. Compressed air used to air blast the reservoir shall not introduce oil into the reservoir. If oil is accidentally introduced into the reservoir, the Contractor shall begin the cleaning process again until the Engineer is satisfied that the reservoir is clean. Compressed air shall be delivered at a minimum rate of 120 cubic feet per minute and develop at least 90 pounds per square inch nozzle pressure. A vacuum sweeper shall be used to remove debris or contaminants from the surrounding pavement surfaces after air blasting.

Backer Rod Installation

Backer rods shall be installed after joint cleaning. Backer rods shall be installed as shown on the plans. Backer rods shall be installed when the temperature of the portland cement concrete pavement is above the dew point of the air and when the air temperature is 40 °F or above. Backer rod shall be installed when the joints to be sealed have been properly patched, cleaned and dried, as determined by the Engineer. Methods of placing backer rods that leave a residue or film on the reservoir walls, shall not be used.

Sealant Installation

The reservoir walls shall be dry before installing the sealant. No sealant shall be installed before it reaches proper manufacturer's recommended installation temperature. The Contractor shall evacuate any cooled sealant and flushing oil that remains from the pumping hoses and nozzle. This evacuated material shall be discarded. Installation of the sealant shall begin only after fresh sealant is ejected from the nozzle at an acceptable temperature.

Joints shall have the sealant recessed below the final finished surface as shown on the plans.

Sealant shall be pumped through a nozzle sized for the width of the sealant reservoir. The nozzle shall fit into the reservoir to allow pumping to the bottom. The nozzle shall be drawn toward the body of the installer versus pushing to reduce the possibility of air voids. Sealant shall not fill the reservoir to the top level of the joint surface.

After pumping the sealant, the Contractor shall draw a tool or backer rod strip over the fresh sealant. The sealant shall be tooled within 10 minutes of installation or before the sealant begins to form a skin as it cures.

After each joint is sealed, surplus joint sealer on the pavement surface shall be removed. Traffic will not be permitted over the sealed joints until the sealant is track free and set sufficiently to prevent embedment of roadway debris into the sealant.

Failure of the joint material in either adhesion or cohesion of the material will be cause for rejection of the joint.

Removed material or material generated by the Contractor's operations shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

A Supplemental Project Information is not available for disposal of concrete sawing residues. Disposal of concrete sawing residue shall conform to the provisions under "Disposal of Concrete Pavement Grinding Residues" of these special provisions.

MEASUREMENT AND PAYMENT

Sealing pavement joints in existing portland cement concrete pavement will be measured by the linear foot.

The contract price paid per linear foot for seal joint (existing concrete pavement) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing joint seals in existing concrete pavement, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for disposing of concrete sawing residue, including costs of handling, temporary storage, hauling and disposal fees, shall be considered as included in the price paid per linear foot for seal joint (existing concrete pavement) and no additional compensation will be allowed therefor.

10-1.71 GRIND EXISTING CONCRETE PAVEMENT

This work shall consist of grinding existing concrete pavement shown on the plans, as specified in Section 42-2, "Grinding," of the Standard Specifications and these special provisions, and as directed by the Engineer.

Grinding equipment for grinding concrete pavements shall use diamond blades mounted on a self-propelled machine designed for grinding and texturing concrete pavements. Grinding that causes raveling, aggregate fracturing, or spalling, or that damages the transverse or longitudinal joints shall not be used.

Grinding shall be performed in the longitudinal direction of the traveled way and shall be done full lane width so that the grinding begins and ends at lines perpendicular to the pavement centerline.

Grinding concrete pavement shall result in a parallel corduroy texture consisting of grooves 0.08-inch to 0.12-inch wide with 55 grooves to 60 grooves per foot width of grinding. Tops of ridges shall be between 0.06-inch and 0.08-inch from the bottom of the blade grooves.

The ground surface at transverse joints or cracks will be tested with a 12-foot $\pm 2-1/2$ inches long straightedge laid on the pavement parallel with the centerline with its midpoint at the joint or crack. The surface shall not vary by more than 0.01-foot from the lower edge of the straightedge.

Cross-slope uniformity and positive drainage shall be maintained across the entire traveled way and shoulder. The cross-slope shall be uniform so that when tested with a 12-foot $\pm 2-1/2$ inches long straightedge placed perpendicular to the centerline, the ground pavement surface shall not vary more than 1/4 inch from the lower edge of the straightedge.

After grinding has been completed, the pavement surface shall be profiled in conformance with the requirements of Section 40-1.03, "Quality Control and Assurance," of the Standard Specifications. Two profiles shall be obtained in each lane approximately 3 feet from the lane lines. The average profile index shall be determined by averaging the two profiles in each lane. Additional grinding shall be performed, where necessary, to bring the ground pavement surface within the Profile Index requirements specified in Section 40-1.03, "Quality Control and Assurance," of the Standard Specifications.

Full compensation for profiling the ground pavement surface with a California profilograph or equivalent and any necessary additional grinding to bring the finished surface within the specified tolerances and for furnishing final profilograms to the Engineer shall be considered as included in the contract price paid per square yard for grind existing concrete pavement and no additional compensation will be allowed therefor.

10-1.72 DISPOSAL OF CONCRETE PAVEMENT GRINDING RESIDUES

Disposal of concrete pavement grinding residues shall be in conformance with the provisions in Section 42, "Groove and Grind Pavement," of the Standard Specifications and these special provisions.

The Contractor shall include water pollution control measures to address the handling of the grinding pavement residue within the Storm Water Pollution Prevention Plan or Water Pollution Control Program, as specified in "Water Pollution Control" of these special provisions.

Temporary storage of concrete pavement grinding residues shall not be allowed within the highway right of way. The Contractor may transport liquid concrete pavement grinding residues to an offsite drying location if the Engineer provides written approval. The offsite drying location shall be identified and protected in conformance with "Water Pollution Control" of these special provisions.

A Materials Information Handout is not available for disposal of concrete pavement grinding residues. The Contractor shall dispose of concrete pavement grinding residues in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside of the Right of Way," of the Standard Specifications. The facilities listed below were permitted by Regional Water Quality Control Board (RWQCB) or other agencies that may accept concrete pavement grinding residues as of July 1, 2004. If the Contractor is planning to use one of these sites, the Contractor shall determine if the facility has a current permit to accept concrete pavement grinding residues and if the facility can accept the waste at the time of generation.

Site Name	Location	Telephone	Waste Types / Restrictions
Clean Harbors Environmental Services Buttonwillow	2500 West Lokern Road Buttonwillow, CA	(562) 432-5445	Hazardous Solids and Non-Hazardous Liquids and Solids
Clean Harbors Environmental Services San Jose	1021 Berryessa San Jose, CA	(408) 451-5000	Hazardous and Non-Hazardous Liquids
Crosby & Overton, Inc.	1610 W. 17th Street Long Beach, CA	(562) 432-5445	Hazardous and Non-Hazardous Liquids
D/K Environmental	3650 East 26th Street Vernon, CA	(323) 268-5056	Hazardous and Non-Hazardous Liquids and Solids
DeMenno-Kerdoon	200 N. Alameda Street Compton, CA	(323) 268-5057 (310) 537-7100	Hazardous and Non-Hazardous Liquids and Solids
Filter Recycling Services, Inc.	180 West Monte Avenue Rialto, CA	(909) 424-1630	Hazardous and Non-Hazardous Liquids
K-Pure Water Works	8910 Rochester Ave Rancho Cucamonga, CA	(909) 476-2308	Non-Hazardous Liquids
Liquid Waste Management McKittrick	56533 Highway 58 McKittrick, CA	(559) 386-6104	Non-Hazardous Liquids and Solids
Onyx Environmental Services LLC	1704 W. First Street Azusa, CA	(626) 334-5117	Hazardous and Non-Hazardous Liquids and Solids
Phibro-Tech, Inc.	8851 Dice Road Santa Fe Springs, CA	(562) 698-8036	Hazardous and Non-Hazardous Liquids and Solids
Romic Environmental Technologies Corporation	2081 Bay Road East Palo Alto, CA	(650) 324-1638	Hazardous and Non-Hazardous Liquids
Seaport Environmental	700 Seaport Boulevard Redwood City, CA	(650) 364-8154	Non-Hazardous Liquids
Southwest Treatment Systems, Inc.	4120 Bandini Boulevard Los Angeles, CA	(800) 900-3366	Non-Hazardous Liquids
US Filter Recovery Services, Inc.	5375 S. Boyle Avenue Vernon, CA	(323) 277-1495	Hazardous and Non-Hazardous Liquids and Solids
Waste Management Kettleman City	35251 Old Skyline Road Kettleman City, CA	(559) 386-6104	Hazardous and Non-Hazardous Liquids and Solids

If the Contractor disposes of concrete pavement grinding residues at locations not listed above, the disposal shall be in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications, and the following:

- A. If the disposal facility is located within the State of California, the facility must be permitted by the RWQCB or other applicable agency, or the Contractor must obtain written approval from the RWQCB or other applicable agency.
- B. If located outside of the State of California, the facility must be permitted by the applicable local, state, or federal agencies, or the Contractor must obtain written approval from the applicable local, state, or federal agencies.

The following shall be delivered to the Engineer at least 5 days before disposal of concrete pavement grinding residues:

- A. The name, address, and telephone number of the disposal facility.
- B. If the facility is not listed above:
 - 1. Copy of the facility's RWQCB or other applicable agency permit, or
 - 2. RWQCB's or other applicable agency's approval, or
 - 3. Copy of the applicable agency permit if the final disposal location is located outside of the State of California.

The Contractor shall deliver landfill receipts and weight ticket of disposal of residues from concrete pavement grinding to the Engineer within 5 days of completing of concrete pavement grinding activities.

The Contractor shall make all arrangements and agreements for the disposal at the time of bidding. Costs related to obtaining approval for disposal within the State of California from the RWQCB or other applicable agency, or the applicable agency if the disposal location is located outside of the State of California, shall be borne by the Contractor and no additional payment shall be made therefore. Full compensation for all costs involved in disposing of concrete pavement grinding residues as specified in this section, including all costs of handling, temporary storage, hauling and disposal fees, shall be considered as included in the price paid for the contract item of work involving concrete pavement grinding residues and no additional compensation will be allowed therefore.

10-1.73 PILING

GENERAL

Piling shall conform to the provisions in Section 49, "Piling," of the Standard Specifications, and these special provisions.

Unless otherwise specified, welding of any work performed in conformance with the provisions in Section 49, "Piling," of the Standard Specifications, shall be in conformance with the requirements in AWS D1.1.

Attention is directed to "Project Information," "Precast Concrete Quality Control," and "Welding" of these special provisions.

Difficult pile installation is anticipated due to the presence of dense soils, hazardous and contaminated materials, existing piles, scattered cobbles and boulders, underground utilities, overhead utilities, sound control, and traffic control.

Alternative "X" type piles shall have a dimension, T, not less than 14 inches at Buena Vista Street Undercrossing Abutment 1, Abutment 1 Retaining Wall, Pier 2, and Abutment 3.

When a calculated nominal driving resistance is shown on the plans for piling, that value shall be utilized in lieu of nominal resistance in Section 49, "Piling," of the Standard Specifications, and these special provisions.

Jetting and Drilling

Jetting or drilling to obtain the specified penetration in conformance with the provisions in Section 49-1.05, "Driving Equipment," of the Standard Specifications shall not be used for driven type piles.

CAST-IN-DRILLED-HOLE CONCRETE PILES

GENERAL

Summary

Cast-in-drilled-hole (CIDH) concrete piling shall conform to the provisions in Section 49-4, "Cast-In-Place Concrete Piles," of the Standard Specifications and these special provisions.

The provisions of "Welding" of these special provisions shall not apply to temporary steel casings.

Definitions

dry hole:

- 1. Except for CIDH concrete piles specified as end bearing, a drilled hole that:
 - 1.1. Accumulates no more than 12 inches of water in the bottom of the drilled hole during a period of 1 hour without any pumping from the hole during the hour.
 - 1.2. Has no more than 3 inches of water in the bottom of the drilled hole immediately before placing concrete.

2. For CIDH concrete piles specified as end bearing, a drilled hole free of water without the use of pumps.

Submittals

Pile Installation Plan

The Contractor shall submit a pile installation plan to the Engineer for approval for all CIDH concrete piling. The pile installation plan shall be submitted at least 15 days before constructing CIDH concrete piling and shall include complete descriptions, details, and supporting calculations for the following:

- A. Concrete mix design, certified test data, and trial batch reports.
- B. Drilling or coring methods and equipment.
- C. Proposed method for casing installation and removal when necessary.
- D. Methods for placing, positioning, and supporting bar reinforcement. If plastic spacers are proposed for use, include the manufacturer's data and a sample of the plastic spacer.
- E. Methods and equipment for determining the depth of concrete and actual and theoretical volume placed, including effects on volume of concrete when any casings are withdrawn.
- F. Methods and equipment for verifying that the bottom of the drilled hole is clean before placing concrete.
- G. Methods and equipment for preventing upward movement of reinforcement, including the Contractor's means of detecting and measuring upward movement during concrete placement operations.

For concrete placed under slurry, the pile installation plan shall also include complete descriptions, details, and supporting calculations for the following:

- A. Concrete batching, delivery, and placing systems, including time schedules and capacities. Time schedules shall include the time required for each concrete placing operation at each pile.
- B. Concrete placing rate calculations. When requested by the Engineer, calculations shall be based on the initial pump pressures or static head on the concrete and losses throughout the placing system, including anticipated head of slurry and concrete to be displaced.
- C. Suppliers' test reports on the physical and chemical properties of the slurry and any proposed slurry chemical additives, including Material Safety Data Sheet.
- D. Slurry testing equipment and procedures.
- E. Methods of removal and disposal of excavation, slurry, and contaminated concrete, including removal rates.
- F. Methods and equipment for slurry agitating, recirculating, and cleaning.

QUALITY ASSURANCE

Concrete Test Batch

Before concrete is deposited under slurry, a concrete test batch shall be produced and delivered to the project under conditions and in time periods similar to those expected during placement of concrete in the piles. Concrete shall be placed in an excavated hole or suitable container of adequate size to allow for testing as specified herein. Depositing of concrete under slurry will not be required. In addition to meeting the specified nominal slump, the concrete test batch shall meet the following requirements:

- A. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be 2 hours or less, the concrete test batch shall demonstrate that the proposed concrete mix design achieves a slump of at least 7 inches after twice that time has elapsed.
- B. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be more than 2 hours, the concrete test batch shall demonstrate that the proposed concrete mix design achieves a slump of at least 7 inches after that time plus 2 hours has elapsed.

The time period shall begin at the start of placement. Concrete shall not be vibrated or agitated during the test period. Slump tests will be performed in conformance with the requirements in California Test 556.

Upon completion of testing, concrete shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Preconstruction Meeting

A preconstruction meeting for CIDH concrete pile construction shall be held (1) at least 5 business days after submitting the pile installation plan and (2) at least 10 days before the start of CIDH concrete pile construction.

The meeting shall include the Engineer, the Contractor, and any subcontractors involved in the CIDH concrete pile construction.

The purpose of this meeting is to:

- A. Establish contacts and communication protocol between the Contractor, any subcontractors involved in CIDH concrete pile construction, and the Engineer
- B. Review the construction process, acceptance testing, and anomaly mitigation of CIDH concrete piles

The Contractor shall schedule the meeting and provide a facility for the meeting. The Engineer will conduct the meeting. The following will be discussed:

- A. Pile placement plan, dry and wet
- B. Acceptance testing, including gamma-gamma logging, cross-hole sonic logging, and coring
- C. Pile Design Data Form
- D. Mitigation process
- E. Timeline and critical path activities
- F. Structural, geotechnical, and corrosion design requirements
- G. Future meetings, if necessary, for pile mitigation and pile mitigation plan review
- H. Safety requirements, including Cal/OSHA and Tunnel Safety Orders

MATERIALS

Concrete

Concrete deposited under slurry shall have a nominal slump equal to or greater than 7 inches, contain not less than 675 pounds of cementitious material per cubic yard, and be proportioned to prevent excessive bleed water and segregation. The nominal and maximum slump and penetration requirements in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications shall not apply.

Aggregate Grading

The combined aggregate grading shall be either the 1-inch maximum grading, the 1/2-inch maximum grading, or the 3/8-inch maximum grading and shall conform to the requirements in Section 90-3, "Aggregate Gradings," of the Standard Specifications.

When concrete is placed under slurry, the combined aggregate grading shall be either the 1/2-inch maximum grading or the 3/8-inch maximum grading and shall conform to the requirements in Section 90-3, "Aggregate Gradings," of the Standard Specifications.

Permanent Steel Casings

Permanent steel casings shall conform to the provisions of "Steel Pipe Piling" of these special provisions.

Grout

Grout used to backfill casings shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications, except that grout shall consist of cementitious material and water, and may contain an admixture if approved by the Engineer. Cementitious material shall conform to Section 90-2.01, "Cementitious Materials," of the Standard Specifications except that SCMs are not required.

Aggregate shall be used to extend the grout, but only to the extent that the cementitious material content of the grout is not less than 845 pounds per cubic yard of grout. California Test 541 will not be required nor will the grout be required to pass through a sieve with a 0.07-inch maximum clear opening before being introduced into the grout pump. Aggregate shall consist of at least 70 percent fine aggregate and approximately 30 percent pea gravel, by weight. Fine aggregate shall conform to the provisions of Section 90-2, "Materials," of the Standard Specifications. The size of pea gravel shall be such that 100 percent passes the 1/2-inch sieve, a minimum of 90 percent passes the 3/8-inch sieve, and not more than 5 percent passes the No. 8 sieve.

Spacers

Spacers shall conform to Section 52-1.07, "Placing," of the Standard Specifications, except plastic spacers may be used.

Plastic spacers shall conform to Sections 3.4 and 3.5 of the Concrete Reinforcing Steel Institute's "Manual of Standard Practice" and shall have at least 25 percent of their gross plane area perforated to compensate for the difference in the coefficient of thermal expansion between the plastic and concrete. Plastic spacers shall be commercial quality.

Slurry

Mineral Slurry

Mineral slurry shall be mixed and thoroughly hydrated in slurry tanks, and slurry shall be sampled from the slurry tanks and tested before placement in the drilled hole.

Slurry shall be recirculated or continuously agitated in the drilled hole to maintain the specified properties.

Recirculation shall include removal of drill cuttings from the slurry before discharging the slurry back into the drilled hole. When recirculation is used, the slurry shall be sampled and tested at least every 2 hours after beginning its use until tests show that the samples taken from the slurry tank and from near the bottom of the hole have consistent specified properties. Subsequently, slurry shall be sampled at least twice per shift as long as the specified properties remain consistent.

Slurry that is not recirculated in the drilled hole shall be sampled and tested at least every 2 hours after beginning its use. The slurry shall be sampled mid-height and near the bottom of the hole. Slurry shall be recirculated when tests show that the samples taken from mid-height and near the bottom of the hole do not have consistent specified properties.

Slurry shall also be sampled and tested before final cleaning of the bottom of the hole and again just before placing concrete. Samples shall be taken from mid-height and near the bottom of the hole. Cleaning of the bottom of the hole and placement of the concrete shall not start until tests show that the samples taken from mid-height and near the bottom of the hole have consistent specified properties.

Mineral slurry shall be tested for conformance to the requirements shown in the following table:

MINERAL SLURRY		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before placement in the drilled hole - during drilling - before final cleaning - immediately before placing concrete	64.3* to 69.1* 64.3* to 75.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) bentonite attapulgate	28 to 50 28 to 40	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 to 10.5	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning - immediately before placing concrete	less than or equal to 4.0	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Any caked slurry on the sides or bottom of hole shall be removed before placing reinforcement. If concrete is not placed immediately after placing reinforcement, the reinforcement shall be removed and cleaned of slurry, the sides of the drilled hole cleaned of caked slurry, and the reinforcement again placed in the hole for concrete placement.

Synthetic Slurry

Synthetic slurries shall be used in conformance with the manufacturer's recommendations and these special provisions. The following synthetic slurries may be used:

PRODUCT	MANUFACTURER
SlurryPro CDP	KB Technologies Ltd. 3648 FM 1960 West Suite 107 Houston, TX 77068 (800) 525-5237
Super Mud	PDS Company c/o Champion Equipment Company 8140 East Rosecrans Ave. Paramount, CA 90723 (562) 634-8180
Shore Pac GCV	CETCO Drilling Products Group 1350 West Shure Drive Arlington Heights, IL 60004 (847) 392-5800
Terragel of Novagel Polymer	Geo-Tech Drilling Fluids 220 N. Zapata Hwy, Suite 11A Laredo, TX 78043 (210) 587-4758

Inclusion of a synthetic slurry on the above list may be obtained by meeting the Department's requirements for synthetic slurries. The requirements can be obtained from the Offices of Structures Design, P.O. Box 168041, MS# 9-4/11G, Sacramento, CA 95816-8041.

Synthetic slurries listed may not be appropriate for a given site.

Synthetic slurries shall not be used in holes drilled in primarily soft or very soft cohesive soils as determined by the Engineer.

A manufacturer's representative, as approved by the Engineer, shall provide technical assistance for the use of their product, shall be at the site before introduction of the synthetic slurry into a drilled hole, and shall remain at the site until released by the Engineer.

Synthetic slurries shall be sampled and tested at both mid-height and near the bottom of the drilled hole. Samples shall be taken and tested during drilling as necessary to verify the control of the properties of the slurry. Samples shall be taken and tested when drilling is complete, but before final cleaning of the bottom of the hole. When samples are in conformance with the requirements shown in the following tables for each slurry product, the bottom of the hole shall be cleaned and any loose or settled material removed. Samples shall be obtained and tested after final cleaning and immediately before placing concrete.

SlurryPro CDP synthetic slurries shall be tested for conformance to the requirements shown in the following table:

SLURRYPRO CDP KB Technologies Ltd.		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - during drilling - before final cleaning - just before placing concrete	less than or equal to 67.0* less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling -before final cleaning - just before placing concrete	50 to 120 less than or equal to 70	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6 to 11.5	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning - just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Super Mud synthetic slurries shall be tested for conformance to the requirements shown in the following table:

SUPER MUD PDS Company		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before final cleaning - just before placing concrete	less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling - before final cleaning - just before placing concrete	32 to 60 less than or equal to 60	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 to 10.0	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning - just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Shore Pac GCV synthetic slurries shall be tested for conformance to the requirements shown in the following table:

Shore Pac GCV CETCO Drilling Products Group		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before final cleaning - just before placing concrete	less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling - before final cleaning - just before placing concrete	33 to 74 less than or equal to 57	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8.0 to 11.0	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning - just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Terragel or Novagel Polymer synthetic slurries shall be tested for conformance to the requirements shown in the following table:

TERRAGEL OR NOVAGEL POLYMER Geo-Tech Drilling Fluids		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - during drilling - before final cleaning - just before placing concrete	less than or equal to 67.0* less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling - before final cleaning - just before placing concrete	45 to 104 less than or equal to 104	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6.0 to 11.5	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning - just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Water Slurry

At the option of the Contractor, water may be used as slurry when casing is used for the entire length of the drilled hole.

Water slurry shall be tested for conformance to the requirements shown in the following table:

WATER SLURRY		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before final cleaning - just before placing concrete	63.5*	Mud Weight (Density) API 13B-1 Section 1
Sand Content (percent) - before final cleaning - just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, salt water slurry may be used and the allowable densities may be increased up to 2 pcf.		

CONSTRUCTION

General

CIDH concrete piling 24 inches in diameter or larger may be constructed by excavation and depositing concrete under slurry.

Disposal of drill cuttings shall conform to the provisions in "Prepare Storm Water Pollution Prevention Plan," "Construction Site Management," "Soil Containing Petroleum Hydrocarbon and Chemicals of Concern," "Soil Containing Volatile Organic Compounds, Petroleum Hydrocarbons, and Metal," and "Soil Containing Petroleum Hydrocarbons and Metal Contamination" of these special provisions.

Portions of CIDH concrete piling shown on the plans to be formed shall be formed and finished in conformance with the provisions for concrete structures in Section 51, "Concrete Structures," of the Standard Specifications.

Unless otherwise shown on the plans, the bar reinforcing steel cage shall have at least 3 inches of clear cover measured from the outside of the cage to the sides of the hole or casing.

Spacers shall be placed at least 5 inches clear from any inspection tubes. Plastic spacers shall be placed around the circumference of the cage and at intervals along the length of the cage, as recommended by the manufacturer of the plastic spacer.

Permanent Steel Casing Installation

Permanent steel casings shall be installed by impact or vibratory hammers, oscillators, rotators, or by placing in a drilled hole. The provisions of Section 49-1.08, "Pile Driving Acceptance Criteria," of the Standard Specifications shall not apply to permanent steel casings.

Permanent steel casings placed in a drilled hole shall conform to the following requirements:

- A. Casings shall be watertight and of sufficient strength to prevent damage and to withstand the loads from installation procedures, drilling and tooling equipment, lateral concrete pressures, and earth pressures.
- B. Casings shall be positioned with spacers to center the casing inside the drilled hole. Spacers may be welded to the outside of the casing.
- C. Voids in the annular space between the casing and the soil shall be filled with grout.
- D. Grout shall be placed from the bottom of the casing using grout tubes. Placement of grout shall continue until all voids have been filled and the grout reaches the top of the casing. Free fall of the grout from the top to the bottom of the casing will not be allowed.
- E. Grout shall be pumped into the annular space such that the grout head is maintained uniformly around the casing and no visible evidence of water or air is ejected at the top of the grout.

- F. One grout tube shall be placed every 4 feet along the circumference of the casing with a minimum of 4 grout tubes per casing.
- G. Grout tubes shall extend down to no less than 1 foot from the bottom of the casing.

Placing Concrete

Concrete deposited under slurry shall be carefully placed in a compact, monolithic mass and by a method that will prevent washing of the concrete. Concrete deposited under slurry need not be vibrated. Placing concrete shall be a continuous operation lasting not more than the time required for each concrete placing operation at each pile, as submitted in the placing plan, unless otherwise approved in writing by the Engineer. Concrete shall be placed with concrete pumps and delivery tube system of adequate number and size to complete the placing of concrete in the time specified. The delivery tube system shall consist of one of the following:

- A. A tremie tube or tubes, each of which are at least 10 inches in diameter, fed by one or more concrete pumps.
- B. One or more concrete pump tubes, each fed by a single concrete pump.

The delivery tube system shall consist of watertight tubes with sufficient rigidity to keep the ends always in the mass of concrete placed. If only one delivery tube is utilized to place the concrete, the tube shall be placed near the center of the drilled hole. Multiple tubes shall be uniformly spaced in the hole. Internal bracing for the steel reinforcing cage shall accommodate the delivery tube system. Tremies shall not be used for piles without space for a 10-inch tube.

Spillage of concrete into the slurry during concrete placing operations shall not be allowed. Delivery tubes shall be capped with a watertight cap, or plugged above the slurry level with a good quality, tight fitting, moving plug that will expel the slurry from the tube as the tube is charged with concrete. The cap or plug shall be designed to be released as the tube is charged. The pump discharge or tremie tube shall extend to the bottom of the hole before charging the tube with concrete. After charging the delivery tube system with concrete, the flow of concrete through a tube shall be induced by slightly raising the discharge end. During concrete placement, the tip of the delivery tube shall be maintained as follows to prevent reentry of the slurry into the tube. Until at least 10 feet of concrete has been placed, the tip of the delivery tube shall be within 6 inches of the bottom of the drilled hole, and then the embedment of the tip shall be maintained at least 10 feet below the top surface of the concrete. Rapid raising or lowering of the delivery tube shall not be permitted. If the seal is lost or the delivery tube becomes plugged and must be removed, the tube shall be withdrawn, the tube cleaned, the tip of the tube capped to prevent entrance of the slurry, and the operation restarted by pushing the capped tube 10 feet into the concrete and then reinitiating the flow of concrete.

When slurry is used, a fully operational standby concrete pump, adequate to complete the work in the time specified, shall be provided at the site during concrete placement. The slurry level shall be maintained 10 feet above the piezometric head or within 12 inches of the top of the drilled hole, whichever is higher.

A log of concrete placement for each drilled hole shall be maintained by the Contractor when concrete is deposited under slurry. The log shall show the pile location, tip elevation, dates of excavation and concrete placement, total quantity of concrete deposited, length and tip elevation of any casing, and details of any hole stabilization method and materials used. The log shall include a 8-1/2" x 11" sized graph of the concrete placed versus depth of hole filled. The graph shall be plotted continuously throughout placing of concrete. The depth of drilled hole filled shall be plotted vertically with the pile tip oriented at the bottom and the quantity of concrete shall be plotted horizontally. Readings shall be made at least at each 5 feet of pile depth, and the time of the reading shall be indicated. The graph shall be labeled with the pile location, tip elevation, cutoff elevation, and the dates of excavation and concrete placement. The log shall be delivered to the Engineer within 1 working day of completion of placing concrete in the pile.

After placing reinforcement and before placing concrete in the drilled hole, if drill cuttings settle out of the slurry, the bottom of the drilled hole shall be cleaned. The Contractor shall verify that the bottom of the drilled hole is clean.

If a temporary casing is used, maintain concrete placed under slurry at a level at least 5 feet above the bottom of the casing. The equivalent hydrostatic pressure inside the casing must be greater than the hydrostatic pressure on the outside of the casing. The withdrawal of the casing must not cause contamination of the concrete with slurry.

Material resulting from using slurry shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Disposal of material resulting from using slurry shall conform to the provisions in "Prepare Storm Water Pollution Prevention Plan," "Construction Site Management," "Soil Containing Petroleum Hydrocarbon and Chemicals of Concern," "Soil Containing Volatile Organic Compounds, Petroleum Hydrocarbons, and Metal," and "Soil Containing Petroleum Hydrocarbons and Metal Contamination" of these special provisions.

Acceptance Testing and Mitigation

Vertical inspection pipes for acceptance testing shall be provided in all CIDH concrete piling 24 inches in diameter or larger, except when the holes are dry or when the holes are dewatered without the use of temporary casing in a manner that controls ground water.

The furnishing and placing of inspection pipes shall conform to the following:

- A. Inspection pipes shall be Schedule 40 PVC pipe conforming to ASTM D 1785 with a nominal pipe size of 2 inches. Watertight PVC couplers conforming to ASTM D 2466 are permitted to facilitate pipe lengths in excess of those which are commercially available. The Contractor shall log the location of the inspection pipe couplers with respect to the plane of pile cut off, and these logs shall be delivered to the Engineer upon completion of the placement of concrete in the drilled hole.
- B. Each inspection pipe shall be capped at the bottom and shall extend from 3 feet above the pile cutoff down to the bottom of the reinforcing cage. A temporary top cap or similar means shall be provided to keep the pipes clean before testing. If pile cutoff is below the ground surface or working platform, inspection pipes shall be extended to 3 feet above the ground surface or working platform. Approved covers or railings shall be provided and inspection pipes shall be located as necessary to minimize exposure of testing personnel to potential falling hazards.
- C. Inspection pipes shall be completely clean, dry, and unobstructed at the time of testing providing a 2-inch diameter clear opening.
- D. The inspection pipes shall be installed in straight alignment, parallel to the main reinforcement, and securely fastened in place to prevent misalignment during installation of the reinforcement and placing of concrete in the hole. The CIDH concrete piling shall be constructed so that the relative distance of inspection pipes to vertical steel reinforcement shall remain constant.
- E. When any changes are made to the tip of CIDH concrete piling, the Contractor shall also extend the inspection pipes to the bottom of the reinforcing cage.

The following additional requirements apply if inspection pipes are not shown on the plans:

- A. Inspection pipes shall be placed radially around the pile, inside the outermost spiral or hoop reinforcement and no more than 1 inch clear of the outermost spiral or hoop reinforcement.
- B. Inspection pipes shall be placed around the pile at a uniform spacing not exceeding 33 inches measured along the circle passing through the centers of inspection pipes. A minimum of 2 inspection pipes per pile shall be used. Inspection pipes shall be placed to provide the maximum diameter circle that passes through the centers of the inspection pipes while maintaining the spacing required herein.
- C. Inspection pipes shall be placed a minimum of 3 inches clear of the vertical reinforcement. When the vertical reinforcement configuration does not permit this clearance while achieving radial location requirements, distance to vertical rebar shall be maximized while still maintaining the requirement for radial location.
- D. Where the dimensions of the pile reinforcement do not permit inspection pipes to be placed per these requirements, a plan for tube placement shall be submitted to the Engineer for approval in the Pile Placement Plan with a request for deviation before fabricating pile reinforcement.

After placing concrete, inspection pipes shall be filled with water to prevent debonding of the pipe. Before requesting acceptance tests, each inspection pipe shall be tested by the Contractor in the presence of the Engineer by passing a 1-1/4-inch-diameter rigid cylinder 4.5 feet long through the length of pipe. If an inspection pipe fails to pass the 1-1/4-inch-diameter cylinder, the Contractor shall immediately fill all inspection pipes in the pile with water.

For each inspection pipe that does not pass the 1-1/4-inch-diameter cylinder, the Contractor shall core a nominal 2-inch diameter hole through the concrete for the entire length of the pile. Cored holes shall be located as close as possible to the inspection pipes they are replacing and shall be no more than 5 inches clear from the reinforcement.

Coring shall not damage the pile reinforcement. Cored holes shall be made with a double wall core barrel system utilizing a split tube type inner barrel. Coring with a solid type inner barrel will not be allowed. Coring methods and equipment shall provide intact cores for the entire length of the pile. The coring operation shall be logged by an Engineering Geologist or Civil Engineer licensed in the State of California and experienced in core logging. Coring logs shall be in conformance with the Department's "Soil and Rock Logging, Classification, and Presentation Manual." Coring logs shall include Core Recovery (REC), Rock Quality Designation (RQD), locations of breaks, and complete descriptions of inclusions and voids encountered during coring, and shall be delivered to the Engineer upon completion. Concrete cores shall be preserved, identified with the exact location the core was

recovered from within the pile, and delivered to the Engineer upon completion. The Engineer will evaluate the portion of the pile represented by the cored hole based on the submitted core logs.

Acceptance tests of the concrete will be made by the Engineer, without cost to the Contractor. Acceptance tests will evaluate the homogeneity of the placed concrete. Tests will include gamma-gamma logging conducted in conformance with California Test 233. The Contractor shall not conduct operations within 25 feet of the gamma-gamma logging operations. The Contractor shall separate reinforcing steel as necessary to allow the Engineer access to the inspection pipes to perform gamma-gamma logging or other acceptance testing. After requesting acceptance tests and providing access to the piles, the Contractor shall allow 15 days for the Engineer to conduct these tests and make determination of acceptance.

If acceptance testing performed by the Engineer determines that a pile does not meet the requirements of the specifications and California Test 233, Part 5C, then that pile will be rejected and all depositing of concrete under slurry or concrete placed using temporary casing for the purpose of controlling groundwater shall be suspended until written changes to the methods of pile construction are approved in writing by the Engineer.

The Engineer will determine whether the rejected pile requires mitigation due to structural, geotechnical, or corrosion concerns. The Engineer will consider the estimated size and location of the anomaly and potential effects upon the design. The Engineer will provide the conclusions of this analysis to the Contractor for development of a mitigation plan, if required. The Contractor shall allow 30 days for the Engineer to determine whether the pile requires mitigation and provide information to the Contractor. Day 1 of the 30 days shall be the 1st day after access has been provided to the Engineer to perform acceptance testing. If the Contractor submits additional information to the Engineer that modifies the size, shape, or nature of the anomaly, the Contractor shall allow 10 additional days for the subsequent analysis.

The Engineer may elect to perform additional tests to further evaluate a rejected pile. These tests may include crosshole sonic logging and other means of inspection selected by the Engineer. The pile acceptance test report will indicate if the Department intends to perform any additional testing and when the testing will be performed. The Contractor shall allow the Department 20 additional days for a total of 50 days to perform these tests and to provide supplemental results. The Contractor may progress with the mitigation plan process without waiting for these supplemental results.

Inspection pipes and cored holes shall be dewatered and filled with grout after notification by the Engineer that the pile is acceptable. Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. Inspection pipes and holes shall be filled using grout tubes that extend to the bottom of the pipe or hole or into the grout already placed.

If a rejected pile does not require mitigation, the Contractor may repair the pile per an approved mitigation plan or the Department will deduct the amount shown in the table for each anomaly up to the maximum total deduction:

Anomaly Location	Anomaly Deduction		
	D < 4 feet	4 ≤ D < 6	D ≥ 6
Entirely or partially within the upper 2/3 of the pile length	\$1,000	\$2,000	\$4,000
Entirely within the lower 1/3 of the pile length	\$500	\$1,000	\$2,000
Maximum total deduction	\$2,000	\$4,000	\$8,000

Note:

D = Nominal pile diameter

The Department deducts the amount from any moneys due, or that may become due to the Contractor under the Contract.

If the Engineer determines that a rejected pile requires mitigation, the Contractor shall submit to the Engineer for approval a mitigation plan for repair, supplementation, or replacement for each rejected CIDH concrete pile conforming to the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. If the Engineer determines that it is not feasible to repair the rejected pile, the Contractor shall not include repair as a means of mitigation and shall proceed with the submittal of a mitigation plan for replacement or supplementation of the rejected pile.

If the Engineer determines it is not feasible to use one of ADSC's standard mitigation plans to mitigate the pile, the Contractor shall schedule a meeting and meet with the Engineer before submitting a nonstandard mitigation plan. The meeting attendees shall include the Contractor's representatives and the Engineer's representatives involved in the pile mitigation. The purpose of the meeting is to discuss the type of pile mitigation that would be acceptable to the Department. The Contractor shall provide the meeting facility. The Engineer will conduct the meeting.

Pile mitigation plans shall include the following:

- A. The designation and location of the pile addressed by the mitigation plan.
- B. A review of the structural, geotechnical, and corrosion design requirements of the rejected pile.
- C. A step by step description of the mitigation work to be performed, including drawings if necessary.
- D. An assessment of how the proposed mitigation work will address the structural, geotechnical, and corrosion design requirements of the rejected pile.
- E. Methods for preservation or restoration of existing earthen materials.
- F. A list of affected facilities, if any, with methods and equipment for protection of these facilities during mitigation.
- G. The State assigned contract number, bridge number, full name of the structure as shown on the contract plans, District-County-Route-Post Mile, and the Contractor's (and Subcontractor's if applicable) name on each sheet.
- H. A list of materials, with quantity estimates, and personnel, with qualifications, to be used to perform the mitigation work.
- I. The seal and signature of an engineer who is licensed as a Civil Engineer by the State of California. This requirement is waived for mitigation plans when either of the following conditions are present:
 1. The proposed mitigation will be performed in conformance with the most recent Department-published version of "ADSC Standard Mitigation Plan 'A' - Basic Repair" without exception or modification.
 2. The Engineer has determined that the rejected pile does not require mitigation due to structural, geotechnical, or corrosion concerns, and the Contractor elects to repair the pile using most recent Department-published version of "ADSC Standard Mitigation Plan 'B' - Grouting Repair" without exception or modification.

The most recent Department published version of the "ADSC Standard Mitigation Plan" is available at:

<http://www.dot.ca.gov/hq/esc/geotech/ft/adscmitplan.htm>

For rejected piles to be repaired, the Contractor shall submit a pile mitigation plan that contains the following additional information:

- A. An assessment of the nature and size of the anomalies in the rejected pile.
- B. Provisions for access for additional pile testing if required by the Engineer.

For rejected piles to be replaced or supplemented, the Contractor shall submit a pile mitigation plan that contains the following additional information:

- A. The proposed location and size of additional piles.
- B. Structural details and calculations for any modification to the structure to accommodate the replacement or supplemental piles.

All provisions for CIDH concrete piling shall apply to replacement piles.

The Contractor shall allow the Engineer 20 days to review the mitigation plan after a complete submittal has been received.

When repairs are performed, the Contractor shall submit a mitigation report to the Engineer within 10 days of completion of the repair. This report shall state exactly what repair work was performed and quantify the success of the repairs relative to the submitted mitigation plan. The mitigation report shall be stamped and signed by an engineer that is licensed as a Civil Engineer by the State of California. The mitigation report shall show the State assigned contract number, bridge number, full name of the structure as shown on the contract plans, District-County-Route-Post Mile, and the Contractor (and subcontractor if applicable) name on each sheet. The Engineer will be the sole judge as to whether a mitigation proposal is acceptable, the mitigation efforts are successful, and to whether additional repairs, removal and replacement, or construction of a supplemental foundation is required.

STEEL PIPE PILING

GENERAL

Summary

Steel pipe piling shall consist of unfilled steel pipe piling, steel shells for open and closed ended cast-in-steel-shell concrete piling, and permanent steel casing for cast-in-drilled-hole concrete piling. Steel pipe piling shall conform to the provisions in Section 49-5, "Steel Piles," of the Standard Specifications and these special provisions.

All steel pipe piling for this project shall be designated as Class R steel pipe piling.

Submittals

Steel pipe piling qualification audits shall be submitted in conformance with the provisions in "Steel Pipe Piling Qualification Audit" of these special provisions.

A Certificate of Compliance demonstrating material traceability shall be furnished in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications, and shall be signed by the facility's authorized Quality Control Representative. The Quality Control Representative shall be on record with the Department's Office of Structural Materials. The Certificate of Compliance shall include:

1. A statement that all materials and workmanship incorporated in the work and all required tests and inspections of this work have been performed in conformance with the details shown on the plans and these special provisions.
2. An attached certified mill test report (MTR) for each heat number of steel pipe piles being furnished.
3. The carbon equivalent (CE) calculated as $CE = C + (Mn+Si)/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$. The CE shall be 0.45% maximum and may be shown on the MTR.

The Contractor shall submit a TL-38 Inspection Request form at least:

1. 48 hours before performing any field welding of steel pipe piling.

The TL-38 Inspection Request form is available at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm>

Working drawings shall be submitted to the Engineer before attaching handling devices to steel pipe piling. Working drawings shall include locations, handling and fitting device details, and connection details. Attachments shall not be made to steel pipe piling until the working drawings are approved in writing by the Engineer. The Contractor shall allow the Engineer 7 days for review.

MATERIALS

General

The provisions of "Welding Quality Control" of these special provisions shall not apply to longitudinal, skelp end, or spiral seam welds in steel pipe piling.

Circumferential welds shall conform to "Welding Quality Control" of these special provisions and the following:

1. Circumferential welds shall be complete joint penetration welds conforming to AWS D1.1.
2. Welds shall be located at least 12 inches away from a skelp end weld.
3. Backing rings shall conform to the following:
 - 3.1. The minimum thickness shall be 1/4 inch and the backing ring shall be continuous.
 - 3.2. Splices in the backing ring shall be made by complete joint penetration welds. These welds shall be completed and inspected, including any required nondestructive testing, before final insertion into a pipe end.
 - 3.3. The attachment of backing rings to pipe ends shall be done using the minimum size and spacing of tack welds that will securely hold the backing ring in place. Tack welding shall be done in the root area of the weld splice. Cracked tack welds shall be removed and replaced before subsequent weld passes.
 - 3.4. The gap between the backing ring and the steel pipe piling wall shall not be greater than 5/64 inch. One localized portion of the backing ring fit-up, that is equal to or less than a length that is 20

percent of the outside circumference of the pipe, as determined by the Engineer, may be offset by a gap equal to or less than 1/4 inch, provided that this localized portion is first seal welded using shielded metal arc E7016 or E7018 electrodes. This localized portion shall be marked so that it can be referenced during any required NDT.

- 3.5. Backing rings shall have sufficient width so that the backing ring will not interfere with the interpretation of the NDT.
4. For steel pipe with an outside diameter greater than 42 inches and with a wall thickness greater than 1 inch, the root opening tolerances may be increased to a maximum of 3/16 inch.
5. For welding limited to fit-up and attaching backing rings and handling devices, the preheat and interpass temperature shall be in conformance with the requirements in AWS D1.1, Clause 3.5, "Minimum Preheat and Interpass Temperature Requirements," and with Table 3.2, Category C.

All steel pipe piling shall be capable of meeting the fit-up requirements of AWS D1.1, Clause 5.22.3.1, "Girth Weld Alignment (Tubular)," when the material is spliced utilizing a girth weld.

For the purposes of welding and prequalification of base metal, steel pipe piling designated as ASTM A 252 shall be treated as ASTM A 572, Grade 50, or ASTM A 709, Grade 50, in conformance with the requirements in AWS D1.1, Table 3.1.

Butt welded seams subsequently formed, including skelp end welds, shall be 100 percent ultrasonically tested in the final formed and welded condition. The acceptance criteria for UT shall conform to API 5L for API-licensed facilities or AWS D1.1 for cyclically loaded nontubular connections for welds subject to tensile stress.

Except for tack welding, gas metal arc welding (GMAW) shall not be used for the welding of steel pipe piling. When GMAW is used for tack welding, the filler metal shall not be deposited by short circuiting transfer.

The dimensional tolerances of steel pipe piling shall conform to the following:

1. Outside diameter: $\pm 0.75\%$ of the specified outside diameter
2. Wall thickness: -5% , $+10\%$ of the specified nominal wall thickness
3. Straightness: $\pm 1.0\%$ over the length of the pipe

Except for steel pipe piling marked with the API monogram, each length of steel pipe piling shall be marked as follows:

1. Name and location of the piling manufacturer
2. State Contract number, for Class N only
3. Heat number
4. Welding process
5. Outer diameter, nominal wall thickness, minimum wall thickness, and length
6. Year piling was produced
7. Marked as specified below for each class of steel pipe piling. Only Caltrans audited facilities are approved to mark piling for use on this project.

Class R Steel Pipe Piling

Class R steel pipe piling shall conform to one of the following:

1. Manufactured, welded, tested, and inspected in conformance with API 5L, minimum Grade X52, PSL1, and the following:
 - 1.1. Steel pipe piling shall be manufactured by a facility licensed to apply the API monogram.
 - 1.2. Hydrostatic testing, flattening tests, and the API monogram will not be required.
 - 1.3. Each length shall be marked "Caltrans Class R - API."
2. Manufactured in conformance with ASTM A 252, Grade 3, and the following:
 - 2.1. Arc welding processes shall conform to AWS D1.1.
 - 2.2. Groove welds using submerged arc welding from both sides without backgouging will require a procedure qualification record witnessed by the Engineer.
 - 2.3. Underfill will not be allowed.
 - 2.4. For electric resistance welded pipe, the outer diameter flash shall be removed to a maximum of 1/32 inch.

- 2.5. The weld reinforcement shall not exceed 1/8 inch.
- 2.6. The weighing of individual pipe will not be required as specified in ASTM A 252.
- 2.7. Each length shall be marked "Caltrans Class R - A 252."

CONSTRUCTION

General

Steel pipe piling may be re-tapped to prevent pile set-up provided the field welded splice remains at least 3 feet above the work platform until that splice is approved in writing by the Engineer.

Welds used to attach handling devices to steel pipe piling shall be aligned parallel to the axis of the pile and shall conform to the requirements for field welding specified herein. Permanent bolted connections shall be corrosion resistant.

Field Welding

Field welding of steel pipe piling is defined as welding performed after the material has been transported from an audited facility.

Field welding shall conform to the requirements for circumferential welds as specified in "Materials" of this section and the following:

1. Welds made in the horizontal position where the longitudinal pipe axis is vertical shall be single-bevel groove welds.
2. The minimum preheat and interpass temperature for splice welding and for making repairs shall be 150 °F, regardless of the pipe pile wall thickness or steel grade. In the event welding is disrupted, preheating to 150 °F shall occur before welding is resumed.
3. Welds shall not be water quenched. Welds shall be allowed to cool unassisted to ambient temperature.

MEASUREMENT AND PAYMENT (PILING)

Measurement and payment for the various types and classes of piles shall conform to the provisions in Sections 49-6.01, "Measurement," and 49-6.02, "Payment," of the Standard Specifications and these special provisions.

Payment for cast-in-place concrete piling shall conform to the provisions in Section 49-6.02, "Payment," of the Standard Specifications and these special provisions except that when the diameter of cast-in-place concrete piling is shown on the plans as 24 inches or larger, reinforcement in the piling will be paid for by the pound as bar reinforcing steel (bridge).

Full compensation for conforming to the provisions in "Steel Pipe Piling" of these special provisions shall be considered as included in the contract prices paid for the various items of work involved, and no additional compensation will be allowed therefor.

Full compensation for cardboard casing shall be considered as included in the contract price paid per linear foot for cast-in-drilled-hole concrete piling and no additional compensation will be allowed therefor.

Full compensation for cast-in-drilled-hole concrete piling for electrical foundation will be considered as included in the contract lump sum price paid for the various items of work requiring electrical foundations, and no separate payment will be made therefor.

10-1.74 JACKED CASING - 60" OUTSIDE DIAMETER STEEL CASING

GENERAL

Summary

This work consists of tunneling using jacked steel casing for highway, culvert, utility and structure crossings tunnels less than 500 feet in length and includes descriptions of carrier pipe installations within the steel casing.

Submittals

Submit manufacturer's mill specification sheet listing diameter, thickness, and class of steel used in making the casing, and the mill certification.

Submit drawings showing the location of approach trench, jacking pit, tunnel and receiving pit, and joint type for both casing and carrier pipe. Include the details of all grout couplings and other attachments and appurtenances to the casing.

Submit a tunnel construction schedule which includes casing installation, carrier pipe installation, approach trench backfill, and receiving pit backfill.

Submit an engineered shoring plan for the bore-pit and receiving-pit. Shoring submittals shall be wet-signed and stamped by a California-licensed Civil or Structural Engineer.

Permits

The Contractor shall secure all required permits for construction of casing pipe installation.

Scheduling

If the pipeline is not installed within the casing as a continuous operation following completion of the jacking of the casing, the casing portals shall be bulkheaded and the approach trenches backfilled and later reopened for pipe installation prior to commencing said work, including but not limited to jacking and receiving pit excavation.

Line and Grade

The Contractor shall continuously survey jacked casing for conformance with design line and grade. Survey data shall be taken at a maximum of 40-foot intervals.

MATERIALS

Steel Casing

Steel casing shall be ASTM A 283, Grade C, ASTM A 570 Grade 30, 33, and ASTM A-36 unless noted otherwise. The maximum outside diameter and wall thickness of the casing shall be as shown on the plans.

The Contractor shall choose a size of casing at or above the minimum specified, in order that the jacking may be done with a sufficient degree of accuracy to permit installation of the carrier pipe to the grades shown on the plans and to properly accommodate the largest dimension of the carrier pipe.

Casing sections shall be joined by full circumference butt welding in the field. Field welds shall be full-penetration bevel welds in accordance with the standards of quality as set forth in the specifications of the American Welding Society. All welding shall be performed by skilled welders qualified under the provisions of ANSI/AWS D1.1. Welder qualifications shall be certified by an independent local, approved testing agency not more than 6 months prior to commencing work. Prepare ends of casings for proper bevel weld by providing a 45-degree bevel on the end of one of the two casing pieces being joined.

Minimum size and thickness of casing pipes for insertion of various sizes of carrier pipes shall be as shown in the plans unless a larger or heavier wall casing pipe is required.

The size and wall thickness of steel casing for pipeline 12" and larger shall be furnished as shown on the plans. The size and thickness of steel casing shown on the plans are required minimum, the Contractor shall ensure that his equipment for boring, jacking and sand blowing are available and suitable for the construction operation, or larger and thicker casing shall be used at no additional cost.

Casing Seals

The Contractor shall fabricate the casing seals in the field. The seals shall be butt welded plates with pups to accommodate link seal to seal the ends of the pipe within the casing. The seals shall be carbon steel hardware. The plates shall be designed to withhold the pressure of the sand within the casing.

Grout

Grout shall consist of one part portland cement, four parts sand, 2% bentonite by weight of the cement, and sufficient water to produce a workable mixture.

Portland cement, water and sand shall conform to the applicable requirements of the Standard Specifications, except that sand shall be of such fineness that 100% will pass a standard No. 8 sieve and at least 45%, by weight, will pass a standard No. 40 sieve.

Bentonite shall be a commercially-processed powdered bentonite, Wyoming type.

Sand

Air blown sand used to fill the annular space in the jacked casing shall conform with the requirements for imported sand, a minimum sand equivalent of 30 per State of California Divisions of Highways, Test "California 217" with 100% passing a 3/8-inch sieve and not more than 20% passing a 200-mesh sieve. Certification that the sand meets these requirements shall be provided.

Grout Connections

Grout connections on the casing pipe shall be provided every 4-feet at top and bottom of casing, or as shown on the plans. Longitudinal spacing between grout connections may be decreased to provide more frequent grouting, but in no case shall the spacings shown on the plans or specifications be exceeded.

CONSTRUCTION

Safety

An Underground Classification of "Potentially Gassy" has been assigned to the tunnel segment in this project by Cal/OSHA. The tunnel in this project shall be constructed under the rules, regulations, and orders developed by the California Department of Industrial Relations, Division of Occupational Safety and Health and approved by the Board for those tunnels that are classified as "Potentially Gassy."

The Contractor shall schedule a preconstruction conference with the California Department of Industrial Relations, Division of Occupational Safety and Health, Mining & Tunneling Unit prior to commencing any activity associated with the tunnel construction. The Division may be contacted at: 6150 Van Nuys Boulevard, Suite 310, Van Nuys, CA 91401, (818) 901-5420.

The Contractor shall train all non-Contractor project staff in entry operations prior to entry.

The Underground Classification Number is C081-037-12T included at the end of this section and shall be conspicuously posted at the jobsite.

Jacking Pit

The approach trench for jacking or boring operations shall be shored to safeguard existing substructures and surface improvements and to ensure against ground movement in the vicinity of the casing portal.

Heavy guide timbers, structural steel, or concrete cradle shall be placed in the approach trench of the jacking pit and firmly bedded on the required line and grade to provide accurate control of jacking alignment. The structure of timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing. A bearing block consisting of a timber or structural steel framework shall be inserted between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.

Sectional Shield or Jacking Head

A sectional shield or steel jacking head shall be attached to the leading section of the casing to extend around the outer surface of the upper two-thirds of the casing and to project at least 18 inches beyond the driving end of the casing. The sectional shield or jacking head shall not protrude more than 1/2-inch outside of the outer casing surface. The head shall be anchored to prevent wobble or alignment variation during the jacking operation.

To avoid loss of ground outside the casing, excavation shall be restricted to the least clearance necessary to prevent binding, and shall be carried out entirely within the jacking head and not in advance of the head. Excavated material shall be removed from the casing as jacking progresses and no accumulation of excavated material within the casing will be permitted.

Control of Alignment and Grade

Application of jacking pressure and excavation of material ahead of the casing as it advances shall be controlled to prevent the casing from becoming earthbound or deviating from the required line and grade shown on the plans. Do not encroach upon the minimum annular space detailed. The Engineer will check line and grade at intervals not exceeding 40-foot to ensure compliance.

Grouting Exterior of Casing

Immediately after completion of the jacking or boring operation, grout shall be injected through the grout connections to completely fill all voids outside the casing pipe resulting from the jacking or boring operation. Where loss of ground outside the casing is suspected, additional grout connections shall be welded to the casing. Grout pressure shall be controlled to avoid deformation of the casing and to avoid movement of the surrounding ground. After completion of grouting, the grout connections shall be closed with extra heavy black steel threaded plugs.

Installation of Carrier Pipe

After grouting the exterior of the casing pipe, the interior shall be cleaned and the carrier pipe installed. The carrier pipe shall be installed within custom casing spacers of sufficient dimension to prevent the pipe bells from touching the casing pipe and to allow for proper alignment of the carrier pipe to meet the specified grade.

The top of the carrier pipe shall be blocked to prevent flotation. The carrier pipe shall be secured to prevent floating and subsequent loss of grade when the annular spacing between the casing and pipe and the carrier pipe is filled.

Casing spacers skids and blocking shall be bolt-on style with a shell made of at least two halves. The band material shall be manufactured of a minimum 14 gauge carbon steel with a minimum of 10 mils of fusion bonded

epoxy and 10 gauge risers when needed. The runners shall be at least 11 inches long and shall be manufactured of high abrasion resistant and low coefficient friction, glass filled polymer. Fasteners and hardware for securing the spacers and runners shall be plated carbon steel. Three spacers shall be installed per joint. Two spacers shall be installed within the last 30-inches of the casing. Detailed product submittals showing all dimensions shall be provided. Casing spacers shall have a flexible EPDM liner having a minimum thickness of 0.090-inch with a hardness of Durometer "A" 85-90. The liner shall have a rating of no less than 60,000 VPM and water absorption of 1% maximum. Casing spacers shall be manufactured by Advance Products & Systems, Inc., Cascade Waterworks Mfg. Co., Pipeline Seal and Insulator, Inc., or equal.

The carrier pipe grade shall be adjusted as required by either changing the height of the casing spacer riser or the thickness of the runner pad skids to compensate for any grade variations of the casing pipe. The Contractor shall ensure that the carrier pipe does not come in contact with and is insulated from the casing pipe.

If the alignment of the casing pipe is such that the carrier pipe grade cannot be met, the grade of the casing pipe shall, if required by the Engineer, be adjusted. If realignment is not deemed feasible by the Engineer, another casing pipe meeting the required grade shall be installed. The abandoned casing pipe shall be filled with sand and the ends plugged with 12 inch thick masonry plugs, brick and mortar plugs or pic seals. Realignment or replacement of the carrier pipe shall be at the Contractor's expense.

Before backfilling the jacking and receiving pits, the carrier pipe shall have passed an initial pressure or leakage test.

Sand backfill for annular space in jacked casing

Air-blown sand shall be used to fill annular space between the casing and the carrier pipe.

Sand, air compressor, hoses, pressure gages, valves, and fittings shall be furnished for the filling operation.

Sand shall be free of lumps when put into the hopper. Sand shall be of a consistency to flow unimpeded and completely fill all voids.

Closing the Jacking Pit and Receiving Pit

After jacking equipment and muck from the tunnel have been removed from the approach trench of jacking pit, the bottom of the jacking pit shall be prepared as for a pipe foundation. Remove loose and disturbed material below pipe grade to undisturbed earth.

The jacking pit and receiving pit represent overwidth trench conditions. Backfill the trench in accordance with "Trenching, Backfilling and Compacting" of these special provisions with native material or imported sand. Compaction testing will be required for pit backfill operations.

MEASUREMENT AND PAYMENT

The contract price paid per linear foot for jacked casing - 60" OD steel casing shall include full compensation for furnishing the 60" outside diameter steel casing and casing spacers, excavating and backfilling jacking pits, jacking operation and all labor, materials, tools, equipment and incidentals for the bore and jack operation, complete in place, as shown on the plans, specified in these special provisions, and as directed by the Engineer.

10-1.75 PRESTRESSING CONCRETE

Prestressing concrete shall conform to the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications and these special provisions.

The details shown on the plans for cast-in-place prestressed box girder bridges are based on a bonded full length draped tendon prestressing system. For these bridges the Contractor may, in conformance with the provisions in Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications, propose an alternative prestressing system utilizing bonded partial length tendons provided the proposed system and associated details meet the following requirements:

- A. The proposed system and details shall provide moment and shear resistances at least equal to those used for the design of the structure shown on the plans.
- B. The concrete strength shall not be less than that shown on the plans.
- C. Not less than 35 percent of the total prestressing force at any section shall be provided by full length draped tendons.
- D. Anchorage blocks for partial length tendons shall be located so that the blocks will not interfere with the placement of the utility facilities shown on the plans or of any future utilities to be placed through openings shown on the plans.

- E. Temporary prestressing tendons, if used, shall be detensioned, and the temporary ducts shall be filled with grout before completion of the work. Temporary tendons shall be either removed or fully encased in grout before completion of the work.
- F. All details of the proposed system, including supporting checked calculations, shall be included in the drawings submitted in conformance with the provisions in Section 50-1.02, "Drawings," of the Standard Specifications.

Moments and shears for loads used in the design shown on the plans will be made available to the Contractor upon written request to the Engineer.

10-1.76 TIEDOWN ANCHORS

Tiedown anchors at the Retaining Walls 25 & 26, consisting of bars or strands and anchorage assemblies that are grouted in cored, formed, or drilled holes, and the testing of installed anchors, shall conform to the details shown on the plans, the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications, and these special provisions.

Difficult tiedown anchor installation is anticipated due to the presence of dense soils, caving soils, hazardous and contaminated materials, scattered cobbles and boulders, underground utilities, and traffic control.

The Contractor shall determine the bonded length necessary to meet acceptance criteria specified herein.

In fabricating, handling, shipping, and placing tiedown anchors, adequate care shall be taken to avoid damage to the sheathing. Damage to the sheathing caused by handling and fabrication prior to tiedown anchor installation shall be repaired or replaced as determined by the Engineer.

The working drawing submittal for tiedown anchors shall contain all information required for the construction and quality control of the tiedown anchors, including the following:

- A. The proposed schedule and detailed construction sequence of the installation and grouting of tiedown anchors.
- B. Complete details and specifications for the anchorage system and tiedown anchors, including encapsulation materials and grouting methods.
- C. Drilling methods and equipment, including proposed drilled hole diameter and equipment space requirements.
- D. Repair procedure for damaged sheathing.
- E. Grout mix designs and testing procedures.
- F. Grout placement procedures and equipment, including minimum required cure time.
- G. Proposed tiedown anchor testing equipment, including jacking frame and appurtenant bracing, and the method and equipment for determining anchor displacement during testing.
- H. Details for providing bonded and unbonded lengths, including type of packers or other appropriate devices, if used.
- I. Shim thickness and supporting calculations, if shims are used during lock-off.

MATERIALS

Whenever "member" is referred to in Section 50, "Prestressing Concrete," of the Standard Specifications, it shall be considered to mean "tiedown anchor."

The anchorage enclosure assembly and the steel tube and bearing plate of the anchorage assembly for the tiedown anchors shall be galvanized and shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions. The provisions of "Welding Quality Control" of these special provisions shall not apply to the anchorage enclosure welds or to the weld between the steel tube and the bearing plate of the anchorage assembly.

The permanent bearing plate of the tiedown anchor shall effectively distribute the design force (T) uniformly to the top of the footing. The size and thickness of the bearing plate shall be such that the footing concrete bearing stress does not exceed 2400 pounds per square inch and the bending stress does not exceed $0.9 f_y$ for steel.

Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. The grout will not be required to pass through a screen with a 0.07-inch maximum clear opening prior to being introduced into the grout pump. Fine aggregate may be added to the grout mixture of cement and water used outside of the grouted sheathing in drilled holes which are 8 inches or greater in diameter, but only to the extent that the cement content of the grout is not less than 845 pounds per cubic yard of grout. Fine aggregate, if used, shall conform to the provisions in Section 90-2, "Materials," and Section 90-3, "Aggregate Gradings," of the Standard Specifications.

When a bond breaker is shown on the plans near the bearing plate, the bond breaker shall be a 1/4-inch premolded joint filler conforming to the provisions in Section 51-1.12C, "Premolded Expansion Joint Fillers," of the Standard Specifications.

The plastic sheathing for tiedown anchors shall conform to one of the following: polyvinyl chloride (PVC) sheathing, high density polyethylene (HDPE) sheathing, or polypropylene sheathing.

Corrugated plastic sheathing shall be PVC or HDPE. The width of corrugations, the distance between corrugations, and the height of corrugations of corrugated plastic sheathing shall be approximately the same.

PVC sheathing may be used for smooth sheathing for bar tendons, and may be used for corrugated sheathing for either strand or bar tendons. PVC sheathing shall conform to ASTM Designation: D 1784, Class 13464-B. Corrugated PVC sheathing shall have a nominal wall thickness of 40 mils. HDPE sheathing may be used for smooth sheathing for bar tendons, and may be used for corrugated sheathing for either strand or bar tendons. HDPE sheathing shall have a density between 940 kg/m^3 and 960 kg/m^3 as measured in accordance with ASTM Designation: D 792. Corrugated HDPE sheathing shall have a nominal wall thickness of 60 mils for sheathing with an outside diameter of 3 inches or greater, and a nominal wall thickness of 40 mils for sheathing with an outside diameter less than 3 inches.

HDPE sheathing may be used for the smooth sheathing encapsulating individual strands of strand type tendons. Smooth HDPE sheathing for encapsulating strands shall have a minimum wall thickness of 40 mils. Polypropylene sheathing may be used for the smooth plastic sheathing encapsulating individual strands of strand type tendons. Polypropylene sheathing shall have a density between 900 kg/m^3 and 910 kg/m^3 as measured in accordance with ASTM Designation: D 792. Smooth polypropylene sheathing shall have a minimum wall thickness of 40 mils.

The smooth sheathing for the unbonded length of the individual strands, including joints, shall have sufficient strength to prevent damage during construction operations and shall be watertight, chemically stable without embrittlement or softening, and nonreactive with concrete, steel, or corrosion inhibiting grease.

The corrugated sheathing, including joints, shall have sufficient strength to prevent damage during construction operations and shall be grout-tight and watertight, chemically stable without embrittlement or softening, and nonreactive with concrete, steel, or corrosion inhibiting grease.

The transition between the corrugated plastic sheathing and the anchorage assembly shall be an approved detail that allows stressing to the maximum test load without evidence of distress in the corrugated plastic sheathing.

Additional requirements for tiedown anchors with strand type tendons are as follows:

- A. The individual strands of a tendon, except for the bonded length, shall be fully coated with corrosion inhibiting grease and then encapsulated by a smooth HDPE or polypropylene sheath. The corrosion inhibiting grease shall fill all space between strand wires and shall encapsulate the strand giving an encasement diameter at least 5 mils greater than the diameter of the bare strand. The sheath shall be hot melt extruded onto the strand or shall be shop applied by an approved method that assures that all spaces between the sheath and the strand and between the strand wires are filled with corrosion inhibiting grease.
- B. The corrosion inhibiting grease shall provide a continuous nonbrittle film of corrosion protection to the prestressing steel and lubrication between the strand and the sheathing, shall resist flow from the sheathing, shall be chemically stable and nonreactive with the prestressing steel, sheathing material, and concrete, and shall be organic with appropriate polar, moisture displacing, and corrosion inhibiting additives.
- C. The corrosion inhibiting grease shall have the physical properties listed in Table 1 of Specification for Unbonded Single Strand Tendons by the Post Tensioning Institute.
- D. At least 40 days before use, a sample from the lot to be used and test results shall be provided for the corrosion inhibiting grease.

CONSTRUCTION

Tiedown anchors shall be installed in accordance with the manufacturer's recommendations. In case of a conflict between the manufacturer's recommendations and these special provisions, these special provisions shall prevail.

Water and grout from tiedown anchor construction operations shall not fall on public traffic, flow across shoulders or lanes occupied by public traffic, or flow into landscaping, gutters, or other drainage facilities. Excessive amounts of water shall not be used in any of the drilling and the tiedown anchor installation procedures.

Tiedown anchor steel shall be protected prior to completion of all grouting against rust, corrosion, and physical damage in conformance with the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications. In addition, there shall be no evidence of distress in the plastic sheathing or crushing of the grout within the pregrouted sheathing.

The anchorage assembly shall be protected against rust, corrosion, and physical damage prior to completion of all grouting of enclosure or encasement in concrete.

The tiedown anchor installation method selected by the Contractor shall be sufficient to achieve the loadings specified herein. Holes for tiedown anchors shall be drilled in the foundation to a depth sufficient to provide the necessary bonded length beyond the minimum unbonded length shown on the plans.

Tiedown anchor holes shall be drilled by either the rotary or rotary percussion drilling method.

Drilling equipment shall be designed to drill straight and clean holes. The drilling method and the size and capability of the drilling equipment shall be as approved in the working drawings. Drill cuttings shall be disposed of as provided in Section 19-2.06, "Surplus Material," of the Standard Specifications.

At locations where caving conditions are anticipated, sufficient casing and auger lengths shall be available on site to maintain uninterrupted installation of tiedown anchors.

At locations where hard drilling conditions such as rock, cobbles, boulders, or obstructions are anticipated, a down hole pneumatic hammer drill rig and drill bit shall be available on site to drill holes for tiedown anchors.

Holes shall be cleaned to remove material resulting from drilling operations. Tiedown anchors shall not be inserted in the drilled holes until the holes have been inspected by the Engineer.

Tiedown anchors shall be installed in drilled holes in an expeditious manner so that caving or deterioration of the drilled holes does not occur.

Where a tiedown anchor cannot be completely inserted without difficulty, the Contractor shall remove the anchor and clean or redrill the hole to permit unobstructed installation. Partially inserted anchors shall not be driven or forced into the drilled hole and will be rejected. When open-hole drilling methods are being used, the Contractor shall have hole cleaning tools on site suitable for cleaning drilled holes along their full length just prior to anchor insertion and grouting.

The diameter of the drilled hole shall be large enough to provide a minimum of one inch grout cover for the full length of the tendon. Centralizers shall be placed at 10-foot maximum intervals for the full length of the tendon, with the uppermost centralizer located 2 feet from the end of the steel tube and the deepest centralizer located 2 feet from the end of the anchor.

Pregrouting shall occur at least 48 hours before placing the tendon in the drilled hole.

Prior to installing each anchor assembly into the drilled hole, the anchor assembly shall be clean and free of oil, grease, dirt, or other extraneous substances, and any damage to the sheathing shall be repaired or replaced.

Grout for all stages of tiedown anchor construction shall be injected at the low end of the void being filled. The grout shall be placed using grout tubes, unless another method is approved by the Engineer. The quantity of the grout and the grout pressures shall be recorded.

After placing initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

Additional requirements for tiedown anchors with bar type tendons are as follows:

- A. The bar tendons in the unbonded area shall be sheathed with smooth sheathing that extends into the steel tube of the permanent anchorage assembly, as shown on the plans. For this portion of smooth sheathing there is no minimum wall thickness and the sheathing shall be either PVC or HDPE.
- B. In addition, bar tendons shall be sheathed full-length with corrugated sheathing. The annular space between the bar and the corrugated sheathing shall be pregouted prior to placing the tendon in the drilled hole. The bar shall be centered in the sheathing.
- C. There shall be a seal between the smooth sheathing and the corrugated sheathing at the top and bottom of the length of smooth sheathing.
- D. For bar tendons, the initial grout in the drilled hole may be placed before or after insertion of the bar tendon.
- E. Grout in the unbonded length shall not be placed under pressure.
- F. Bars for multiple bar tendons shall be stressed simultaneously.

Additional requirements for tiedown anchors with strand type tendons are as follows:

- A. The strand tendons shall be sheathed with corrugated sheathing. The individual strands within the bonded length shall be separated by spacers so that the entire surface of each strand is bonded in the grout. The maximum spacing of strand spacers shall be 5 feet. The strand spacers shall be plastic and of a construction and strength that will provide support for the individual strands during construction operations.
- B. The tendon shall be sheathed full length with corrugated sheathing and pregouted a minimum length of 2 feet before placing the tendon in the hole. After placing the tendon into the drilled hole and before placing initial grout in the drilled hole, the grout shall be injected at the low end of the corrugated sheathing and the grout shall be expelled at the high end until there is no evidence of entrapped air, water, or diluted grout.

- C. Grout in the unbonded length shall not be placed under pressure.

Testing

Load testing shall be performed against the completed structural element shown on the plans. Load testing shall not be performed directly against the soil. Concrete shall either attain a compressive strength of 2880 pounds per square inch or cure for 7 days before loading. Bearing pads shall be kept a minimum of one foot away from the edges of the drilled hole. Test loads shall be applied using a hydraulic jack supported by a reaction frame capable of supporting the test equipment without excessive deformation. Each jack and its gage shall be accompanied by a certified calibration chart. Test loads shall be maintained within 5 percent of the intended load throughout hold periods. The magnitude of applied test loads shall be determined with a calibrated pressure gage or a load cell.

The test load may be verified by State forces with State-furnished equipment operated in conformance with the requirements of California Test 677. The Contractor shall provide sufficient labor, equipment, and material to install and support such testing equipment at the tiedown anchor and to remove the testing equipment after the testing is complete, as ordered by the Engineer.

Movements of the end of the anchor, relative to an independent fixed reference point, shall be measured using a gage capable of measuring to 0.001-inch and recorded to the nearest 0.001-inch at each load increment, including the ending alignment load, during the load tests. The gage shall have sufficient capacity to allow the test to be completed without resetting the gage during testing. Unloading or repositioning of test equipment during testing will not be allowed. The Contractor shall perform the measuring and recording and shall furnish the Engineer copies of the recorded movements.

At the completion of testing tiedown anchors, or when requested by the Engineer, the Contractor shall furnish to the Engineer complete test results for each tiedown anchor tested. Data for each test shall list key personnel, test loading equipment, tiedown anchor location, hole diameter and depth, method of drilling, type of soil, and bonded and unbonded length of tiedown anchor. Test data shall also list quantity of grout and grout pressure used within the bonded length, amount of ground water encountered within the bonded length, and the time and dates of drilling, tiedown anchor installation, grouting, and testing. The tiedown anchors end movements at each increment of load or at each increment of time during the load hold period of the loading schedule shall be included in the test data.

A minimum of 3 tiedown anchors shall be performance tested at each retaining wall footing. The Engineer shall determine the location of the anchors to be performance tested.

The performance test or proof test shall be conducted by measuring and recording the test load applied to the tiedown anchor and the tiedown anchor end movement during incremental loading and unloading of the anchor in accordance with the loading schedule. The maximum test load shall be held constant for 10 minutes. During the maximum test load hold, the movement of the end of the tendon shall be measured at 1, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between one minute and 10 minutes exceeds 0.04-inch, the maximum test load shall be held for an additional 50 minutes. Total movement shall be measured at 15, 20, 25, 30, 45, and 60 minutes. If the maximum test load is held for 60 minutes, a creep curve showing the creep movement between 6 minutes and 60 minutes shall be plotted as a function of the logarithm of time. The load shall be reduced to the ending alignment load and the residual movement shall be recorded.

LOADING SCHEDULES	
PERFORMANCE TEST	PROOF TEST
AL	AL
0.20T	0.20T
AL	0.40T
0.20T	0.60T
0.40T	0.80T
AL	1.00T*
0.20T	AL
0.40T	
0.60T	
AL	
0.20T	
0.40T	
0.60T	
0.80T	
AL	
0.20T	
0.40T	
0.60T	
0.80T	
1.00T*	
AL	
T = Design force for the anchor shown on the plans. AL = Alignment load = 0.10T * Maximum test load	

For performance and proof tests, each increment of load shall be applied in less than one minute and held for at least one minute but not more than 2 minutes or as specified above. The observation period for the maximum test load hold shall start when the pump begins to apply the last increment of load.

The jacking equipment, including the tendon movement measuring system, shall be stable during all phases of the tiedown anchor loading operations.

All tiedown anchors not performance tested shall be proof tested. If a tiedown anchor fails to conform to the acceptance criteria, the tiedown anchor shall be redesigned or replaced. Tiedown anchors shall not be retested, unless the anchor bonded length is post-grouted after the unacceptable test.

A performance tested or proof tested tiedown anchor shall conform to the following acceptance criteria:

- A. The total measured movement at the maximum test load minus the measured residual movement at the ending alignment load exceeds 80 percent of the theoretical elastic elongation of the sum of the unbonded length and the jacking length; and
- B. The creep movement between one and 10 minutes is less than 0.04-inch.

Performance tested or proof tested tiedown anchors which fail to meet acceptance criterion B will be acceptable if the maximum test load is held for 60 minutes and the creep movement is less than 0.08-inch between 6 and 60 minutes and the creep rate is linear or decreasing in time logarithmic scale from the 6- to the 60-minute reading.

Lock-off

After successful testing of the tiedown anchors, they shall be tensioned and locked off at the lock-off load shown on the plans. The lock-off load is the load on the jacks that is maintained while the anchor head or anchor nuts on the tiedown anchor are permanently set. Immediately after lock-off, a lift-off test shall be performed to demonstrate that the lock-off load was attained. Adjustments in the shim thickness shall be made if required to maintain the lock-off load.

To lock-off a strand tendon, the tendon shall be stressed to the maximum test load, the permanent wedges shall be fully set in the anchor head, and then the shims shall be removed or other appropriate means shall be used to achieve the lock-off load shown on the plans.

Grouting to the level of secondary grouting to the dimensions shown on the plans shall be completed only after successful testing and lock-off has been completed. At least 24 hours after the secondary grout has set, the

remaining void in the steel tube and bearing plate shall be filled with grout. Grout shall be injected at the low end and expelled at the high end until there is no evidence of entrapped air or water. A minimum grout head of 2 feet shall be maintained until the grout has set.

The anchor head or anchor nuts shall be enclosed with a grouted anchorage enclosure device. After grouting the steel tube, the bearing plate surface shall be cleaned, sealant placed, and the anchorage enclosure bolted in place. After bolting the anchorage enclosure in place the void in the anchorage enclosure shall be filled with grout by injecting grout at the low end of the void and venting at the high end. Any holes in the top of the anchorage enclosure used for grout placement shall be cleaned and sealed with sealant. Sealant shall be a non-sag polysulfide or polyurethane sealing compound conforming to the requirements in ASTM Designation: C 920.

MEASUREMENT AND PAYMENT

No payment will be made for tiedown anchors which do not pass the specified testing requirements.

Tiedown anchors will be measured and paid for by the unit, and the number for payment will be determined by the requirements of the details shown on the plans.

The contract unit price paid for tiedown anchor shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the tiedown anchors, including special measures taken to contain grout in the drilled hole, testing, and furnishing and installing anchorage assemblies, complete in place, including repair or replacement of sheathing as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for coring concrete shall be considered as included in the contract unit price paid for tiedown anchors, and no separate payment will be made therefor.

10-1.77 CONCRETE STRUCTURES

Portland cement concrete structures and austin vault sand filter concrete structures shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

GENERAL

Attention is directed to "Precast Concrete Quality Control" of these special provisions.

Shotcrete shall not be used as an alternative construction method for reinforced concrete members unless otherwise specified.

When a roughened concrete surface is shown on the plans, the existing concrete surface shall be roughened to a full amplitude of approximately 1/4 inch by abrasive blasting, water blasting, or mechanical equipment.

Neoprene strip shall be furnished and installed at abutment shear keys and abutment backwall joint protection in conformance with the details shown on the plans, the provisions in the Standard Specifications, and these special provisions.

Furnishing and installing neoprene strip shall conform to the requirements for strip waterstops as provided in Section 51-1.145, "Strip Waterstops," of the Standard Specifications, except that the protective board will not be required.

Forms used to support the deck of cast-in-place box girders or to form the voids of precast members for the following structures may remain in place, provided the portions of the forms that obstruct access openings or conflict with utility facilities are removed, the forming system employed leaves no sharp projections into the cells or voids, and forms between hinges and 5 feet beyond access openings adjacent to hinges are removed:

Bridge No. 53-1110

Bridge No. 53-C2171

Bridge No. 53-3057

Materials for access opening covers in soffits of new cast-in-place concrete box girder bridges shall conform to the provisions for materials in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Plastic pipe located at vertical drains used behind retaining walls, including horizontal or sloping drains down slopes and across sidewalk areas, shall be polyvinyl chloride (PVC) plastic pipe, Schedule 80, conforming to the provisions for pipe for edge drains and edge drain outlets in Section 68-3.02, "Materials," of the Standard Specifications. The vertical drain pipe shall be rigidly supported in place during backfilling operations.

DECK BLEEDER DRAINS

Deck bleeder drains, consisting of plastic pipes installed in deck slabs and covered with wire cloth, shall conform to the details shown on the plans and the requirements in these special provisions.

The exact location of each bleeder shall be as ordered by the Engineer.

Plastic pipe shall be polyvinyl chloride (PVC) plastic pipe conforming to the requirements of ASTM Designation: D 1785, Schedule 40.

The pipe shall be installed so that the top of the pipe is approximately 1/4 inch below the concrete deck surface. Bleeders that are significantly out of position shall be replaced by the Contractor and at the Contractor's expense.

The galvanized wire cloth shall be 1/4 inch mesh, 0.047 inch diameter wire. The wire cloth shall be centered above the pipe and secured, by methods that will not damage the seal, to prevent displacement during placing of the asphalt concrete. The mesh shall be placed after placing the deck seal and before placing the asphalt concrete.

FALSEWORK

Falsework shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

Attention is directed to "Railroad Relations and Insurance" of these special provisions for additional requirements for falsework over railroads.

In addition to the provisions in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications, the time to be provided for the Engineer's review of the working drawings for specific structures, or portions thereof, shall be as follows:

Structure or Portion of Structure	Total Review Time - Weeks
Bridge No. 53-1110	5
Bridge No. 53-3057	5
Bridge No. 53-2920	5
Bridge No. 53C-2171	4

Temporary crash cushion modules, as shown on the plans and conforming to the provisions in "Temporary Crash Cushion Module" of these special provisions, shall be installed at the approach end of temporary railings which are located less than 15 feet from the edge of a traffic lane. For 2-way traffic openings, temporary crash cushion modules shall be installed at the departing end of temporary railings which are located less than 6 feet from the edge of a traffic lane.

The Contractor's engineer who signs the falsework drawings shall also certify in writing that the falsework is constructed in conformance with the approved drawings and the contract specifications prior to placing concrete. This certification shall include performing any testing necessary to verify the ability of the falsework members to sustain the stresses required by the falsework design. The engineer who signs the drawings may designate a representative to perform this certification. Where falsework contains openings for railroads, vehicular traffic, or pedestrians, the designated representative shall be qualified to perform this work, shall have at least 3 years of combined experience in falsework design or supervising falsework construction, and shall be registered as a Civil Engineer in the State of California. For other falsework, the designated representative shall be qualified to perform this work and shall have at least 3 years of combined experience in falsework design or supervising falsework construction. The Contractor shall certify the experience of the designated representative in writing and provide supporting documentation demonstrating the required experience if requested by the Engineer.

Welding and Nondestructive Testing

Welding of steel members, except for previously welded splices and except for when fillet welds are used where load demands are less than or equal to 1,000 pounds per inch for each 1/8 inch of fillet weld, shall conform to AWS D1.1 or other recognized welding standard. The welding standard to be utilized shall be specified by the Contractor on the working drawings. Previously welded splices for falsework members are defined as splices made prior to the member being shipped to the project site.

Splices made by field welding of steel beams at the project site shall undergo nondestructive testing (NDT). At the option of the Contractor, either ultrasonic testing (UT) or radiographic testing (RT) shall be used as the method of NDT for each field weld and any repair made to a previously welded splice in a steel beam. Testing shall be performed at locations selected by the Contractor. The length of a splice weld where NDT is to be performed, shall be a cumulative weld length equal to 25 percent of the original splice weld length. The cover pass shall be ground smooth at the locations to be tested. The acceptance criteria shall conform to the requirements of AWS D1.1, Clause 6, for cyclically loaded nontubular connections subject to tensile stress. If repairs are required in a portion of the weld, additional NDT shall be performed on the repaired sections. The NDT method chosen shall be used for an entire splice evaluation including any required repairs.

For all field welded splices, the Contractor shall furnish to the Engineer a letter of certification which certifies that all welding and NDT, including visual inspection, are in conformance with the specifications and the welding standard shown on the approved working drawings. This letter of certification shall be signed by an engineer who is

registered as a Civil Engineer in the State of California and shall be provided prior to placing any concrete for which the falsework is being erected to support.

For previously welded splices, the Contractor shall determine and perform all necessary testing and inspection required to certify the ability of the falsework members to sustain the stresses required by the falsework design. This welding certification shall (1) itemize the testing and inspection methods used, (2) include the tracking and identifying documents for previously welded members, (3) be signed by an engineer who is registered as a Civil Engineer in the State of California, (4) and shall be provided prior to erecting the members.

COST REDUCTION INCENTIVE PROPOSALS FOR CAST-IN-PLACE PRESTRESSED BOX GIRDER BRIDGES

Except as provided herein, cast-in-place prestressed box girder bridges shall be constructed in conformance with the details shown on the plans and the provisions in Section 50, "Prestressing Concrete," and Section 51, "Concrete Structures," of the Standard Specifications.

If the Contractor submits cost reduction incentive proposals for cast-in-place prestressed box girder bridges, the proposals shall be in conformance with the provisions in Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications and these special provisions.

The Engineer may reject any proposal which, in the Engineer's judgment, may not produce a structure which is at least equivalent to the planned structure.

At the time the cost reduction incentive proposal (CRIP) is submitted to the Engineer, the Contractor shall also submit 4 sets of the proposed revisions to the contract plans, design calculations, and calculations from an independent checker for all changes involved in the proposal, including revisions in camber, predicted deck profile at each construction stage, and falsework requirements to the Offices of Structure Design, Documents Unit, P.O. Box 942874, Sacramento, CA 94274-0001 (1801 30th Street, Sacramento, CA 95816), telephone (916) 227-8230. When notified in writing by the Engineer, the Contractor shall submit 12 sets of the CRIP plan revisions and calculations to the Offices of Structure Design for final approval and use during construction. The calculations shall verify that all requirements are satisfied. The CRIP plans and calculations shall be signed by an engineer who is registered as a Civil Engineer in the State of California.

The CRIP plans shall be either 11" x 17", or 22" x 34" in size. Each CRIP plan sheet and calculation sheet shall include the State assigned designations for the contract number, bridge number, full name of the structure as shown on the contract plans, and District-County-Route-Post Mile. Each CRIP plan sheet shall be numbered in the lower right hand corner and shall contain a blank space in the upper right hand corner for future contract sheet numbers.

Within 3 weeks after final approval of the CRIP plan sheets, one set of the corrected good quality prints on 20-pound (minimum) bond paper, 22" x 34" in size, of all CRIP plan sheets prepared by the Contractor for each CRIP shall be furnished to the Offices of Structure Design, Documents Unit.

Each CRIP shall be submitted prior to completion of 25 percent of the contract working days and sufficiently in advance of the start of the work that is proposed to be revised by the CRIP to allow time for review by the Engineer and correction by the Contractor of the CRIP plans and calculations without delaying the work. The Contractor shall allow a minimum of 8 weeks for the review of a CRIP. In the event that several CRIPs are submitted simultaneously, or an additional CRIP is submitted for review before the review of a previously submitted CRIP has been completed, the Contractor shall designate the sequence in which the CRIPs are to be reviewed. In this event, the time to be provided for the review of any proposal in the sequence shall be not less than the review time specified herein for that proposal, plus 2 weeks for each CRIP of higher priority which is still under review.

Should the review not be complete by the date specified in the Contractor's CRIP, or such other date as the Engineer and Contractor may subsequently have agreed to in writing and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in review of CRIP plans and calculations, an extension of time commensurate with the delay in completion of the work thus caused will be granted as provided in Section 8-1.07, "Liquidated Damages," of the Standard Specifications except that the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications shall not apply.

Permits and approvals required of the State have been obtained for the structures shown on the plans. Proposals which result in a deviation in configuration may require new permits or approvals. The Contractor shall be responsible for obtaining the new permits and approvals before the Engineer will reach a decision on the proposal. Delays in obtaining permits and approvals will not be reason for granting an extension of contract time.

All proposed modifications shall be designed in conformance with the bridge design specifications and procedures currently employed by the Department. The proposal shall include all related, dependent or incidental changes to the structure and other work affected by the proposal. The proposal will be considered only when all aspects of the design changes are included for the entire structure. Changes, such as but not limited to, additional reinforcement and changes in location of reinforcement, necessary to implement the CRIP after approval by the Engineer, shall be made at the Contractor's expense.

Modifications may be proposed in (1) the thickness of girder stems and deck slabs, (2) the number of girders, (3) the deck overhang dimensions as specified herein, (4) the amount and location of reinforcing steel, (5) the amount and location of prestressing force in the superstructure, and (6) the number of hinges, except that the number of hinges shall not be increased. The strength of the concrete used may be increased but the strength employed for design or analysis shall not exceed 6,000 psi.

Modifications proposed to the minimum amount of prestressing force which must be provided by full length draped tendons are subject to the provisions in "Prestressing Concrete" of these special provisions.

No modifications will be permitted in (1) the foundation type, (2) the span lengths or (3) the exterior dimensions of columns or bridge superstructure, except that the overhang dimension from face of exterior girder to the outside edge of roadway deck may be uniformly increased or decreased by 25 percent on each side of the box girder section. Fixed connections at the tops and bottoms of columns shown on the plans shall not be eliminated.

The Contractor shall be responsible for determining construction camber and obtaining the final profile grade as shown on the plans.

The Contractor shall reimburse the State for the actual cost of investigating CRIPs for cast-in-place prestressed box girder bridges submitted by the Contractor. The Department will deduct this cost from any moneys due, or that may become due the Contractor under the contract, regardless of whether or not the proposal is approved or rejected.

BRIDGE DECK SURFACE TEXTURE

General

This work includes the longitudinal texturing of new bridge decks including approach slabs.

Construction

General

Except for bridge widenings, texture the deck surfaces longitudinally using grinding and grooving or longitudinal tining.

For bridge widenings, texture the deck surface longitudinally using longitudinal tining.

After receiving surface texture, portions of surfaces that do not meet the friction requirements of Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications shall be ground or grooved parallel to the centerline in conformance with the provisions of Section 42, "Groove and Grind Pavement," of the Standard Specifications until the friction criteria are met.

Grinding and Grooving

Place an additional 1/4 inch of sacrificial concrete cover on the bridge deck above the finished grade shown on the plans. Place embedments in the concrete based on the final profile grade elevations shown on the plans. Construct joint seals after completing grinding and grooving operations.

Grind and groove surfaces in the following sequence:

1. Comply with the smoothness and deck crack treatment requirements of Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications.
2. Grind the entire surface between the face of concrete barriers to within 18 inches of the toe of barrier under Section 42-2, "Grinding," of the Standard Specifications. Grinding must not reduce the concrete cover on reinforcing steel to less than 1 3/4 inches.
3. Groove the ground surfaces longitudinally, parallel to the centerline, under Section 42-1, "Grooving," of the Standard Specifications.

Longitudinal Tining

Construct the surface texture by longitudinal deck tining.

Perform initial texturing with a burlap drag or broom device that produces striations parallel to the centerline. Perform final texturing with spring steel tines that produce grooves parallel with the centerline.

Construct grooves to within 6 inches of the layout line for the toe of the concrete barrier. The tines must be rectangular in cross section and be from 3/32 to 1/8 inch wide, on 3/4-inch centers, and have enough length, thickness, and resilience to form grooves approximately 3/16 inch deep. Grooves must be from 1/8 to 3/16 inch deep and 3/16 inch wide after concrete has hardened.

For irregular areas and areas inaccessible to the grooving machine, you may hand-construct grooves. Hand-constructed grooves must comply with the specifications for machine-constructed grooves.

Grooving must not cause tearing of the surface or visible separation of coarse aggregate at the surface.

Measurement and Payment

Full compensation for bridge deck surface texture is included in the contract price paid per cubic yard for the structural concrete item requiring the texturing, and no additional compensation will be allowed therefor.

DECK CLOSURE POURS

Where a deck closure pour is shown on the plans, reinforcement protruding into the closure space and forms for the closure pour shall conform to the following:

- A. During the time of placement of concrete in the deck, other than for the closure pour itself, reinforcing steel which protrudes into the closure space shall be completely free from any connection to the reinforcing steel, concrete, or other attachments of the adjacent structure, including forms. The reinforcing steel shall remain free of any connection for a period of not less than 24 hours following completion of the pour.
- B. Forms for the closure pour shall be supported from the superstructure on both sides of the closure space.

SLIDING BEARINGS

Sliding bearings consisting of elastomeric bearing pads lubricated with grease and covered with sheet metal shall conform to the following requirements:

- A. Grease shall conform to the requirements of Society of Automotive Engineers AS 8660. A uniform film of grease shall be applied to the upper surface of the pads prior to placing the sheet metal.
- B. Sheet metal shall be commercial quality galvanized sheet steel. The sheet metal shall be smooth and free of kinks, bends, or burrs.
- C. Construction methods and procedures shall prevent grout or concrete seepage into the sliding bearing assembly.

ELASTOMERIC BEARING PADS

Elastomeric bearing pads shall conform to the provisions in Section 51-1.12H, "Elastomeric Bearing Pads," of the Standard Specifications, except that elastomeric bearing pads for the Buena Vista Street and Empire Avenue railroad underpasses shall conform to the details shown on the plans and to the requirements of Chapter 15, Part 10 and Part 11, of the AREMA Manual for Railway Engineering.

MEASUREMENT AND PAYMENT

Measurement and payment for concrete in structures shall conform to the provisions in Section 51-1.22, "Measurement," and Section 51-1.23, "Payment," of the Standard Specifications and these special provisions.

Full compensation for roughening existing concrete surfaces to a full amplitude of approximately 1/4 inch, where shown on the plans, shall be considered as included in the contract price paid per cubic yard for structural concrete, bridge and no separate payment will be made therefor.

Full compensation for furnishing and installing access opening covers in soffits of new cast-in-place box girder bridges shall be considered as included in the contract price paid per cubic yard for structural concrete, bridge and no separate payment will be made therefor.

Full compensation for furnishing and installing plastic pipe located at vertical drains used behind retaining walls and bridge abutments, including horizontal or sloping drains down slopes and across sidewalk areas, including excavation and backfill involved in placing the plastic pipe, shall be considered as included in the contract price paid per cubic yard for the various items of concrete work involved and no separate payment will be made therefor.

Full compensation for public notification and airborne monitoring for deck crack treatment shall be considered as included in the contract price paid per cubic yard for structural concrete, bridge, and no additional compensation will be allowed therefor.

Full compensation for furnishing all materials for and constructing the concrete median at Br.No. 53-3057 shall be considered as included in the contract price paid per cubic yard for structural concrete, bridge and no additional compensation will be allowed therefor.

10-1.78 PRECAST PRESTRESSED CONCRETE SLABS

Precast prestressed concrete slabs shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

Forms for providing the circular voids in the slabs shall be watertight and shall be constructed of an approved material that will resist breakage or deformation during the placement of the concrete and will not materially

increase the dead load of the span. The forms shall be properly supported and tied and shall remain in correct position at all times during the placement of the concrete.

Except where otherwise shown on the plans, the top surface of the slab shall be given a coarse texture by brooming with a stiff bristled broom or by other suitable devices which will result in uniform transverse scoring, in advance of curing operations. The requirements of the seventh paragraph of Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications shall not apply.

After the concrete slabs are in final position, the anchor dowel holes shall be filled with mortar.

Keyways shall be filled with Class 1 concrete produced from aggregate with a one-inch, maximum grading. The penetration of the concrete shall be near the lower limit of the specified nominal penetration. Keyways shall be mortar-tight before placing concrete. The concrete shall be thoroughly consolidated.

No equipment or other loads will be allowed on spans until at least 72 hours after the last mortar has been placed in the anchor dowel holes or the last concrete has been placed in the keyways.

Precast prestressed concrete slabs will be measured by the square foot for furnish precast prestressed concrete slab of the various types shown on the plans and by the unit for erect precast prestressed concrete deck as shown on the plans. The pay quantities for furnishing the slabs will be computed on the basis of the width and length of individual slabs as shown on the plans. No measurement or payment will be made for any portion of the superstructure in excess of the width shown on the plans.

The contract price paid per square foot for furnish precast prestressed concrete slab of the type shown on the plans shall include full compensation for furnishing all labor, materials (including reinforcing and prestressing steel), tools, equipment, and incidentals, and for doing all the work involved in constructing and furnishing precast prestressed concrete slabs at the site of the work, complete and ready for erection, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for furnishing and placing mortar in holes and concrete in keyways shall be considered as included in the contract price paid per square foot for the type of precast prestressed concrete slab involved and no additional compensation will be allowed therefor.

Full compensation for furnishing and placing neoprene strip, manhole covers, and channel ladder rungs shall be considered as included in the contract price paid per square foot for furnish precast prestressed concrete slab (Type SIV) and no additional compensation will be allowed therefor.

Full compensation for furnishing and stressing tierods shall be considered as included in the contract price paid per square foot for furnish precast prestressed concrete slab (Type SIV) and no additional compensation will be allowed therefor.

10-1.79 STRUCTURE APPROACH SLABS (TYPE N), (TYPE EQ) (TYPE N MODIFIED) AND (RAILROAD)

GENERAL

Summary

This work includes constructing reinforced concrete approach slabs, structure approach drainage systems, and treated permeable base.

Reinforced concrete approach slabs must comply with Section 51, "Concrete Structures," of the Standard Specifications.

Submittals

Furnish a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the geocomposite drain certifying that the drain complies with these special provisions. The Certificate of Compliance must be accompanied by a flow capability graph for the geocomposite drain showing flow rates and the externally applied pressures and hydraulic gradients. The flow capability graph must be stamped with the verification of an independent testing laboratory.

Notify the Engineer of the type of treated permeable base to be furnished at least 30 days before the start of placement. Once you have notified the Engineer of the selection, the type to be furnished must not be changed without a prior written request to do so and approval thereof by the Engineer.

Notify the Engineer of the source of woven tape fabric at least 45 days before use.

MATERIALS

Concrete

Concrete for structure approach slabs must contain not less than 675 pounds of cementitious material per cubic yard and must either:

1. Cure for not less than 5 days before opening to public traffic, or
2. Comply with "Rapid Strength Concrete for Structures" of these special provisions.

Drainage Pads

Concrete for use in drainage pads must be minor concrete.

Geocomposite Drain

Geocomposite drain must consist of a manufactured core not less than 0.25 inch thick nor more than 2 inches thick with one or both sides covered with a layer of filter fabric that will provide a drainage void. The drain must produce a flow rate through the drainage void of at least 2 gallons per minute per foot of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 3,500 psf.

The manufactured core must be one of the following:

1. Preformed grid of embossed plastic
2. Mat of random shapes of plastic fibers
3. Drainage net consisting of a uniform pattern of polymeric strands forming 2 sets of continuous flow channels
4. System of plastic pillars and interconnections forming a semirigid mat

The core material and filter fabric must be capable of maintaining the drainage void for the entire height of geocomposite drain. Filter fabric must be integrally bonded to the side of the core material with the drainage void.

Filter Fabric

Filter fabric must comply with the specifications for Class A filter fabric in Section 88-1.02, "Filtration," of the Standard Specifications.

Plastic Pipe

Plastic pipe shall conform to the provisions for pipe for edge drains and edge drain outlets in Section 68-3, "Edge Drains," of the Standard Specifications.

Treated Permeable Base

Treated permeable base under structure approach slabs must be an asphalt treated permeable base or a cement treated permeable base as specified in Section 29, "Treated Permeable Bases," of the Standard Specifications.

Miscellaneous Materials

Steel components of abutment ties, including plates, nuts, washers, and rods, must comply with Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Steel angles, plates, and bars at the concrete barrier joints must comply with Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Hardboard and expanded polystyrene must comply with Section 51-1.12D, "Sheet Packing, Preformed Pads, and Board Fillers," of the Standard Specifications.

Building paper must be commercial quality 30-pound asphalt felt.

PVC conduit used to encase the abutment tie rod must be commercial quality.

CONSTRUCTION

Geocomposite Drain

Install the geocomposite drain with the drainage void and the filter fabric facing the embankment. The fabric facing the embankment side must overlap a minimum of 3 inches at all joints and wrap around the exterior edges a minimum of 3 inches beyond the exterior edge. If additional fabric is needed to provide overlap at joints and wraparound at edges, the added fabric must overlap at least 6 inches and be attached to the fabric on the geocomposite drain.

Place core material manufactured from impermeable plastic sheeting having non-connecting corrugations with the corrugations approximately perpendicular to the drainage collection system.

If the fabric on the geocomposite drain is torn or punctured, replace the damaged section completely or repair it by placing a piece of fabric that is large enough to cover the damaged area and provide a 6-inch overlap.

If asphalt treated permeable base is placed around the slotted plastic pipe at the bottom of the geocomposite drain, it must be placed at a temperature of not less than 180 °F nor more than 230 °F.

Filter Fabric

Place filter fabric immediately after grading and compacting the subgrade to receive the filter fabric.

Align, handle, and place filter fabric in a wrinkle-free manner under the manufacturer's recommendations.

Adjacent borders of the filter fabric must be overlapped from 12 inches to 18 inches or stitched. The preceding roll must overlap the following roll in the direction the material is being spread or must be stitched. When the fabric is joined by stitching, it must be stitched with yarn of a contrasting color. The size and composition of the yarn must be as recommended by the fabric manufacturer. The number of stitches per 1 inch of seam must be 5 to 7.

Equipment or vehicles must not be operated or driven directly on the filter fabric.

Woven Tape Fabric

Woven tape fabric to be placed between the treated permeable base and the approach slab must be a fabric made of woven strips or tapes and shall conform to the following:

Property	ASTM Designation	Requirement
Weight, ounces per square yard, min.	D 3776	3
Grab Tensile Strength, pounds, min.	D 4632	50
Elongation, percent, max.	D 4632	35
Toughness, pounds, min. (Percent elongation times grab tensile strength)	----	1,200

Woven tape fabric must be treated to provide a minimum of 70 percent breaking strength retention after 500 hours exposure when tested under ASTM D 4355.

Treated Permeable Base

Construct treated permeable base under Section 29, "Treated Permeable Bases," of the Standard Specifications and these special provisions.

Place asphalt treated permeable base at a temperature of not less than 200 °F nor more than 250 °F. Do not use material stored in excess of 2 hours in the work.

Asphalt treated permeable base may be spread in 1 layer. Compact the base with a vibrating shoe type compactor or a roller weighing at least 1.5 tons but not more than 5 tons. Begin compacting the base as soon as the mixture has cooled sufficiently to support the weight of the equipment without undue displacement.

Cement treated permeable base may be spread in 1 layer. Compact the base with a vibrating shoe type compactor or with a steel-drum roller weighing at least 1.5 tons but not more than 5 tons. Compaction must begin within one-half hour of spreading and must consist of 2 complete coverages of the cement treated permeable base.

Finishing Approach Slabs

Finish and treat the top surface of approach slabs under Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications. Edges of slabs must be edger finished.

Cure approach slabs with pigmented curing compound (1) under the specifications for curing structures in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications.

Sealing Joints

Type AL joint seals must comply with Section 51-1.12F, "Sealed Joints," of the Standard Specifications. The sealant may be mixed by hand-held power-driven agitators and placed by hand methods.

The pourable seal between the steel angle and concrete barrier must comply with the requirements for Type A and AL seals in Section 51-1.12F(3), "Materials and Installation," of the Standard Specifications.

The sealant may be mixed by hand-held power-driven agitators and placed by hand methods. Immediately before placing the seal, thoroughly clean the joint, including abrasive blast cleaning of the concrete surfaces, so that all foreign material and concrete spillage are removed from all joint surfaces. Joint surfaces must be dry at the time the seal is placed.

MEASUREMENT AND PAYMENT

Structural concrete, approach slab (Type N), structural concrete, approach slab (Type EQ), structure concrete, approach slab (Type N Modified) and structure concrete, approach slab (Railroad) will be measured and paid for in conformance with the provisions in Section 51-1.22, "Measurement," and Section 51-1.23, "Payment," of the Standard Specifications and these special provisions.

Full compensation for the structure approach drainage system including geocomposite drain, plastic pipe, and drainage pads, treated permeable base, filter fabric, woven tape fabric, miscellaneous metal, pourable seals, epoxy-coated bar reinforcement, waterstops, and sliding joints shall be considered as included in the contract price paid per cubic yard for structural concrete, approach slab of the type shown in the Bid Item List, and no additional compensation will be allowed therefor.

10-1.80 STRUCTURE APPROACH SLABS (TYPE R)

GENERAL

Summary

This work includes removing portions of existing structures, existing pavement and base including reinforced concrete approach slabs, asphalt concrete surfacing, portland cement concrete pavement, subsealing material, and cement treated base, and constructing new reinforced concrete approach slabs at structure approaches.

Reinforced concrete approach slabs must comply with Section 51, "Concrete Structures," of the Standard Specifications.

Quality Control and Assurance

Trial Slab

Before beginning work on approach slabs constructed using RSC, you must successfully complete one or more trial slabs for each concrete mix design to be used in constructing the approach slabs.

Trial slabs must be constructed, finished, cured, and tested with the materials, tools, equipment, personnel, and methods to be used in completing the approach slab. Trial slabs must demonstrate that you are capable of producing approach slabs in conformance with the provisions in this section, within anticipated time periods including delivery, placement, finishing, and curing times, and under similar atmospheric and temperature conditions expected during construction operations. Multiple trial slabs for each approach slab concrete mix design may be required to envelop variable atmospheric conditions.

The minimum trial slab dimensions must be 10' x 20' x 9". Place trial slabs near the job site at a location acceptable to the Engineer except slabs must not be placed on the roadway or within the project limits.

Perform compressive strength testing under Section 90-9, "Compressive Strength," of the Standard Specifications. Trial slab concrete must develop compressive strengths of at least 1200 psi at the age of break used for prequalification of the concrete, and at least 2500 psi at 3 days.

MATERIALS

Concrete

Concrete for structure approach slabs must contain not less than 675 pounds of cementitious material per cubic yard and must either:

1. Cure for not less than 5 days before opening to public traffic, or
2. Comply with "Rapid Strength Concrete for Structures" of these special provisions.

Temporary Structural Section

HMA must consist of commercial quality aggregate and asphalt binder. The grading of the aggregate must comply with the 3/4-inch HMA Types A and B grading specified in Section 39-1.02E, "Aggregate," of the Standard Specifications. The asphalt binder must comply with the requirements for liquid asphalt SC-800 in Section 93, "Liquid Asphalts," of the Standard Specifications. The amount of asphalt binder to be mixed with the aggregate must be approximately 0.3 percent less than the optimum bitumen content as determined by California Test 367.

Aggregate Base (Approach Slab)

Aggregate base (approach slab) for filling voids below the reinforced structure approach slab concrete must be produced from commercial quality aggregates consisting of broken stone, crushed gravel or natural rough-surfaced gravel, and sand, or any combination thereof. The grading of the aggregate base must comply with the 3/4-inch maximum grading specified in Section 26-1.02A, "Class 2 Aggregate Base," of the Standard Specifications.

Miscellaneous Materials

Steel components of abutment ties, including plates, nuts, washers, and rods, must comply with Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Steel angles, plates, and bars at the concrete barrier joints must comply with Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Hardboard and expanded polystyrene must comply with Section 51-1.12D, "Sheet Packing, Preformed Pads, and Board Fillers," of the Standard Specifications.

Building paper must be commercial quality 30-pound asphalt felt.

PVC conduit used to encase the abutment tie rod must be commercial quality.

CONSTRUCTION

General

The thickness shown on the plans for structure approach slabs is the minimum thickness. The thickness may vary depending on the thickness of the pavement and base materials removed.

At locations where the removal of existing materials and approach slab construction is not required to be completed within the same work period, the requirements in "Temporary Roadway Structural Section" and "Trial Slab" do not apply.

Dispose of all materials no longer required in the work under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

If the existing pavement and base materials are removed, and you are unable to construct, finish, and cure the new approach slab by the time the lane is to be opened to public traffic, you must fill the excavation with a temporary roadway structural section as specified in this section, "Structure Approach Slabs (Type R)."

Temporary Roadway Structural Section

Provide a standby quantity of hot mix asphalt (HMA) and aggregate base at the job site equal to the quantity of pavement removed during the work shift for construction of a temporary roadway structural section. The temporary structural section must consist of a 0.3-foot-thick layer of HMA over aggregate base.

Spread and compact aggregate base and HMA by methods that will produce a well-compacted, uniform base, free from pockets of coarse or fine material and a surfacing of uniform smoothness, texture, and density. The aggregate base and the HMA may each be spread and compacted in one layer. The finished surface of the HMA must not vary more than 0.05 foot from the lower edge of a 12-foot straightedge placed parallel with the centerline and must match the elevation of the existing pavement and structure along the joints between the existing pavement and structure and the temporary surfacing.

Maintain the temporary structural section until you are able to construct and cure the approach slab with the prescribed time limit.

Removing Portions Of Existing Structures

Remove portions of the existing structure under "Existing Highway Facilities" of these special provisions.

Removing Existing Pavement And Base Materials

Sawcut full depth the outline of portland cement concrete to be removed with a power-driven concrete saw.

Cut the outlines of excavations in asphalt concrete on a neat line to a minimum depth of 0.25 foot with a power-driven concrete saw or wheel-type rock cutting excavator before any asphalt concrete material is removed. These excavations must be permanently or temporarily backfilled to conform to the grade of the adjacent pavement before opening the lane to public traffic. Surplus excavated material may be used as temporary backfill material.

Regardless of the type of equipment used to remove concrete within the sawed outline, do not use power impact tools within 1.5 feet of the pavement that is required to remain in place.

Uniformly grade and compact the existing base material remaining in place after removing the existing pavement and base materials to the required depth. The finished surface of the base material at any point must not extend above the grade approved by the Engineer.

Fill areas of base material that are low as a result of over excavation with structure approach slab concrete in the same operation that the new concrete is placed.

Where pavement subsealing has been performed under existing approach slabs, remove the full depth of subsealing material. Where removal of cement treated base is required to construct the approach slab, remove the full depth of the cement treated base.

Fill voids between the new structure approach slab and the base material remaining in place that are caused by removal of subsealing material or cement treated base with either aggregate base (approach slab) or structure approach slab concrete. If you choose to fill these voids with structure approach slab concrete, fill the voids in the same operation that the new concrete is placed.

Establish a grade line for the new approach slab that will provide a smooth profile grade. The profile grade will be subject to approval by the Engineer.

Aggregate Base (Approach Slab)

Spread and compact aggregate base (approach slab) for filling voids below the reinforced structure approach slab concrete by methods that will produce a well-compacted, uniform base, free from pockets of coarse or fine material to the grade approved by the Engineer. Where the required thickness of aggregate base is 8 inches or less, the base may be spread and compacted in one layer. Where the required thickness of aggregate base is more than 8 inches, the base must be spread and compacted in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 8 inches.

The finished surface of the base material at any point must not extend above the grade approved by the Engineer. Fill areas of base material that are lower than the grade approved by the Engineer with structure approach slab concrete in the same operation that the new concrete is placed.

Bonding Bar Reinforcement

Bond bar reinforcement or abutment tie rods in drilled holes under the provisions for drilling and bonding dowels in Section 83-2.02D(1), "General," of the Standard Specifications.

If reinforcement is encountered during drilling before the specified depth is attained, notify the Engineer. Unless the Engineer approves coring through the reinforcement, the hole will be rejected and a new hole must be drilled adjacent to the rejected hole to the depth shown on the plans.

Finishing Approach Slabs

Finish the top surface of the approach slab under the provisions for decks in Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications. The finished top surface must not vary more than 0.02 foot from the lower edge of a 12-foot straightedge placed parallel with the centerline. Edges of slabs must be edger finished. The provisions for deck crack treatment do not apply to Type R approach slabs.

The surface of the approach slab will not be profiled, and the Profile Index requirements do not apply.

Approach slab concrete shall be cured before the time the lane is to be opened to public traffic as specified in "Maintaining Traffic" of these special provisions.

Sealing Joints

Type AL joint seals must comply with Section 51-1.12F, "Sealed Joints," of the Standard Specifications. The sealant may be mixed by hand-held power-driven agitators and placed by hand methods.

The pourable seal between the steel angle and concrete barrier must comply with the requirements for Type A and AL seals in Section 51-1.12F(3), "Materials and Installation," of the Standard Specifications. The sealant may be mixed by hand-held power-driven agitators and placed by hand methods. Immediately before placing the seal, thoroughly clean the joint, including abrasive blast cleaning of the concrete surfaces, so that all foreign material and concrete spillage are removed from all joint surfaces. Joint surfaces must be dry at the time the seal is placed.

MEASUREMENT AND PAYMENT

Structural concrete, approach slab (Type R) will be measured and paid for in conformance with the provisions in Section 51-1.22, "Measurement," and Section 51-1.23, "Payment," of the Standard Specifications and these special provisions.

Full compensation for removing and disposing of portions of existing structures and pavement materials, and for furnishing and placing epoxy-coated materials, Type AL joint seals, and pourable seals shall be considered as included in the contract price paid per cubic yard for structural concrete, approach slab (Type R), and no separate payment will be made therefor.

The quantity of aggregate base (approach slab) to be paid for shall include the actual volume of aggregate base (approach slab) used to fill voids below the reinforced structure approach slab concrete, except for the volume of areas low as a result of over excavation. The volume to be paid for will be calculated on the basis of the constructed length, width, and thickness of the filled voids. Structure approach slab concrete used to fill voids lower than the approved grade of the base, except for the areas low as a result of over excavation, will be measured and paid for by the cubic yard as aggregate base (approach slab).

The contract price paid per cubic yard for aggregate base (approach slab) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing aggregate base (approach slab), complete in place, including excavation and removing and disposing of base and subsealing materials, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for furnishing, stockpiling, and disposing of standby material for construction of temporary structural sections; and for constructing, maintaining, removing, and disposing of temporary structural sections shall

be considered as included in the contract price paid per cubic yard for structural concrete, approach slab (Type R), and no separate payment will be made therefor.

Full compensation for drilling and bonding of bar reinforcement or abutment tie rods shall be considered as included in the contract price paid per cubic yard for structural concrete, approach slab (Type R), and no separate payment will be made therefor.

Full compensation for constructing, testing, and removing trial slabs shall be considered as included in the contract price paid per cubic yard for structural concrete, approach slab (Type R), and no separate payment will be made therefor.

10-1.81 PAVING NOTCH EXTENSION

This work shall consist of extending existing paving notches in conformance with the details shown on the plans and these special provisions.

Concrete for paving notch extension shall be a high-strength material consisting of either magnesium phosphate concrete, modified high alumina based concrete, or portland cement based concrete. Magnesium phosphate concrete shall conform to the provisions for magnesium phosphate concrete in Section 83-2.02D(1), "General," of the Standard Specifications and these special provisions. Modified high alumina based concrete and portland cement based concrete shall be water activated and shall conform to the provisions for single component (water activated) magnesium phosphate concrete in Section 83-2.02D(1), "General," of the Standard Specifications and these special provisions.

At least one hour shall elapse between the time of placing concrete for the paving notch extension and placing concrete for the structure approach slab.

A clean, uniform, rounded aggregate filler may be used to extend the concrete. The moisture content of the aggregate shall not exceed 0.5 percent. Grading of the aggregate shall conform to the following:

Sieve Sizes	Percentage Passing
1/2"	100
No. 16	0-5

The amount of aggregate filler shall conform to the manufacturer's recommendation, but in no case shall the concrete strengths be less than that specified for magnesium phosphate concrete in Section 83-2.02D(1), "General," of the Standard Specifications.

The components of dual component (with a prepackaged liquid activator) magnesium phosphate shall be combined by mixing complete units supplied by the manufacturer. Portions of units shall not be used. Water shall not be added to dual component magnesium phosphate.

Magnesium phosphate concrete shall not be mixed in containers or worked with tools containing zinc, cadmium, aluminum or copper. Modified high alumina based concrete shall not be mixed in containers or worked with tools containing aluminum.

Concrete shall not be retempered. Finishing tools that are cleaned with water shall be thoroughly dried before working the concrete.

When placing concrete on slopes exceeding 5 percent, the Engineer may require the Contractor to provide a flow controlled modified material.

Modified high alumina based concrete and portland cement based concrete shall be cured in conformance with the provisions in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications. Magnesium phosphate concrete shall not be cured.

The surface temperature of the areas to receive the concrete shall be 40° F or above when the concrete is placed. The contact surface to receive the magnesium phosphate concrete shall be dry. The contact surfaces to receive the modified high alumina concrete or portland cement based concrete may be damp but not saturated.

The construction joint between the paving notch extension and the existing abutment shall conform to the provisions for horizontal construction joints in Section 51-1.13, "Bonding," of the Standard Specifications. Concrete shall be placed in the spalled portions of the existing paving notch concurrently with the concrete for the paving notch extension.

Attention is directed to "Reinforcement" of these special provisions.

Structure excavation and backfill shall conform to the provisions in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications, except for payment.

Drilling of holes and bonding of reinforcing steel dowels shall conform to the provisions for drilling and bonding dowels in Section 83-2.02D(1), "General," of the Standard Specifications. If reinforcement is encountered during drilling before the specified depth is attained, the Engineer shall be notified. Unless the Engineer approves

coring through the reinforcement, the hole will be rejected and a new hole, in which reinforcement is not encountered, shall be drilled adjacent to the rejected hole to the depth shown on the plans.

The quantity of concrete for paving notch extension will be measured by the cubic foot.

The contract price paid per cubic foot for paving notch extension shall include full compensation for furnishing all labor, materials (including concrete for the paving notch spalled areas), tools, equipment, and incidentals, and for doing all the work involved in constructing the paving notch extension, complete in place, including structure excavation and backfill, reinforcement, and drilling and bonding dowels, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.82 SOUND WALL

DESCRIPTION

This work shall consist of constructing sound walls of masonry block, precast concrete panel, composite panel, and ribbed steel panels. Sound walls shall be supported on concrete barriers, retaining walls, footings, piles, pile caps, grade beams or posts as shown on the plans.

SOUND WALL (MASONRY BLOCK)

General

Summary

This section includes specifications for constructing masonry block sound walls.

The angle of internal friction (ϕ) to be used with the plans for the soil at sound walls is 30.

Submittals

Submit test data for:

1. Prepackaged mortar materials
2. Compressive strength of masonry for preconstruction testing and field QC testing
3. Grout compressive strength

Submit samples of the CMUs to the Engineer for each color and texture as specified in ASTM C 90. Submit manufacturer's descriptive data for each type of CMU, accessory, and manufactured product.

Submit mix designs for approval for:

1. Each grout mix proposed for use. Admixtures are not allowed unless authorized.
2. Mortar cap.

Submit qualification documentation for the authorized laboratory.

Submit certificates of compliance for CMUs, aggregate for grout, and grout.

Submit a copy of the daily field report on the business day following the preparation of the report.

Upon completion of the work requiring special inspection, submit a copy of the final report.

Quality Control And Assurance

General

Obtain CMUs of a uniform color and texture from a single source and from a single manufacturer.

Obtain mortar ingredients of a uniform quality, including color, from a single manufacturer for cement and lime and from a single source or producer for each aggregate.

If prepackaged mortar materials are used, perform the following preconstruction tests at an authorized laboratory:

1. California Test 551. Test data must be from samples having a moist cure except that the samples must not be immersed in lime water. The average 28-day compressive strength of mortar must be not less than 1,800 psi.
2. California Test 422 or 417. Mortar must not contain more than 0.05 percent soluble chlorides when tested under California Test 422 or more than 0.25 percent soluble sulfates as SO_4 when tested under California Test 417.

Masonry Preconstruction Testing

Perform masonry preconstruction testing at an authorized laboratory. The authorized laboratory must comply with ASTM E 329.

Determine the compressive strength of masonry for each grout mix to be used under one of the following 2007 California Building Code (CBC) test methods:

1. Section 2105.2.2.1, "Unit strength method," except the grout must meet the requirements under Section 2105.2.2.1.2, "Concrete Masonry," 3.3.2
2. Section 2105.2.2.2, "Prism test method"

If the prism test method is used to determine the compressive strength, you must also test the grout compressive strength under ASTM C 1019.

Field Quality Control

You must employ a special inspector and an authorized laboratory to perform Level 1 inspections and structural tests of masonry to verify the masonry construction complies with Section 1704, "Special Inspections," and Section 2105, "Quality Assurance," of the 2007 CBC.

Masonry special inspection personnel used in the work must not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project.

The special inspector must be an ICC certified Structural Masonry Special Inspector. The special inspector must perform the inspections required under Section 1704.5, "Masonry Construction," of the 2007 CBC.

The special inspector must prepare a daily field report providing information regarding the specific activities witnessed, including placing of CMUs and bar reinforcing, grouting, fabrication of test specimens, and other observations of importance to the work.

A daily field report is required for each day that the special inspector is on the job site. The special inspector must prepare a signed final report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in compliance with the plans, specifications, and the applicable workmanship requirements of these specifications and the 2007 CBC.

Test the compressive strength of masonry for each 10,000 square feet of sound wall area, or portion thereof. Determine the compressive strength as specified for masonry preconstruction testing in the "Masonry Preconstruction Testing" section.

Materials

Concrete

Concrete for sound wall footings, pile caps, and grade beams, if required, must comply with Section 51, "Concrete Structures," of the Standard Specifications.

Concrete Masonry Units

CMUs must comply with ASTM C 90 for hollow, load bearing, lightweight or medium weight class units. You may use standard or open-end units. If using open-ended units, do not reduce the spacing of the bar reinforcement shown.

The weight of a CMU for a sound wall on a bridge must not exceed 38 pounds.

The color of the CMUs must comply with color chosen for this corridor.

Identify each high-strength CMU with a groove in an interior corner. The groove must extend from a mortar surface for a length of about 2 inches and must have a depth of about 3/16 inch.

Mortar

Mortar must comply with ASTM C 270 except the cement must comply with Section 90-2.01A, "Cement," of the Standard Specifications.

Aggregate must comply with ASTM C 144.

Hydrated lime must comply with ASTM C 207, Type S.

Mortar for laying CMUs must consist by volume of 1 part cement, 0.25 to 0.5 part hydrated lime, and 2.25 to 3 parts mortar sand. Add enough water to make a workable mortar. Accurately measure and thoroughly mix each batch of mortar. Do not retemper mortar more than 1 hour after mixing.

Color mortar to match the CMUs. Color pigments must be iron oxides complying with ASTM C 979. The dosage must not exceed 10 percent by weight of cement in the mortar.

If authorized, you may use prepackaged mortar materials and mortar containing admixtures complying with ASTM C 270.

Packages of mortar materials must bear the manufacturer's name, brand, contents, weight, and color identification.

Grout

The minimum compressive strength of the grout at 28 days must be 85 percent of the greater of (1) the masonry compressive strength shown on the plans or (2) 2,000 psi.

Cementitious material must comply with Section 90-2.01, "Cementitious Materials," of the Standard Specifications.

Grout must contain at least 550 pounds of cementitious material per cubic yard. Grout for high strength CMUs must contain at least 675 pounds of cementitious material per cubic yard.

Aggregate must comply with Section 90-2.02, "Aggregates," of the Standard Specifications. Aggregate for grout must be a mixture of fine and coarse aggregate. At least 20 percent of the aggregate must be coarse aggregate. One hundred percent of the combined grading must pass the 1/2-inch sieve.

Mix grout with sufficient water to produce a mix consistency suitable for pumping without segregation. Provide grout with a slump from 8 to 11 inches.

Reinforcement

Bar reinforcing steel must comply with ASTM A 615/A 615 M, Grade 60 or ASTM A 706/A 706 M.

Ladder type joint reinforcement must comply with ASTM A 951, hot-dip galvanized.

Expansion Joint Filler

Expansion joint filler must comply with ASTM D 1751 or ASTM D 2000 M2AA 805.

Construction

General

Construct sound wall with hand laid CMUs.

Vertical lines and surfaces must not vary from plumb by more than 1/4 inch in 10 feet.

Provide bond beam units or recesses for horizontal reinforcement.

Construct the walls in 4-foot-maximum-height lifts. Complete grouting of each lift before beginning construction of the next lift. The top course of each lift must be a bond beam.

Bond beams must be continuous. Cover the top of unfilled cells under horizontal bond beams with metal or plastic lath.

Roughen, clean, and lightly wet contact surfaces where fresh masonry joins masonry that is partially or totally set. The roughened surface must be at least as rough as a wood troweled surface. Remove laitance, curing compounds, debris, dirt, and any substance which decreases bond to the fresh masonry.

Roughen and clean concrete surfaces on which masonry walls are to be constructed, exposing the aggregate. Immediately before laying the CMUs, flush the surface with water and allow to dry to a surface dry condition.

Use a masonry saw to cut CMUs to neat and true lines.

Protect masonry as specified for protecting concrete in Section 90-8, "Protecting Concrete," of the Standard Specifications

During erection in inclement weather, keep cells dry by covering partially completed walls. The covering must be waterproof fabric, plastic or paper sheeting, or other authorized material. Do not use wooden boards or planks as covering materials. Extend the covering down each side of masonry walls approximately 2 feet.

Remove splashes, stains, and spots from exposed faces of the wall.

Mortar Bedding and Jointing

Mortar joints must be approximately 3/8 inch thick.

Walls and cross webs forming cells to be filled with grout shall be full bedded in mortar to prevent leakage of grout. All head and bed joints must be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells. Shove head joints tight.

Reinforcement

Before placing grout, securely hold reinforcement in position at the top and bottom and at intervals not exceeding 192 bar diameters with wire ties or spacing devices. Wire must be 16 gage or heavier. Wooden, aluminum, or plastic spacing devices must not be used.

Splice vertical reinforcement only at the locations shown on the plans.

Grouting

Preserve the unobstructed vertical continuity of the grout during mortar placement in joints. Any overhanging mortar projecting more than 1/2 inch, or other obstruction or debris, must be removed from the inside of cells.

Only fill those cells containing reinforcement with grout.

Consolidate grout in the cells by vibrating and reconsolidating after excess moisture has been absorbed and before plasticity is lost. Do not slice grout with a trowel.

If placing of grout in grout filled cells is stopped for more than 1 hour, a construction joint must be made. The construction joint must be approximately 1-1/2 inches below the top of the last course filled with grout.

MEASUREMENT AND PAYMENT

Sound walls of the types designated in the Bid Item List will be measured by the square foot of the area of wall projected on a vertical plane between the elevation lines shown on the plans and length of wall (including the exposed posts, backup wall for access openings, and access gates).

The contract price paid per square foot for sound wall of the types designated in the Bid Item List shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the sound wall, complete in place, including all anchorages, access gates, ladders, and reinforcement, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer. Sound wall supports will be measured and paid for as separate items of work.

Full compensation for performing testing, special inspections, and preparing all required testing and inspection reports shall be considered as included in the contract price paid per square foot for sound wall (masonry block) and no additional compensation will be allowed therefor.

10-1.83 DRILL AND BOND DOWELS

Drilling and bonding dowels shall conform to the details shown on the plans, the provisions in Section 83-2.02D(1), "General," of the Standard Specifications, and these special provisions.

Dowels shall conform to the provisions for bar reinforcement in "Reinforcement" of these special provisions.

If reinforcement is encountered during drilling before the specified depth is attained, the Engineer shall be notified. Unless the Engineer approves coring through the reinforcement, the hole will be rejected and a new hole, in which reinforcement is not encountered, shall be drilled adjacent to the rejected hole to the depth shown on the plans.

Unless otherwise provided, dowels to be bonded into drilled holes will be paid for as bar reinforcing steel (bridge).

Unless otherwise provided, drilling and bonding dowels will be measured and paid for by the linear foot determined by the number and the required depth of holes as shown on the plans or as ordered by the Engineer.

The contract price paid per linear foot for drill and bond dowel shall include full compensation for furnishing all labor, materials (except reinforcing steel dowels), tools, equipment, and incidentals, and for doing all the work involved in drilling the holes, including coring through reinforcement when approved by the Engineer, and bonding the dowels, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.84 CORE CONCRETE

Coring concrete shall consist of coring holes through reinforced concrete bridge members as shown on the plans and in conformance with these special provisions.

The holes shall be cored by methods that will not shatter or damage the concrete adjacent to the holes.

Water for core drilling operations shall be from the local domestic water supply or shall not contain more than 1,000 parts per million of chlorides as Cl, nor more than 1,300 parts per million of sulfates as SO₄, nor shall the water contain any impurities in a sufficient amount that would cause discoloration of the concrete or produce etching of the surface.

Water from core drilling operations shall not be permitted to fall on public traffic, to flow across shoulders or lanes occupied by public traffic, or to flow into gutters or other drainage facilities.

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in coring the holes, including control of water from core drilling and repairing any damaged reinforcement, as shown on the plans, as specified in these special provisions, and as directed by the Engineer shall be considered as included in the contract price paid for structural concrete bridge, and no separate payment will be allowed therefor.

10-1.85 SEALING JOINTS

Joints in concrete bridge decks and joints between concrete structures and concrete approach slabs must be sealed in conformance with the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

When ordered by the Engineer, a joint seal larger than called for by the Movement Rating shown on the plans must be furnished and installed. Payment to the Contractor for furnishing the larger seal and for saw cutting the increment of additional depth of groove required will be determined as provided in Section 4-1.03, "Changes," of the Standard Specifications.

10-1.86 REFINISHING BRIDGE DECKS

Surfaces of bridge decks that are exposed when existing railings, curbs, or sidewalks are removed shall be prepared and refinished flush with the adjoining deck surface in conformance with these special provisions.

The Contractor may refinish the deck surface using Portland cement concrete or rapid setting concrete.

The exact area to be refinished will be designated by the Engineer.

When work is being performed within 10 feet of a traffic lane or performed over traffic, dust and residue from deck preparation and cleaning shall be removed or controlled by vacuum, water spray, or shield methods approved by the Engineer.

Concrete shall be removed without damage to concrete that is to remain in place. Damage to concrete that is to remain in place shall be repaired to a condition satisfactory to the Engineer.

The concrete in deck areas to be refinished shall be removed to a depth of approximately 3/4 inch below the adjoining deck surface. A 3/4 inch deep saw cut shall be made along the perimeter of deck areas to be refinished before removing the concrete.

Existing areas of the deck more than 3/4 inch below the adjoining deck surface shall be prepared by removing not less than 1/4 inch of surface material to expose sound aggregate.

Concrete removal may be done by abrasive blast cutting, abrasive sawing, impact tool cutting, machine rotary abrading, or by other methods, all to be approved by the Engineer. Cut areas shall be cleaned free of dust and all other loose and deleterious materials by brooming, abrasive blast cleaning, and high pressure air jets. Equipment shall be fitted with suitable traps, filters, drip pans, or other devices to prevent oil or other deleterious matter from being deposited on the deck.

Existing reinforcement, exposed during the removal of concrete, that is to remain in place shall be protected from damage.

Steel dowels shall be cut off 1 inch below the existing concrete deck surface or at the bottom of concrete removal, whichever is lower.

Where refinishing is not required, steel dowels shall be cut off 1 inch below the finished surface and the holes shall be patched with rapid setting concrete.

Refinishing isolated high areas in the existing deck may be accomplished by cutting the concrete down to be flush with the plane of the adjoining deck surface by abrasive sawing, grinding, impact tool cutting, or by other methods approved by the Engineer. When grinding is performed to bring the deck concrete flush with the adjoining deck surface, the resulting surface shall have a coefficient of friction of not less than 0.35 as determined by California Test 342.

PORTLAND CEMENT CONCRETE

An epoxy adhesive shall be applied to the surfaces to be refinished before placing the portland cement concrete. Immediately before applying the adhesive, the area to receive the adhesive shall be cleaned by abrasive blasting and blown clean by compressed air to remove dust and any other loose material. The area to be covered shall be surface dry and the substrate temperature shall be 40° F or above when the adhesive is applied.

The epoxy adhesive shall be furnished and applied in conformance with the provisions in Section 95-1, "General," and Section 95-2.03, "Epoxy Resin Adhesive for Bonding New Concrete to Old Concrete," of the Standard Specifications. The exact rate of applying epoxy adhesive will be determined by the Engineer. The adhesive shall be worked onto the surface with stiff brushes or equal.

Portland cement concrete used to fill the prepared areas shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and the following:

- A. The concrete shall contain a minimum of 675 pounds of cementitious material per cubic yard.
- B. The amount of free water used in concrete shall not exceed 280 pounds per cubic yard.
- C. The aggregate shall contain between 50 and 55 percent fine aggregate and the remainder shall be pea gravel. The grading of pea gravel shall be such that 100 percent passes the 1/2 inch sieve and not more than 5 percent passes the No. 16 sieve, unless a larger size is ordered by the Engineer.

- D. Admixtures shall be furnished and used if directed by the Engineer.
- E. Immediately after depositing on the newly placed adhesive, the portland cement concrete shall be thoroughly consolidated until all voids are filled and free mortar appears on the surface and then struck off to the required grade.
- F. Concrete shall be cured as provided in Section 90-7.03, "Curing Structures," of the Standard Specifications.
- G. No loads of any kind shall be applied to the portland cement concrete for at least 7 days after placing.

RAPID SETTING CONCRETE

Rapid setting concrete used to fill the prepared areas shall be a high-strength material consisting of magnesium phosphate concrete, modified high alumina based concrete, or portland cement based concrete. Magnesium phosphate concrete shall conform to the requirements for magnesium phosphate concrete in Section 83-2.02D(1), "General," of the Standard Specifications. Modified high alumina based concrete and portland cement based concrete shall be water activated and shall conform to the requirements for single component (water activated) magnesium phosphate concrete in Section 83-2.02D(1), "General," of the Standard Specifications.

A clean uniform rounded aggregate filler may be used to extend the rapid setting concrete. The moisture content of the aggregate shall not exceed 0.5 percent. Grading of the aggregate shall conform to the following:

Sieve Size	Percentage Passing
1/2"	100
No. 16	0-5

The amount of aggregate filler shall conform to the manufacturer's recommendation, but in no case shall the concrete strengths be less than that specified for magnesium phosphate concrete in Section 83-2.02D(1), "General," of the Standard Specifications.

Mixing of components of dual component (with a prepackaged liquid activator) magnesium phosphate shall be by complete units, supplied by the manufacturer. Portions of units shall not be used. Water shall not be added to dual component magnesium phosphate.

Immediately before applying the rapid setting concrete, the surface shall be dry and blown clean by compressed air to remove accumulated dust and any other loose material. If the surface becomes contaminated at any time before placing the concrete, the surface shall be cleaned by abrasive blasting. The surface temperature of the areas to be covered shall be 39 F or above when the concrete is applied. Methods proposed to heat said surfaces are subject to approval by the Engineer. The surface for the magnesium phosphate concrete shall be dry. The surfaces for modified high alumina based concrete or portland cement based concrete may be damp but not saturated.

Magnesium phosphate concrete shall not be mixed in containers or worked with tools containing zinc, cadmium, aluminum, or copper. Modified high alumina based concrete shall not be mixed in containers or worked with tools containing aluminum.

Concrete shall not be retempered. Finishing tools that are cleaned with water shall be thoroughly dried before working the concrete.

When placing concrete on slopes exceeding 5 percent, the Engineer may require the Contractor to provide a flow controlled modified material.

Modified high alumina based concrete and portland cement based concrete shall be cured in conformance with the provisions in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications. Magnesium phosphate concrete shall not be cured.

Unless otherwise permitted in writing by the Engineer, public traffic shall not be permitted on the new concrete until at least 24 hours after final set.

FINISHING REQUIREMENTS

In advance of the curing operations, the surface of the concrete shall be textured by brooming with a stiff bristled broom or by other suitable devices that will result in uniform scoring. Brooming shall be performed transversely. The operation shall be performed at a time and in a manner that produces a hardened surface having a uniform texture and a coefficient of friction of not less than 0.35 as determined by California Test 342.

Refinished surfaces that are found to have a coefficient of friction less than 0.35 shall be ground or grooved by the Contractor at his expense in conformance with the applicable provisions in Section 42, "Groove and Grind Pavement," of the Standard Specifications.

In the longitudinal direction, refinished surfaces shall not vary more than 0.02 foot from the lower edge of a 12-foot straightedge. The refinished surface shall be flush with the existing adjoining surface.

MEASUREMENT AND PAYMENT

No adjustment of compensation will be made for any increase or decrease in the quantity of refinish bridge deck, regardless of the reason for the increase or decrease. The provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications shall not apply to the contract item of refinish bridge deck.

The quantity in square feet of refinish bridge deck to be paid for will be determined from the lengths and widths of the refinished areas, measured horizontally, plus 0.2 square foot for patching around each dowel.

The contract price paid per square foot for refinish bridge deck shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in refinishing areas of the existing bridge deck, including cutting steel dowels, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.87 POLYESTER CONCRETE OVERLAY

GENERAL

Summary

This work includes placing a polyester concrete overlay with a high molecular weight methacrylate (HMWM) resin prime coat to bridge decks.

Submittals

Submit an overlay placement plan and a public safety plan under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The plan review time will be 15 days.

The overlay placement plan must include:

1. Schedule of overlay work and testing for each bridge
2. Description of equipment for applying HMWM resin
3. Description of equipment for measuring, mixing, placing, and finishing polyester concrete overlay
4. Method for isolating expansion joints
5. Cure time for polyester concrete
6. Description of equipment for applying sand
7. Storage and handling of HMWM resin and polyester concrete components
8. Disposal of excess HMWM resin, polyester concrete, and containers

The public safety plan must include details for:

1. A public notification letter with a list of delivery and posting addresses. The letter must describe the work to be performed and state overlay work locations, dates, and times. Deliver the letter to residences and businesses within 100 feet of overlay work and to local fire and police officials at least 7 days before starting work. Post the letter at the job site.
2. An airborne emissions monitoring plan prepared and executed by a certified industrial hygienist (CIH) certified in comprehensive practice by the American Board of Industrial Hygiene. The plan must have at least 4 monitoring points including the mixing point, application point, and point of nearest public contact. Monitor airborne emissions during overlay work and submit emissions monitoring results after completing the work.
3. An action plan for protection of the public when airborne emissions levels exceed permissible levels.
4. A copy of the CIH's certification.

Submit a material safety data sheet for each shipment of HMWM and polyester resin components before use.

Quality Control and Assurance

Submit samples of HMWM and polyester resins 15 days before use under Section 6-3, "Testing," of the Standard Specifications. Notify the Engineer 15 days before delivery of resin in containers over 55 gallons to the job site.

Complete a trial overlay before starting work. Results from airborne emissions monitoring of the trial overlay must be submitted to the Engineer before starting production work.

The trial overlay must:

1. Be at least 12 feet wide by 6 feet long and the same thickness as the project overlay
2. Be constructed on a prepared concrete base

3. Be placed within the project limits at an approved location
4. Be constructed using the same equipment as the production work
5. Replicate field conditions for the production work
6. Determine the initial polyester concrete set time
7. Demonstrate suitability of the proposed means and methods
8. Demonstrate suitability of the airborne emissions monitoring plan
9. Be disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications

MATERIALS

Polyester concrete consists of polyester resin binder and aggregate.
 Polyester resin binder must:

1. Be an unsaturated isophthalic polyester-styrene co-polymer.
2. Contain at least 1 percent by weight gamma-methacryloxypropyltrimethoxysilane, an organosilane ester silane coupler.
3. Be used with a promoter compatible with suitable methyl ethyl ketone peroxide and cumene hydroperoxide initiators.
4. Comply with the following:

Polyester Resin Binder		
Property	Requirement	Test Method
Viscosity *	75 to 200 cP (RVT, No. 1 Spindle, 20 RPM at 77°F)	ASTM D 2196
Specific Gravity *	1.05 to 1.10 at 77°F	ASTM D 1475
Elongation	35 percent, minimum Type I at 0.45 inch/min. Thickness = 0.25 ± 0.03 inch	ASTM D 638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D 618
Tensile Strength	2500 psi, minimum Type I at 0.45 inch/min. Thickness = 0.25 ± 0.03 inch	ASTM D 638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D 618
Styrene Content *	40 percent to 50 percent by weight	ASTM D 2369
PCC Saturated Surface-Dry Bond Strength	3.5 MPa, minimum, at 24 hours and 21° ± 1°C	California Test 551
Static Volatile Emission *	60 gram per square meter, loss, maximum	SCAQMD Method 309-91

*Test must be performed before adding initiator.

Aggregate for polyester concrete must:

1. Comply with Section 90-2.02, "Aggregates," of the Standard Specifications
2. Have at most 45 percent crushed particles retained on the No. 8 sieve when tested under California Test 205
3. Have fine aggregate consisting of natural sand
4. Have a weighted average aggregate absorption of at most 1 percent when tested under California Tests 206 and 207
5. At the time of mixing with resin, have a moisture content of at most one half of the weighted average aggregate absorption when tested under California Test 226
6. Comply with one of the following aggregate gradings:

Combined Aggregate Grading

Sieve Size	Percentage Passing	
	3/8 inch Maximum	No. 4 Maximum
1/2 inch	100	100
3/8 inch	83 - 100	100
No. 4	65 - 82	62 - 85
No. 8	45 - 64	45 - 67
No. 16	27 - 48	29 - 50
No. 30	12 - 30	16 - 36
No. 50	6 - 17	5 - 20
No. 100	0 - 7	0 - 7
No. 200	0 - 3	0 - 3

HMWM resin prime coat consists of a resin, promoter, and initiator. HMWM resin must:

1. Be low odor and wax-free
2. Comply with the following:

Methacrylate Resin

Property	Requirement	Test Method
Volatile Content *	30 percent, maximum	ASTM D 2369
Viscosity *	25 cP, maximum, (Brookfield RVT with UL adaptor, 50 RPM at 77°F)	ASTM D 2196
Specific Gravity *	0.90 minimum, at 77°F	ASTM D 1475
Flash Point *	180°F, minimum	ASTM D 3278
Vapor Pressure *	1.0 mm Hg, maximum, at 77°F	ASTM D 323
PCC Saturated Surface-Dry Bond Strength	3.5 MPa, minimum at 24 hours and 21 ± 1°C	California Test 551

* Test must be performed before adding initiator.

Sand for abrasive sand finish must:

1. Be commercial quality blast sand
2. Have at least 95 percent pass the No. 8 sieve and at least 95 percent retained on the No. 20 sieve when tested under California Test 205
3. Have an average absorption of at most 1 percent when tested under California Test 207

CONSTRUCTION

Use a continuous mixer to mix polyester concrete. The continuous mixer must:

1. Employ an auger screw/chute device.
2. Be equipped with an automatic metering device that measures and records aggregate and resin volumes. Record volumes at least every 5 minutes, including time and date. Submit recorded volumes at the end of the work shift.
3. Have a visible readout gage that displays volumes of aggregate and resin being recorded.
4. Be certified under California Test 109 before use.
5. Produce a satisfactory mix consistently during a demonstration.

Finishing equipment for polyester concrete must:

1. Have grade control capabilities
2. Be used to consolidate the polyester concrete

The Engineer will provide final grade and cross slope before the start of overlay work.

New concrete deck surfaces must comply with Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications before starting overlay work.

The deck must be dry before placing the HMWM prime coat. The concrete surface must be at least 50 degrees F and at most 100 degrees F. Relative humidity must be at most 85 percent.

Sweep the deck. Blow the deck clean with compressed air.

Thoroughly mix all components of HMWM resin prime coat. Apply the HMWM resin to the deck surface:

1. Within 5 minutes of mixing
2. At a rate of approximately 90 sq ft per gallon
3. Uniformly and spread to completely cover surfaces to be overlaid

Place the HMWM prime coat on magnesium phosphate concrete no sooner than 72 hours after final set or on modified high alumina based concrete no sooner than 30 minutes after final set.

Place the polyester concrete:

1. Immediately after applying the HMWM prime coat
2. Before gelling
3. Within 15 minutes of adding initiator

The resin binder must weigh approximately 12 percent of the weight of the aggregate. The Engineer will determine the exact percentage. Polyester concrete must have an initial set time of at least 30 minutes and at most 120 minutes when tested using an initial-setting time Gillmore needle under ASTM C 266.

Consolidate and finish the overlay to the required grade and cross section using finishing equipment. Polyester concrete must be consolidated to a relative compaction of at least 97 percent when tested under California Test 552.

Texture the polyester concrete surface by longitudinal tining by texturing with spring steel tines that produce grooves parallel with the centerline.

The tines must:

1. Be rectangular in cross section
2. Be from 3/32 to 1/8 inch wide on 3/4-inch centers
3. Have enough length, thickness, and resilience to form grooves approximately 3/16 inch deep

Construct grooves to within 6 inches of the layout line of the concrete barrier toe. Grooves must be from 1/8 to 3/16 inch deep and 3/16 inch wide after concrete has hardened.

For irregular areas and areas inaccessible to the grooving machine, you may hand construct grooves. Hand-constructed grooves must comply with the specifications for machine-constructed grooves.

Tining must not cause tearing of the deck surface or visible separation of coarse aggregate at the surface.

Apply a sand finish of at least 0.8 lbs per sq yd before gelling occurs.

Protect the overlay from moisture for at least 4 hours after finishing. Allow traffic or equipment on the overlay no sooner than 4 hours after final finishing.

Completed polyester concrete deck surfaces must comply with Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications.

Taper polyester concrete overlay edges if the overlay is not completed within the allowable lane closure time and is more than 1/2 inch higher in elevation than the adjacent pavement. Taper edges transverse to the direction of traffic at a 20:1 (horizontal:vertical) slope. Taper edges longitudinal to the direction of traffic at a 4:1 (horizontal:vertical) slope. Tapers may remain and be overlaid with polyester concrete overlay.

MEASUREMENT AND PAYMENT

Furnish polyester concrete overlay will be measured and paid for by the cubic foot. The volume to be paid for will be determined based on the quantity of resin binder used, the percent by weight of resin binder in the polyester concrete, and a unit weight of 135 lb per cu ft. The payment quantity shall be the calculated quantity of polyester concrete overlay used in the work, except material used in trial overlays and wasted or unused material. When the plans show that unsound concrete patching material is polyester overlay, the payment quantity will include the patches.

Place polyester concrete overlay will be measured and paid for by the square foot. The area to be paid for will be based on the plan dimensions.

The contract price paid per cubic foot for furnish polyester concrete overlay shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing polyester concrete, including furnishing HMWM resin prime coat and materials for trial overlays, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as ordered by the Engineer.

The contract price paid per square foot for place polyester concrete overlay shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the polyester concrete overlay, complete in place, including application of HMWM prime coat and constructing and disposing of trial overlays and base, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as ordered by the Engineer.

Public safety plan will be paid for on the basis of a lump sum price.

The contract lump sum price paid for public safety plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, including the public action plan and airborne emissions monitoring work performed by the CIH, notification of the public, and reporting test results, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Modifications to existing bridge deck smoothness will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

10-1.88 ARCHITECTURAL TREATMENT

GENERAL

Summary

This work includes constructing architectural textures for concrete surfaces.

Architectural textures must comply with Section 51, "Concrete Structures," of the Standard Specifications.

Architectural textures listed below are required at concrete surfaces shown on the plans:

1. Fractured rib texture
2. Formed relief texture

The fractured rib texture must be an architectural texture simulating the appearance of straight ribs of concrete with a fractured concrete texture imparted to the raised surface between the ribs. Grooves between ribs must be continuous with no apparent curves or discontinuities. Variation of the groove from straightness must not exceed 1/4 inch for each 10 feet of groove. The architectural texture must have random shadow patterns. Broken concrete at adjoining ribs and groups of ribs must have a random pattern. The architectural texture must not have secondary patterns imparted by shadows or repetitive fractured surfaces.

The architectural texture must be a formed relief constructed to the dimensions and shapes shown on the plans. Corners at the intersection of plane surfaces must be sharp and crisp without easing or rounding. A Class 1 surface finish must be applied to the architectural texture.

Test Panel

Test panels corresponding in size and locations as shown on the contract plans must be successfully completed at a location approved by the Engineer before beginning work on architectural textures. The test panel must be constructed and finished with the materials, tools, equipment, and methods to be used in constructing the architectural texture. If ordered by the Engineer, additional test panels must be constructed and finished until the specified finish, texture, and color are obtained, as determined by the Engineer.

The test panel approved by the Engineer must be used as the standard of comparison in determining acceptability of architectural texture for concrete surfaces.

MATERIALS

Not Used

CONSTRUCTION

Form Liners

Form liners must be used for textured concrete surfaces and must be installed in conformance with the manufacturer's recommendations, unless other methods of forming textured concrete surfaces are approved by the Engineer. Form liners must be manufactured from an elastomeric material by a manufacturer of commercially available concrete form liners. Form liners must leave crisp, sharp definition of the architectural surface. Recurring textural configurations exhibited by repeating, recognizable shadow patterns must be prevented by proper casting of

form liner patterns. Textured concrete surfaces with such recurring textural configurations must be reworked to remove such patterns as approved by the Engineer or the concrete must be replaced.

Form liners must have the following properties:

Property	Test	Requirement
Shore A hardness	ASTM D 2240	50–90
Tensile strength	ASTM D 412	1,000 psi min

Cuts and tears in form liners must be sealed and repaired in conformance with the manufacturer's recommendations. Form liners that are delaminated from the form must not be used. Form liners with deformations to the manufactured surface caused by improper storage practices or any other reason must not be used.

Form liners must extend the full length of texturing with transverse joints at 8 foot minimum spacing. Small pieces of form liners must not be used. Grooves must be aligned straight and true. Grooves must match at joints between form liners. Joints in the direction of grooves in grooved patterns must be located only in the depressed portion of the textured concrete. Adjoining liners must be butted together without distortion, open cracks, or offsets at the joints. Joints between liners must be cleaned before each use to remove any mortar in the joint.

Adhesives must be compatible with the form liner material and with concrete. Adhesives must be approved by the liner manufacturer. Adhesives must not cause swelling of the liner material.

Releasing Form Liners

Products and application procedures for form release agents must be approved by the form liner manufacturer. Release agents must not cause swelling of the liner material or delamination from the forms. Release agents must not stain the concrete or react with the liner material. For reliefs simulating fractured concrete or wood grain surfaces the application method must include the scrubbing method using a natural bristle scrub brush in the direction of grooves or grain. The release agent must coat the liner with a thin film. Following application of form release agent, the liner surfaces must be cleaned of excess amounts of agent using compressed air. Buildup of form release agent caused by the reuse of a liner must be removed at least every 5 uses.

Form liners must release without leaving particles or pieces of liner material on the concrete and without pulling or breaking concrete from the textured surface. The concrete surfaces exposed by removing forms must be protected from damage.

Curing

Concrete surfaces with architectural texture must be cured only by the forms-in-place or water methods. Seals and curing compounds must not be used.

MEASUREMENT AND PAYMENT

Architectural treatment will be measured and paid for by the square foot.

The contract price paid per square foot for architectural treatment of the types listed in the Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in architectural texture, complete in place, including test panels, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for architectural texture on concrete barrier rails is included in the contract price paid per linear foot for concrete barrier rails of the types listed in the Bid Item List, and no separate payment will be made therefor.

10-1.89 COLORED CONCRETE

Colored concrete shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

The retaining walls of Bridge No. 53-2920 shall be integrally pigmented concrete. The color shall closely conform to Federal Standard 595B No. 30318.

Color pigments shall be of high quality iron oxides conforming to ASTM C 979. The dosage shall not exceed 10 percent by weight of cementitious material in the concrete mix design.

The Contractor shall submit technical data and manufacturer's specifications for colored concrete components and a proposed plan for mixing, delivery, placement, finishing, and curing of the colored concrete. This plan shall be submitted to the Engineer for approval at least 20 days prior to constructing the architectural texture test panel.

A test panel of at least 4' x 4' with a minimum depth of 5 inches shall be successfully completed at a location approved by the Engineer at least 20 days before placing colored concrete. The test panel shall be constructed, finished, and cured with the same materials, tools, equipment, and methods that will be used in placing the colored

concrete. At the completion of the curing period, the test panel shall exhibit a color that closely matches the specified color. If ordered by the Engineer, additional test panels shall be constructed, finished, and cured until the specified color is obtained.

The approved test panel shall be the standard of comparison in determining the acceptability of colored concrete. Upon successful completion of all colored concrete, all test panels shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Cementitious materials and aggregates from the same sources used in the approved architectural texture test panel shall be used for the colored concrete in the finished work.

The Contractor shall monitor the water content, weight of cementitious materials, and size, weight, and color of aggregate to maintain consistency and accuracy of the mixed colored concrete. The Contractor shall schedule delivery of concrete to provide consistent mix times from batching until discharge. No water shall be added after a portion of the batch has been discharged.

When more than one concrete pump is used to place concrete, the Contractor shall designate the pumps to receive colored concrete. The designated pumps shall receive only colored concrete throughout the concrete placement operation.

Consistent finishing practices shall be used to ensure uniformity of texture and color.

Unless otherwise specified, curing of colored concrete shall be by the forms-in-place method or the curing compound method only and shall conform to Section 90-7.03, "Curing Structures," of the Standard Specifications and these special provisions. The curing compound used for curing colored concrete surfaces shall be clear or match the color of the colored concrete and shall be manufactured specifically for colored concrete. Curing compounds containing calcium chloride shall not be used. The time between completing surface finishing and applying curing compound shall be the same for each colored concrete component.

Surrounding exposed surfaces shall be protected during placement, finishing, and curing operations of colored concrete.

Full compensation for colored concrete shall be considered as included in the contract price paid per square foot for architectural treatment, and no separate payment will be made therefor.

10-1.90 REINFORCEMENT

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

The provisions in "Welding Quality Control" of these special provisions do not apply to resistance butt welding.

When joining new reinforcing bars to existing reinforcement, sample splices shall be made using only the deformation pattern of the new reinforcement to be spliced.

The following shall apply to ultimate splices for bar reinforcing cages of columns and cast-in-place piles where the longitudinal bars are spliced vertically at the job site in or above their final positions:

1. Instead of being removed from the completed lot, sample splices may be prepared in the same manner as specified in Section 52-1.08C(2)(a), "Production Test Requirements for Service Splices," of the Standard Specifications for service sample splices. These sample splices shall be tested in conformance with the requirements in Section 52-1.08C(3), "Ultimate Butt Splice Test Criteria," of the Standard Specifications.
2. Splices may be encased in concrete prior to having the QCM review, approve, and forward each Production Test Report to the Engineer. Should the Contractor exercise this option, it is expressly understood that the Contractor will not be relieved of the Contractor's responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

For bar reinforcing cages measuring 4 feet in diameter and larger:

1. At least 4 vertical bars of each cage, equally spaced around the circumference, shall be tied at all reinforcement intersections with double wire ties.
2. At least 25 percent of remaining reinforcement intersections in each cage shall be tied with single wire ties. Tied intersections shall be staggered from adjacent ties.
3. Bracing shall be provided to avoid collapse of the cage during assembly, transportation, and installation.

Successful completion of these minimum baseline requirements for reinforcement cages 4 feet in diameter and larger will in no way relieve the Contractor of full responsibility for engineering the temporary support and bracing of the cages during construction.

Reinforcement shown on the plans to be galvanized shall be galvanized in conformance with the requirements in ASTM Designation: A 767/A 767M, Class 1, except that chromating will not be required.

Within areas where galvanized reinforcement is required, tie wire and bar chairs or other metallic devices used to secure or support the reinforcement shall be galvanized, plastic coated, or epoxy coated to prevent corrosion of the devices or damage to the galvanized reinforcement.

Galvanized surfaces that are abraded or damaged caused by shipping, handling, or installation shall be repaired as specified in Section 75-1.05, "Galvanizing," of the Standard Specifications.

EPOXY-COATED PREFABRICATED REINFORCEMENT

Bar reinforcement to be epoxy coated shall conform to the ASTM designation and grade required or permitted by Section 52-1.02A, "Bar Reinforcement," of the Standard Specifications for the location or type of structure involved. The coated bar reinforcement shall conform to the requirements in ASTM Designation: A 934/A 934M except as provided herein.

Wire reinforcement to be epoxy coated shall conform to the ASTM designation and grade required or permitted by Section 52-1.02D, "Reinforcing Wire," of the Standard Specifications for the location or type of structure involved. The coated wire reinforcement shall conform to the requirements for Class A, Type 2 coating of ASTM Designation: A 884/A 884M except as provided herein.

Appendices X1 and X2, "Guidelines For Job-Site Practices," of ASTM Designation: A 884/A 884M and A 934/A 934M, respectively, applies except as provided herein. The term "shall" replaces the term "should" in these appendices. Section X1.2 of Appendix X1 and Section X2.2 of Appendix X2 do not apply.

All coatings shall be purple or gray in color.

The epoxy powder coating shall be selected from the Department's Pre-Qualified Products List.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for each shipment of epoxy-coated bar or wire reinforcement certifying that the coated bars or wire conform to the requirements in ASTM Designation: A 934/A 934M for bars or Designation: A 884/A 884M for wire and the provisions in these special provisions. This Certificate of Compliance shall include all the certifications specified in ASTM Designation: A 934/A 934M for bars or ASTM Designation: A 884/A 884M for wire. All qualification testing and certification shall be by an independent laboratory.

Except for field welding of butt splices, all welding of reinforcement shall be complete before epoxy coating the reinforcement.

Before epoxy coating, all resistance butt welds shall have the weld flash removed to produce a smooth profile free of any sharp edges that would prevent proper coating of the bar. The flash shall be removed such that the ultimate tensile strength and elongation properties of the bar are not reduced and the outside radius of the flash at any point along the circumference of the bar is (1) not less than the nominal radius of the bar nor (2) greater than 3/16 inch beyond the nominal radius of the bar.

A proposed weld flash removal process shall be submitted to and approved by the Engineer in writing before performing any removal work. The submittal shall demonstrate that the proposed flash removal process produces a smooth profile that can be successfully epoxy coated in conformance with the requirements specified herein.

Bending of epoxy-coated reinforcement after the coating has been applied will not be allowed.

When any portion of a reinforcing bar or wire requires epoxy coating, the entire bar or wire shall be coated except when the bar or wire is spliced outside of the limits of epoxy coating shown on the plans, epoxy coating will not be required on the portion of bar or wire beyond the splice.

Within areas where epoxy-coated reinforcement is required, tie wire and bar chairs or other metallic devices used to secure or support the reinforcement shall be plastic coated or epoxy coated to prevent corrosion of the devices or damage to the coated reinforcement.

Prior to coating, the Contractor shall furnish to the Transportation Laboratory a representative 4 ounce sample from each batch of epoxy coating material to be used. Each sample shall be packaged in an airtight container identified with the manufacturer's name and batch number.

Two 30-inch-long samples of coated bar or wire reinforcement from each size and from each load shipped to the job site shall be furnished to the Engineer for testing. These samples shall be representative of the material furnished. These samples, as well as any additional random samples taken by the Engineer, may be tested for specification compliance. Additional sampling and all tests performed by the Engineer may be performed at any location deemed appropriate by the Engineer. Failure of any sample to meet the requirements of the specifications will be cause for rejection.

If any bar tested for coating thickness or for adhesion of coating fails to meet the requirements for coated bars in Section 9 of ASTM Designation: A 934/A 934M, 2 retests on random samples taken from bars represented by the failed test will be conducted for each failed test. If the results of both retests meet the specified requirements, the coated bars represented by the samples may be certified as meeting the test requirements.

If any wire reinforcement tested for coating thickness or for flexibility fails to meet the requirements for coated wire in Section 8 of ASTM Designation: A 884/A 884M, 2 retests on random samples taken from wire represented by the failed test will be conducted for each failed test. If the results of both retests meet the specified requirements, the coated wire represented by the samples may be certified as meeting the test requirements.

Epoxy-coated reinforcement shall be covered with an opaque polyethylene sheeting or other suitable protective material to protect the reinforcement from exposure to sunlight, salt spray, and weather. For stacked bundles, the protective covering shall be draped around the perimeter of the stack. The covering shall be adequately secured; however, it should allow for air circulation around the reinforcement to prevent condensation under the covering. Epoxy-coated reinforcement shall not be stored within 1000 feet of ocean or tidal water for more than 2 months.

All visible damage to coatings caused by shipping, handling, or installation shall be repaired as required for repairing coating damaged before shipment conforming to the requirements in ASTM Designation: A 934/A 934M for bar reinforcement or ASTM Designation: A 884/A 884M for wire reinforcement. When the extent of coating damage prior to repair exceeds 2 percent of the bar or wire surface area in one foot length, repair of the bar or wire will not be allowed and the coated bar or wire will be rejected.

The patching material and process shall be suitable for field application. The patching material shall be prequalified as required for the coating material and shall be either identified on the container as a material compatible with the reinforcement coating or shall be accompanied by a Certificate of Compliance certifying that the material is compatible with the reinforcement coating. Damaged areas shall be patched in conformance with the patching material manufacturer's recommendations.

Except for lap splices, all splices for epoxy-coated reinforcement shall be coated with a corrosion protection covering that is selected from the Department's Pre-Qualified Products List. The covering shall be installed in conformance with the manufacturer's recommendations.

Any portion of bar or wire reinforcement extending beyond the limits for epoxy-coated reinforcement shown on the plans will be measured and paid for as bar reinforcing steel (bridge).

MEASUREMENT AND PAYMENT

Measurement and payment for reinforcement in structures shall conform to the provisions in Section 52-1.10, "Measurement," and Section 52-1.11, "Payment," of the Standard Specifications and these special provisions.

Full compensation for galvanizing steel reinforcement shall be considered as included in the prices paid for the various items of work involved and no additional compensation will be allowed therefor.

10-1.91 WATERPROOFING

Waterproofing shall conform to the provisions in Section 54, "Waterproofing," of the Standard Specifications and these special provisions.

Membrane waterproofing shall be applied to the painted undercoat of steel column casings in the same manner provided for waterproofing concrete surfaces.

The exposed surfaces of the membrane waterproofing applied to steel column casings shall be of uniform height above ground without unsightly bulges, depressions or other imperfections.

At the option of the Contractor, a preformed membrane waterproofing system may be furnished and applied in lieu of the asphalt membrane waterproofing specified above. Preformed membrane waterproofing shall conform to these special provisions.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for the preformed membrane sheet. The Certificate of Compliance shall include the following information: (1) type of preformed membrane sheet, and (2) the conditioner or primer application rates.

The preformed membrane waterproofing system shall consist of an adhesive, conditioner or primer applied to a prepared surface; a preformed membrane sheet of rubberized asphalt or polymer modified bitumen; mastic or tape for sealing the edges of the sheet; and a protective covering over the sheet held by an adhesive.

The preformed membrane sheet shall be either permanently applied to a polyethylene film or reinforced with a polypropylene mesh fabric, polyester/polypropylene fabric or a fiberglass mesh fabric. The membrane sheet shall conform to the following requirements:

Property	Test	Requirement	
		Polyethylene Film	Fabric Reinforced
Tensile Strength (min.)(1)	ASTM D 882 (2)	20 lbs/in (3)	20 lbs/in (3)
Percent Elongation at break (min.) (4)	ASTM D 882 (2)	150 percent (3)	25 percent (3)
Pliability	ASTM D 146 (5)	No cracks	No cracks
Thickness (min.) (6)	-----	60 mils	60 mils
Rubberized Asphalt Softening Point (min.)	AASHTO T 53	165° F	165° F
Polymer Modified Bitumen Softening Point (min.)	AASHTO T 53	210° F	210° F

Notes:

- (1) Breaking factor in machine direction.
- (2) Method A, average 5 samples.
- (3) At 73.4° F ±3.6° F
- (4) Machine direction.
- (5) 180-degree bend over a one-inch mandrel at 10° F
- (6) Total thickness of preformed membrane sheet and polyethylene film or fabric reinforcement

Adhesives, conditioners, primers, mastics and sealing tapes shall be manufactured for use with the respective preformed membrane sheet materials and shall be applied according to the manufacturer's recommendations.

The protective covering shall be 1/8 inch minimum thickness hardboard or other material that furnishes equivalent protection. Backfill material and equipment shall not cut, scratch, depress or cause any other damage to the preformed membrane.

Surfaces designated to receive preformed membrane waterproofing shall be thoroughly cleaned of dirt, dust, loose or unsound concrete, and other extraneous material and shall be free from fins, sharp edges, and protrusions that would, in the opinion of the Engineer, puncture or otherwise damage the membrane. Sharp corners to be covered shall be rounded (outside) or chamfered (inside).

Surfaces shall be dry when components of the preformed membrane waterproofing system are applied.

Preformed membrane waterproofing shall not be applied to any surface until the Contractor is prepared to follow its application with the placing of the protective covering and backfill within a sufficiently short time that the membrane will not be damaged by workers or equipment, exposure to weathering, or from any other cause. Damaged membrane or protective covering shall be repaired or replaced by the Contractor at the Contractor's expense.

All projecting pipe, conduits, sleeves or other facilities passing through the preformed membrane waterproofing shall be flashed with prefabricated or field-fabricated boots, fitted coverings or other devices as necessary to provide watertight construction.

All conditioner or primers shall be thoroughly mixed and continuously agitated during application. Conditioner, primers or adhesive shall be allowed to dry to a tack free condition prior to placing membrane sheets.

The surfaces shall be recoated if membrane sheets are not placed over primer, conditioner or adhesive within the time recommended by the manufacturer.

The preformed membrane sheet shall not be applied in wet or foggy weather, nor when the ambient temperature is below 40° F.

Preformed membrane material shall be placed starting at the bottom and lapped by a minimum of 6 inches at splices and at repairs to holes or tears.

Exposed edges of membrane sheets shall have a trowelled bead of manufacturer's recommended mastic or sealing tape applied after the membrane is placed.

The surface of the preformed membrane shall be cleaned free of dirt and other deleterious material before the protective covering is placed.

The protective covering shall be placed on a coating of adhesive of a type recommended by the manufacturer. The adhesive shall be applied at a rate sufficient to hold the protective covering in position until the backfill is placed.

Preformed membrane waterproofing will be measured and paid for by the square foot as asphalt membrane waterproofing.

10-1.92 WATERPROOFING AND COVER

Membrane waterproofing and protective cover shall be furnished and applied to the surface of the deck of the Empire Avenue and Buena Vista Street railroad underpass in conformance with the details shown on the plans and the requirements of the AREMA Manual for Railway Engineering and these special provisions.

The waterproofing membrane shall be butyl rubber secured with an approved adhesive. At the option of the Contractor and subject to the requirements for butyl rubber, ethylene-propylene-diene-monomer (EPDM) may be substituted for butyl rubber.

The butyl rubber membrane, adhesive, splicing cement, butyl gum splicing tape, anti-bonding paper, and fibered aluminum roof coating shall conform to the requirements of the AREMA Manual, Chapter 29, Part 2, "Membrane Waterproofing."

Butyl rubber membrane shall be 0.060 inch thick, minimum.

The protective cover over the membrane waterproofing shall be 2 layers of asphaltic panels applied with adhesive and sealing compound to a total thickness not less than 3/4 inch, unless otherwise shown on the plans. Sealing compound for joints and edges shall be compatible with the membrane, the adhesive used to fasten the membrane to the deck, splicing cement, and the protective cover panels. All materials shall conform to the requirements of AREMA Manual, Chapter 29, and the following:

- A. The individual panels shall be at least 3/8 inch thick. Panels shall be installed in sizes not less than 4' x 8', except as cut for closures.
- B. Panels shall be shipped and stored on smooth, flat surfaces.
- C. When panels are shipped with an inert material between the sheets to prevent sticking, all inert material shall be removed from the panel before installation.

Membrane waterproofing shall not be applied to any surface until the Contractor is prepared to follow its application with the placing of the protective cover within a sufficiently short time that the membrane will not be damaged by workers or equipment, exposure to weathering or from any other cause.

Concrete surfaces to receive the seal shall be swept or air blown clean of all dirt, dust, gravel, loose concrete particles, and other extraneous materials. Projections or depressions on the surface on which the membrane is to be applied that may cause injury to the membrane shall be removed or filled as directed by the Engineer.

There shall be no depressions or pockets in horizontal surfaces of the finished waterproofing. The membrane shall be carefully turned into drainage fittings. Special care shall be taken to make the waterproofing effective along the sides and ends of girders and decks and at stiffeners, gussets, expansion joints, offsets in ballast retainers, and other discontinuities.

The Contractor shall be responsible for preventing damage to the membrane waterproofing by workers or equipment.

Construction of butyl membrane waterproofing shall conform to the following:

- A. The surface shall be dry at the time of application and the membrane shall not be applied when the atmospheric temperature is below 34° F.
- B. Butyl rubber membrane shall be fastened to the surface to be waterproofed by adhesive material.
- C. The adhesive shall be applied by squeegee to the entire deck surfaces to be waterproofed at a rate of not less than one gallon per 100 square feet of deck surface.
- D. Membrane sheets shall first be positioned and drawn tight without stretching. Half of the membrane shall then be uniformly rolled in a direction away from the starting edge or subsequent splice. Adhesive shall then be applied to the exposed deck area. Adhesive shall be allowed to dry to a tack free condition. The membrane shall then be unrolled and pressed firmly and uniformly in place, using care to avoid trapping of air. The same procedure shall be repeated for the remaining half of the membrane sheet. Wrinkles and buckles shall be avoided. Each succeeding sheet shall be positioned to fit the previously installed sheet and spliced.
- E. Splices shall be tongue-and-groove type conforming to the details in Figure 2, Type No. 3 of AREMA Manual, Chapter 29. All seam, lap, and splice areas shall be cleaned with heptane, hexane, toluene, trichloroethylene or white gasoline, using a clean cloth, mop, or similar synthetic cleaning device. Splicing cement shall be spread continuously on the seam, lap, and splice areas at a uniform rate of not less than one gallon per 75 square feet based on both mating surfaces. After cement has dried to a tack free condition, apply butyl gum splicing tape to cemented area of membrane, extending tape to at least 1/8 inch beyond edges of splice and lap areas. Roll or press the tape firmly into place so as to obtain full contact. Bridging and wrinkles shall be avoided. Corner splices shall be reinforced with 2 continuous layers of rubber membrane over one layer of butyl tape.

- F. All projections, such as pipes, conduits or sleeves, passing through the butyl rubber membrane waterproofing shall be flashed with prefabricated or field-fabricated boots or fitted coverings as necessary to provide watertight construction. Butyl gum tape shall be used between layers of rubber membrane.
- G. Holes in the membrane sheeting shall be patched with a minimum overlap of 4 inches and in accordance with manufacturer's instructions.
- H. At transverse expansion joints in the bridge deck, a 24-inch wide galvanized 16-gage steel plate covered by a 30-inch wide strip of antibond paper shall be laid and centered on the joint prior to laying the membrane across the joint.

Construction of asphaltic protective cover shall conform to the following:

- A. The surface of the membrane applied to the deck shall be thoroughly cleaned of dirt and other deleterious material before the protective cover is placed.
- B. At transverse expansion joints in the bridge deck, a 12-inch wide galvanized 22-gage steel plate covered by a 18-inch wide strip of antibond paper shall be laid and centered on the joint above the membrane before the protective cover is placed.
- C. Panels shall be laid with 2 superimposed layers. Joints in the second layer shall be offset from the joints in the first layer by approximately one-half the width of the panel.
- D. Panels shall be laid in a coating of adhesive. The adhesive shall be applied by squeegee at a rate of not less than one-gallon per 100 square feet of deck surface. As successive panels are laid, the edges and ends of adjacent panels already laid shall be thoroughly coated with a sealing compound. Panels shall be laid tightly against those previously laid so that the sealing compound will completely fill the joints and be squeezed out at the top. After all of the panels have been laid, any void between panels shall be filled with the sealing compound.
- E. Where edges or protrusions of asphaltic panels are exposed to prolonged sunlight exposure, exposed areas shall be coated with fibered aluminum roof coating.

Steel and sheet cover metal plates, arm plate, and flashing assemblies, shall be furnished and installed where shown on the plans. Steel bolts, plates, and sheet metal shall be commercial quality, hot-dip galvanized.

Membrane waterproofing and asphaltic protective cover panels will be paid for at the contract price per square foot for waterproofing and cover. The quantity of waterproofing and cover will be computed from measurements, along the slopes of the actual areas placed.

The contract price paid per square foot for waterproofing and cover shall include full compensation for furnishing all labor, materials (including galvanized sheet metal, flashing assemblies, steel bolts and plates), tools, equipment, and incidentals, and for doing all the work involved in furnishing and applying membrane waterproofing and protective cover, complete in place, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

10-1.93 STEEL STRUCTURES

Construction of steel structures shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

GENERAL

Attention is directed to "Welding" in Section 8, "Materials," of these special provisions.

MATERIALS

Steel for members, shown on the plans for Empire Avenue Underpass and Buena Vista Street Underpass as fracture critical members and non-fracture critical members requiring impact testing, shall conform to the Charpy V-notch (CVN) impact values, welding, and welding inspection of the Fracture Control Plan for Fracture Critical Members in Chapter 15, Part 1 of the AREMA Manual of Railway Engineering. Fabricators of fracture critical members shall be certified under the AISC Quality Certification Program, Category Cbr, Major Steel Bridges, with Endorsement F, Fracture Critical Members. CVN impact values for fracture critical members and non-fracture critical members requiring impact testing shall conform to the requirements for Zone 2.

High-strength fastener assemblies and other bolts attached to structural steel with nuts and washers shall be zinc coated. When direct tension indicators are used in these assemblies, the direct tension indicator and all components of the fastener assembly shall be zinc coated by the mechanical deposition process.

CHECK TESTING

Structural steel shall conform to the designated ASTM Standard and the check testing requirements of this section.

Check samples shall be furnished for each heat of maximum thickness of:

- A. Tension flanges and webs of fracture critical members.

Steel plates, shapes, or bars containing check samples shall be furnished from the mill with extra length in order to provide for removal of material for check samples at the point of fabrication. Check samples may be cut from either end of the designated plate, shape, or bar.

At the option of the Contractor, check samples may be removed at the rolling mill rather than at the point of fabrication. The sample will be removed from the mill plate that will be stripped by the fabricator to produce the designated plate and may be taken from any location within that plate. The mill plate from which samples are removed shall be marked with the same identifying numbers as are used on the samples.

Material for check samples shall be removed by the Contractor in the presence of the Engineer. Check samples for plates wider than 24 inches shall be 14 inches wide and 18 inches long with the long dimension transverse to the direction of rolling. Check samples for all other products shall be 18 inches long, taken in the direction of rolling, and the width shall be the product width. Check samples shall be removed and delivered to the Engineer before the material is fabricated into components. The direction of rolling, heat numbers, and plate numbers shall be marked on the samples with paint or other indelible marking material or may be steel stamped in one corner of the plate.

Check samples shall be delivered to the Transportation Laboratory at the Contractor's expense. The check samples will be tested by the Transportation Laboratory for compliance with the requirements specified in ASTM and these special provisions. Check sample test results will be reported to the Contractor within 3 weeks of delivery to the Transportation Laboratory. In the event several samples are submitted on the same day, an additional day will be added for every 2 samples submitted. The test report will be made for the group of samples.

The results of the tensile and impact tests shall not vary more than 5 percent below the specified minimum or 5 percent above the specified maximum requirements. If the initial check test results vary more than 5 percent but not more than 10 percent from the specified requirements, a retest may be performed on another sample from the same heat and thickness. The results of the retest shall not vary more than 5 percent from the original specified requirements. If the results of check tests exceed these permissible variations, material planned for use from the heat represented by said check samples shall be subject to rejection.

ROTATIONAL CAPACITY TESTING PRIOR TO SHIPMENT TO JOB SITE

Rotational capacity tests shall be performed on all lots of high-strength fastener assemblies prior to shipment of these lots to the project site. Zinc-coated assemblies shall be tested after all fabrication, coating, and lubrication of components has been completed. One hardened washer shall be used under each nut for the tests.

The requirements of this section do not apply to high-strength cap screws or high-strength bolts used for slip base plates.

Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly.

A rotational capacity lot number shall be assigned to each combination of lots tested. Each shipping unit of fastener assemblies shall be plainly marked with the rotational capacity lot number.

Two fastener assemblies from each rotational capacity lot shall be tested.

The following equipment, procedure, and acceptance criteria shall be used to perform rotational capacity tests on and determine acceptance of ASTM A 325 long bolts. Fasteners are considered to be long bolts when full nut thread engagement can be achieved when installed in a bolt tension measuring device:

- A. Long Bolt Test Equipment:

1. Calibrated bolt tension measuring device with adequate tension capacity for the bolts being tested.
2. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Long Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F 436.
4. Steel beam or member, such as a girder flange or cross frame, to which the bolt tension measuring device will be attached. The device shall be accessible from the ground.

B. Long Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.
3. Insert the bolt into the bolt tension measuring device and install the required number of washers, and additional spacers as needed, directly beneath the nut to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug tension shall not be less than the Table A value but may exceed the Table A value by a maximum of 2 kips.

Table A

High-Strength Fastener Assembly Tension Values to Approximate Snug-Tight Condition	
Bolt Diameter (inches)	Snug Tension (kips)
1/2	1
5/8	2
3/4	3
7/8	4
1	5
1-1/8	6
1-1/4	7
1-3/8	9
1-1/2	10

5. Match-mark the assembly by placing a heavy reference start line on the face plate of the bolt tension measuring device which aligns with (1) a mark placed on one corner of the nut and (2) a radial line placed across the flat on the end of the bolt or on the exposed portions of the threads of tension control bolts. Place an additional mark on the outside of the socket that overlays the mark on the nut corner such that this mark will be visible while turning the nut. Make an additional mark on the face plate, either 2/3 of a turn, one turn, or 1-1/3 turn clockwise from the heavy reference start line, depending on the bolt length being tested as shown in Table B.

Table B

Required Nut Rotation for Rotational Capacity Tests ^{(a) (b)}	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	2/3
Greater than 4 bolt diameters but no more than 8 bolt diameters	1
Greater than 8 bolt diameters, but no more than 12 bolt diameters ^(c)	1-1/3

(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance shall be plus or minus 45 degrees.

(b) Applicable only to connections in which all material within grip of the bolt is steel.

(c) When bolt length exceeds 12 diameters, the required rotation shall be determined by actual tests in a suitable tension device simulating the actual conditions.

6. Turn the nut to achieve the applicable minimum bolt tension value listed in Table C. After reaching this tension, record the moving torque, in foot-pounds, required to turn the nut, and also record the corresponding bolt tension value in pounds. Torque shall be measured with the nut in motion. Calculate the value, T, where $T = [(the\ measured\ tension\ in\ pounds) \times (the\ bolt\ diameter\ in\ inches) / 48]$.

Table C

Minimum Tension Values for High-Strength Fastener Assemblies	
Bolt Diameter (inches)	Minimum Tension (kips)
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1-1/8	56
1-1/4	71
1-3/8	85
1-1/2	103

7. Turn the nut further to increase bolt tension until the rotation listed in Table B is reached. The rotation is measured from the heavy reference line made on the face plate after the bolt was snug-tight. Record this bolt tension.
8. Loosen and remove the nut and examine the threads on both the nut and bolt.

C. Long Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: (1) the measured moving torque (Step 6) shall be less than or equal to the calculated value, T (Step 6), (2) the bolt tension measured in Step 7 shall be greater than or equal to the applicable turn test tension value listed in Table D, (3) the nut shall be able to be removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, (4) the bolt does not shear from torsion or fail during the test, and (5) the assembly does not seize before the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head is expected and will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

Table D

Turn Test Tension Values	
Bolt Diameter (inches)	Turn Test Tension (kips)
1/2	14
5/8	22
3/4	32
7/8	45
1	59
1-1/8	64
1-1/4	82
1-3/8	98
1-1/2	118

The following equipment, procedure, and acceptance criteria shall be used to perform rotational capacity tests on and determine acceptance of ASTM A 325 short bolts. Fasteners are considered to be short bolts when full nut thread engagement cannot be achieved when installed in a bolt tension measuring device:

A. Short Bolt Test Equipment:

1. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Short Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
2. Spud wrench or equivalent.

3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F 436.
4. Steel plate or girder with a hole to install bolt. The hole size shall be 1/16 inch greater than the nominal diameter of the bolt to be tested. The grip length, including any plates, washers, and additional spacers as needed, shall provide the proper number of threads within the grip, as required in Step 2 of the Short Bolt Test Procedure.

B. Short Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.
3. Install the bolt into a hole on the plate or girder and install the required number of washers and additional spacers as needed between the bearing face of the nut and the underside of the bolt head to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug condition shall be the full manual effort applied to the end of a 12-inch long wrench. This applied torque shall not exceed 20 percent of the maximum allowable torque in Table E.

Table E

Maximum Allowable Torque for High-Strength Fastener Assemblies	
Bolt Diameter (inches)	Torque (ft-lb)
1/2	145
5/8	285
3/4	500
7/8	820
1	1220
1-1/8	1500
1-1/4	2130
1-3/8	2800
1-1/2	3700

5. Match-mark the assembly by placing a heavy reference start line on the steel plate or girder which aligns with (1) a mark placed on one corner of the nut and (2) a radial line placed across the flat on the end of the bolt or on the exposed portions of the threads of tension control bolts. Place an additional mark on the outside of the socket that overlays the mark on the nut corner such that this mark will be visible while turning the nut. Make 2 additional small marks on the steel plate or girder, one 1/3 of a turn and one 2/3 of a turn clockwise from the heavy reference start line on the steel plate or girder.
6. Using the torque wrench, tighten the nut to the rotation value listed in Table F. The rotation is measured from the heavy reference line described in Step 5 made after the bolt was snug-tight. A second wrench shall be used to prevent rotation of the bolt head during tightening. Measure and record the moving torque after this rotation has been reached. The torque shall be measured with the nut in motion.

Table F

Nut Rotation Required for Turn-of-Nut Installation ^{(a),(b)}	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	1/3

(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30 degrees.

(b) Applicable only to connections in which all material within grip of the bolt is steel.

7. Tighten the nut further to the 2/3-turn mark as indicated in Table G. The rotation is measured from the heavy reference start line made on the plate or girder when the bolt was snug-tight. Verify that the radial line on the bolt end or on the exposed portions of the threads of tension control bolts is still in alignment with the start line.

Table G

Required Nut Rotation for Rotational Capacity Test	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	2/3

8. Loosen and remove the nut and examine the threads on both the nut and bolt.

C. Short Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: (1) the measured moving torque from Step 6 shall be less than or equal to the maximum allowable torque from Table E, (2) the nut shall be able to be removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, (3) the bolt does not shear from torsion or fail during the test, and (4) the assembly shall not seize before the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

INSTALLATION TENSION TESTING AND ROTATIONAL CAPACITY TESTING AFTER ARRIVAL ON THE JOB SITE

Installation tension tests and rotational capacity tests on high-strength fastener assemblies shall be performed by the Contractor prior to acceptance or installation and after arrival of the fastener assemblies on the project site. Installation tension tests and rotational capacity tests shall be performed at the job site, in the presence of the Engineer, on each rotational capacity lot of fastener assemblies.

The requirements of this section do not apply to high-strength cap screws or high-strength bolts used for slip base plates.

Installation tension tests shall be performed on 3 representative fastener assemblies in conformance with the provisions in Section 8, "Installation," of the RCSC Specification. For short bolts, Section 8.2, "Pretensioned Joints," of the RCSC Specification shall be replaced by the "Pre-Installation Testing Procedures," of the "Structural Bolting Handbook," published by the Steel Structures Technology Center, Incorporated.

The rotational capacity tests shall be performed in conformance with the requirements for rotational capacity tests in "Rotational Capacity Testing Prior to Shipment to Job Site" of these special provisions.

At the Contractor's expense, additional installation tension tests, tests required to determine job inspecting torque, and rotational capacity tests shall be performed by the Contractor on each rotational capacity lot, in the presence of the Engineer, if:

1. Any fastener is not used within 3 months after arrival on the job site,
2. Fasteners are improperly handled, stored, or subjected to inclement weather prior to final tightening,
3. Significant changes are noted in original surface condition of threads, washers, or nut lubricant, or
4. The Contractor's required inspection is not performed within 48 hours after all fasteners in a joint have been tensioned.

Failure of a job-site installation tension test or a rotational capacity test will be cause for rejection of unused fasteners that are part of the rotational capacity lot.

When direct tension indicators are used, installation verification tests shall be performed in conformance with Appendix Section X1.4 of ASTM Designation: F 959, except that bolts shall be initially tensioned to a value 5 percent greater than the minimum required bolt tension.

SURFACE PREPARATION

For all bolted connections, the new contact surfaces and inside surfaces of bolt holes shall be cleaned and coated before assembly in conformance with the provisions for cleaning and painting structural steel of these special provisions.

SEALING

When zinc-coated tension control bolts are used, the sheared end of each fastener shall be completely sealed with non-silicone type sealing compound conforming to the requirements in ASTM Designation: C 920. The sealant shall be gray in color and shall have a minimum thickness of 50 mils. The sealant shall be applied to a clean sheared surface on the same day that the splined end is sheared off.

WELDING

Table 2.2 of AWS D1.5 is superseded by the following table:

Base Metal Thickness of the Thicker Part Joined, inches	Minimum Effective Partial Joint Penetration Groove Weld Size*, inches
Over 1/4 to 1/2 inclusive	3/16
Over 1/2 to 3/4 inclusive	1/4
Over 3/4 to 1-1/2 inclusive	5/16
Over 1-1/2 to 2-1/4 inclusive	3/8
Over 2-1/4 to 6 inclusive	1/2
Over 6	5/8

* Except the weld size need not exceed the thickness of the thinner part

Dimensional details and workmanship for welded joints in tubular and pipe connections shall conform to the provisions in Part A, "Common Requirements of Nontubular and Tubular Connections," and Part D, "Specific Requirements for Tubular Connections," in Section 2 of AWS D1.1.

The requirement of conformance with AWS D1.5 shall not apply to work conforming to Section 56-1, "Overhead Sign Structures," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

MEASUREMENT AND PAYMENT

If a portion of or all check samples are removed at a mill more than 300 air line miles from both Sacramento and Los Angeles, shop inspection expenses will be sustained by the State which are in addition to expenses incurred for fabrication site inspection. Payment to the Contractor for furnishing structural steel will be reduced \$2,000 for each mill located more than 300 air line miles from both Sacramento and Los Angeles.

10-1.94 COLUMN CASINGS

Column casings shall consist of cleaned and painted structural steel shells filled with grout as shown on the plans and conforming to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

Attention is directed to "Welding Quality Control" of these special provisions.

For field welding of column casings, only visual inspection will be required, and the requirements of the second sentence of paragraph 3.13.2 and the first sentence of paragraph 3.13.3 of AWS D1.5 will not apply.

Structural steel for column casings shall conform to the requirements in ASTM Designation: A 36/A 36M, or, at the Contractor's option, ASTM Designation: A 709/A 709M, Grade 36.

Polyethylene shall have a compressive strength of at least 10 psi at no more than 15 percent deflection determined in conformance with the requirements in ASTM Designation: D 3575, Test B. Polyethylene shall be bonded to the column using a suitable waterproof adhesive applied to the entire contact surface.

The spaces to be occupied by the column casing materials shall be cleared of plants and other materials prior to encasing the column.

Removed plants and other materials shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

The same information that is on existing columns shall be painted on casings in conformance with the provisions in Section 51-1.21, "Bridge Name, Number and Bent Numbers," of the Standard Specifications.

CLEAN AND PAINT COLUMN CASING

New metal surfaces, except where galvanized or thermal spray coated, shall be cleaned and painted in conformance with the provisions in Sections 59-2, "Painting Structural Steel," and 91, "Paint," of the Standard Specifications and these special provisions.

Prior to performing any painting or paint removal, the Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 3 copies of a separate Painting Quality Work Plan (PQWP) for each item of work for which painting or paint removal is to be performed. As a minimum, each PQWP shall include the following:

- A. The name of each Contractor or subcontractor to be used.
- B. One copy each of all current "SSPC: The Society for Protective Coatings" specifications or qualification procedures which are applicable to the painting or paint removal to be performed. These documents shall become the permanent property of the Department.
- C. A copy of the coating manufacturer's guidelines and recommendations for surface preparation, painting, drying, curing, handling, shipping, and storage of painted structural steel, including testing methods and maximum allowable levels for soluble salts.
- D. Proposed methods and equipment to be used for any paint application.
- E. Proof of each of any required certifications, SSPC-QP 1, SSPC-QP 3. Where SSPC-QP 3 certification is required, an enclosed shop facility shall be required. Certification of AISC Sophisticated Paint Endorsement Quality Program, P-1 Enclosed endorsement, will be considered equivalent to SSPC-QP 3.
 1. In lieu of certification in conformance with the requirements in SSPC-QP 1 for this project, the Contractor may submit written documentation showing conformance with the requirements in Section 3, "General Qualification Requirements," of SSPC-QP 1.
- F. Proposed methods to control environmental conditions in accordance with the manufacturer's recommendations and these special provisions.
- G. Proposed methods to protect the coating during curing, shipping, handling, and storage.
- H. Proposed rinse water collection plan.
- I. A detailed paint repair plan for the repair of damaged areas.
- J. Procedures for containing blast media and water during application of coatings and coating repair of erected steel.
- K. Examples of proposed daily reports for all testing to be performed, including type of testing, location, lot size, time, weather conditions, test personnel, and results.

Prior to submitting the PQWP, a pre-painting meeting between the Engineer, the Contractor, and a representative from each entity performing painting for this project shall be held to discuss the requirements for the PQWP.

The Contractor shall allow the Engineer 3 weeks to review the PQWP submittal after a complete plan has been received. No painting or paint removal shall be performed until the PQWP for that work is reviewed by the Engineer. Should the Engineer fail to complete the review within this time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the PQWP, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The Engineer's approval of the Contractor's PQWP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications.

The Contractor shall provide enclosures to permit cleaning and painting during inclement weather. Provisions shall be made to control atmospheric conditions inside the enclosures within specified limits during cleaning and painting operations, drying to solvent insolubility, and throughout the curing period in accordance with the manufacturer's recommendations and these special provisions. Full compensation for providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work requiring cleaning and painting, and no additional compensation will be allowed therefor.

Fresh, potable water with a maximum chloride content of 75 ppm and a maximum sulfate content of 200 ppm shall be used for water rinsing or pressure washing operations. No continuous recycling of rinse water will be permitted. If rinse water is collected into a tank and subsequent testing determines the collected water conforms to the specified requirements, reuse may be permitted by the Engineer if no collected water is added to the tank after sample collection for determination of conformance to specified requirements.

Column casing surfaces in contact with grout shall not be considered embedded in concrete.

Column casing surfaces to be painted with inorganic zinc coating shall be blast cleaned and painted with the single undercoat prior to shipment to the job site.

Cleaning

The surfaces to be cleaned and painted shall be dry blast cleaned in conformance with the requirements of SSPC-SP 10, "Near White Blast Cleaning," of the "SSPC: The Society for Protective Coatings." Blast cleaning shall leave surfaces with a dense, uniform, angular anchor pattern of not less than 1.6 mils nor more than 3.5 mils as measured in conformance with the requirements in ASTM Designation: D 4417.

Mineral and slag abrasives used for blast cleaning steel surfaces shall conform to the requirements for Class A, Grade 2 to 3 abrasives contained in SSPC-AB 1, "Mineral and Slag Abrasives," of the "SSPC: The Society for Protective Coatings," and shall not contain hazardous material.

Steel abrasives used for blast cleaning steel surfaces shall comply with the requirements of SSPC-AB 3, "Ferrous Metallic Abrasive," of the "SSPC: The Society for Protective Coatings." If steel abrasive is recycled through shop or field abrasive blast cleaning units, the recycled abrasive shall conform to the requirements of SSPC-AB 2, "Specification for Cleanliness of Recycled Ferrous Metallic Abrasive," of the "SSPC: The Society for Protective Coatings."

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications and a Material Safety Data Sheet shall be furnished prior to use for each shipment of blast cleaning material for steel.

Abrasive blast cleaned surfaces shall be tested by the Contractor for soluble salts using a Class A or B retrieval method as described in Technology Guide 15, "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates," of the "SSPC: The Society for Protective Coatings," and cleaned so the maximum level of soluble salts does not exceed the lesser of the coating manufacturer's written recommendations or 10 micrograms per square centimeter. Areas of abrasive blast cleaned steel shall be tested at the rate of 3 tests for the first 1000 square feet prepared per day, and one test for each additional 1000 square feet or portion thereof, at locations selected by the Engineer. When less than 1000 square feet of surface area is prepared in a shift, at least 2 tests shall be performed. If levels of soluble salts exceed the maximum allowed by these special provisions, the entire area represented by the testing will be rejected. The Contractor shall perform additional cleaning and testing of rejected areas until soluble salt levels conform to these requirements.

Corners shall be chamfered to remove sharp edges.

Thermal cut edges (TCEs) to be painted shall be conditioned before blast cleaning by shallow grinding or other method approved by the Engineer to remove the thin, hardened layer of material resulting from resolidification during cooling.

Visually evident base metal surface irregularities and defects shall be removed in accordance with ASTM Designation: A 6 or AASHTO Designation: M 160 prior to blast cleaning steel. When material defects exposed by blast cleaning are removed, the blast profile shall be restored by either blast cleaning or by using mechanical tools in accordance with SSPC-SP 11, "Power Tool Cleaning to Bare Metal," of the "SSPC: The Society for Protective Coatings."

Painting

Blast cleaned surfaces to be painted shall receive a single undercoat, and a final coat where specified, consisting of an inorganic zinc coating conforming to the requirements in AASHTO Designation: M 300, Type I or Type II.

The color of the final coat of inorganic zinc coating shall match Federal Standard 595B No. 36373.

Inorganic zinc coating shall be selected from the qualified products list, which may be obtained from the Transportation Laboratory.

Inorganic zinc coating shall be used within 12 hours of initial mixing.

Application of inorganic zinc coating shall conform to the provisions for applying zinc-rich coating in Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications.

The single undercoat of inorganic zinc coating shall be applied to the required dry film thickness in 2 or more applications within 8 hours of the start of blast cleaning. Abrasive blast cleaned steel shall not be exposed to relative humidity exceeding 85 percent prior to application of inorganic zinc coating.

The total dry film thickness of all applications of the single undercoat of inorganic zinc coating shall be not less than 4 mils nor more than 8 mils.

Damaged areas and areas where mudcracking occurs in the inorganic zinc coating shall be blast cleaned and repainted with inorganic zinc coating to the specified thickness.

Steel surfaces coated with Type II inorganic zinc coating shall be protected from conditions that may cause the coating film to dissolve. The Contractor, at the Contractor's expense, shall repair areas where the coating has dissolved by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

Dry spray, or overspray, as defined in the Steel Structures Painting Manual, Volume 1, "Good Painting Practice," of the "SSPC: The Society for Protective Coatings," shall be removed prior to application of subsequent coats or final acceptance. Removal of dry spray shall be by screening or other methods that minimize polishing of the inorganic zinc surface. The dry film thickness of the coating after removal of dry spray shall be in conformance with the provisions for applying the single undercoat, as specified herein.

The Contractor shall test the inorganic zinc coating prior to application of final coats. The locations of the tests will be determined by the Engineer. The Contractor shall determine the sequence of the testing operations. The testing for adhesion and hardness will be performed no sooner than 72 hours after application of the single undercoat of inorganic zinc coating. At the Contractor's expense, satisfactory access shall be provided to allow the Engineer to determine the location of the tests.

The inorganic zinc coating shall pass the following tests:

- A. The inorganic zinc coating shall have a minimum adhesion to steel of 600 psi when measured using a self-aligning adhesion tester in conformance with the requirements in ASTM Designation: D 4541. The Engineer will select 3 locations per column casing section for adhesion testing. If 2 or more of the locations tested fail to meet adhesion requirements, the section will be rejected. If one of the locations tested fails to meet adhesion requirements, an additional 3 locations shall be tested. Should any of the additional locations fail to meet adhesion requirements, the column casing section will be rejected. The Contractor, at the Contractor's expense, shall repair the rejected area by blast cleaning and repainting with inorganic zinc to the specified thickness. Test locations for areas of inorganic zinc meeting adhesion testing requirements shall be repaired by application of organic zinc primer as specified in Section 91-1.04, "Materials," of the Standard Specifications to the specified minimum dry film thickness.
- B. Areas of inorganic zinc coating where finish coats are to be applied shall be tested by the Contractor for soluble salts using a Class A or B retrieval method as described in Technology Guide 15, "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates," of the "SSPC: The Society for Protective Coatings," and cleaned so the maximum level of soluble salts does not exceed the lesser of the manufacturer's written recommendations or 10 micrograms per square centimeter. Areas of inorganic zinc coating shall be tested at the rate of 3 tests for the first 1000 square feet to be painted per day and one test for each additional 1000 square feet or portion thereof at locations selected by the Engineer. When less than 1000 square feet of surface area is painted in a shift, at least 2 tests shall be performed. If levels of soluble salts exceed the maximum allowed by these special provisions, the entire area represented by the testing will be rejected. The Contractor shall perform additional cleaning and testing of rejected areas until soluble salt levels conform to these requirements.
- C. Prior to application of final coats, the inorganic zinc coating shall exhibit a solid, hard, and polished metal surface when firmly scraped with the knurled edge of a quarter. Inorganic zinc coating that is powdery, soft, or does not exhibit a polished metal surface, as determined by the Engineer, shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

Additional Requirements for Water Borne Inorganic Zinc Primers

- A. The surface pH of the inorganic zinc primer shall be tested by wetting the surface with deionized water for a minimum of 15 minutes but no longer than 30 minutes and applying pH paper with a capability of measuring in increments of 0.5 pH units. At least 2 surface pH readings shall be taken for every 500 square feet or portion thereof. If less than 500 square feet of steel is coated in a single shift or day, at least 2 surface pH readings shall be taken for primer applied during that period. Application of finish coats will not be permitted until the surface pH is less than or equal to 7.
- B. Dry to solvent insolubility for water borne inorganic zinc primers shall be determined in conformance with the requirements in ASTM Designation: D 4752, except that water shall be the solvent. The resistance rating shall be not less than 4. Areas of inorganic zinc coating shall be tested for solvent insolubility at the rate of one test per 500 square feet or portion thereof. Inorganic zinc coating represented by the tested area that does not meet the solvent insolubility requirements will be rejected. The Contractor, at the

Contractor's expense, shall repair rejected areas by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

Additional Requirements for Solvent Borne Inorganic Zinc Primers

- A. Dry to solvent insolubility for solvent borne inorganic zinc primers shall be determined in conformance with the requirements in ASTM Designation: D 4752. The resistance rating shall be not less than 4. Areas of inorganic zinc coating shall be tested for solvent insolubility at the rate of one test per 500 square feet or portion thereof. Inorganic zinc coating represented by the tested area that does not meet the solvent insolubility requirements will be rejected. The Contractor, at the Contractor's expense, shall repair rejected areas by blast cleaning and repainting with inorganic zinc coating to the specified thickness.
- B. Surface hardness of solvent borne inorganic zinc shall be a minimum 2H when measured in conformance with the requirements in ASTM Designation: D 3363. Areas of inorganic zinc coating shall be tested at the rate of one test per 500 square feet or portion thereof. Inorganic zinc coating that fails to meet the surface hardness requirements shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

The Contractor, at the Contractor's expense, shall retest all rejected areas of inorganic zinc coating after repairs have been completed.

Except as approved by the Engineer, a minimum curing time of 72 hours shall be allowed between application of inorganic zinc coating and water rinsing.

Exposed areas of inorganic zinc coating where finish coats are specified shall be thoroughly pressure rinsed in conformance with the provisions in Section 59-1.03, "Application," of the Standard Specifications.

The final coat of inorganic zinc coating shall be applied after testing and completion of all operations that may damage or discolor the steel surface, including correction of runs, sags, thin and excessively thick areas in the paint film, skips and holidays, dry spray, or areas of nonuniform appearance.

The area to receive the final coat of inorganic zinc coating shall be lightly roughened by abrasive blasting using an abrasive no larger than No. 30 mesh. Abrasive blasting shall remove no more than 0.6-mil of inorganic zinc. The surface to be lightly roughened shall be free from moisture, dust, grease or any deleterious material. The undercoated areas of column casing surfaces not receiving a final coat shall be protected from abrasive blast cleaning operations.

The final coat of inorganic zinc coating shall be applied to the required dry film thickness in one uniform application within 24 hours after light roughening. The dry film thickness of the final coat of inorganic zinc coating shall be not less than one mil nor more than 3 mils.

The total dry film thickness of all applications of the single undercoat and final coat of inorganic zinc coating shall be not less than 5 mils nor more than 9 mils.

Finish coats will not be required.

GROUTING

Grouting shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications and these special provisions.

The Contractor shall limit the height of each lift of grout to minimize undulations and displacements of the surface of the shell during grouting. Undulations in the shell surface, including undulations from fabrication and erection, shall not exceed 1/4-inch in one foot nor shall the total displacement from plan location exceed 2 inches at any point. At the Contractor's option, a bracing system or other means may be employed to restrain the casing within the specified tolerances. Except where shown on the plans, restraints shall not pass through the columns. The grout shall harden prior to placing the next lift of grout, unless a bracing system is used.

In addition to the above grout lift restrictions, the height of grout lifts for portions of column casings containing polyethylene shall not exceed 10 feet.

Suitable external grout injection valves shall be installed for filling of the casings. The filling operation shall begin at the bottom of the casing. Spacing of the valves shall be such that the grout will fill the gap between the casing and the polyethylene or column.

Casings shall be sealed at the bottom. Grout shall be pumped into the casing such that the grout head is maintained uniformly around the column, and no visible evidence of water or air is ejected at the top of the grout. The grout at the casing top shall be covered with mortar and sloped to drain. Mortar shall conform to the provisions in Section 51-1.135, "Mortar," of the Standard Specifications.

Casings shall be positioned with spacers to center the casing around the existing column at the location shown on the plans. Spacers may be welded to the inside of the casing. Spacers shall not be used in areas occupied by the polyethylene.

Grout shall not be permitted to flow across shoulders or lanes occupied by public traffic, or to flow into gutters or other drainage facilities.

Clamps, valves, injection ports, lifting ears, and other accessories shall be completely removed not less than 24 hours after placing grout. Voids shall be filled with mortar and finished flush with the exterior surface of the casing.

MEASUREMENT AND PAYMENT

Column casings will be measured and paid for in conformance with the provisions in Section 55-4, "Measurement and Payment," of the Standard Specifications and these special provisions.

The contract price paid per pound for column casing shall include full compensation for furnishing all labor, materials (including polyethylene and adhesive), tools, equipment, and incidentals, and for doing all the work involved in column casings filled with grout, complete in place, including cleaning and painting of structural steel, and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.95 SIGN STRUCTURES

Sign structures and foundations for overhead signs shall conform to the provisions in Section 56-1, "Overhead Sign Structures," of the Standard Specifications, "Steel Structures" of these special provisions, and the following requirements.

Before commencing fabrication of sign structures, the Contractor shall submit 2 sets of working drawings to the Engineer in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The working drawings shall include sign panel dimensions, span lengths, post heights, anchorage layouts, proposed splice locations, a snugging and tensioning pattern for anchor bolts and high-strength bolted connections, and details for permanent steel anchor bolt templates. The working drawings shall be supplemented with a written quality control program that includes methods, equipment, and personnel necessary to satisfy the requirements specified herein.

Working drawings shall be 22" x 34" or 11" x 17" in size and each drawing and calculation sheet shall include the State assigned designations for the sign structure type and reference as shown on the contract plans, District-County-Route-Post Mile, and contract number.

The Engineer shall have 30 days to review the sign structure working drawings after a complete submittal has been received. No fabrication or installation of sign structures shall be performed until the working drawings are approved in writing by the Engineer.

Steel bolts not designated on the plans as high strength (HS) or stainless steel shall be for general applications and shall conform to the requirements in ASTM Designation: A 307.

A permanent steel template shall be used to maintain the proper anchor bolt spacing.

One top nut, one leveling nut, and 2 washers shall be provided for the upper threaded portion of each anchor bolt.

Flatness of surfaces for the following shall conform to the requirements in ASTM Designation: A 6/A 6M:

1. Base plates that are to come in contact with concrete, grout, or washers and leveling nuts
2. Plates in high-strength bolted connections

No holes shall be made in members unless the holes are shown on the plans or are approved in writing by the Engineer.

Partial joint penetration longitudinal seam welds for tapered tubular members shall have at least the minimum penetration shown but not less than 60 percent penetration, except that within 6 inches of circumferential welds, longitudinal seam welds shall be complete joint penetration groove welds. Longitudinal seam welds on structures having telescopic pole segment splices shall be complete joint penetration groove welds on the female end for a length on each end equal to the designated slip-fit splice length plus 6 inches.

Except for welds at posts shown as partial joint penetration welds, longitudinal seam welds of fabricated pipe posts shall be complete joint penetration groove welds.

The length of telescopic slip-fit splices shall be at least 1.5 times the inside diameter of the exposed end of the female section.

Steel members used for overhead sign structures shall receive nondestructive testing (NDT) in conformance with AWS D1.1 and the following:

1.

Weld Location	Weld Type	Minimum Required NDT
Splice welds around the perimeter of tubular sections, poles, and arms.	CJP groove weld with backing ring	100% UT ^a or RT ^b
Longitudinal seam welds	CJP or PJP ^c groove weld	Random 25% MT ^d
Longitudinal seam welds within 6 inches of a circumferential splice.	CJP groove weld	100% UT or RT
Welds attaching base plates, flange plates, or pole or mast arm plates, to poles or arm tubes.	CJP groove weld with backing ring and reinforcing fillet	$t \geq 5/16$ inch: 100%UT and MT $t < 5/16$ inch: 100% MT after root weld pass and final weld pass $t =$ pole or arm thickness
	External (top) fillet weld for socket-type connections	100% MT

- a ultrasonic testing
- b radiographic testing
- c partial joint penetration
- d magnetic particle testing

2. The acceptance and repair criteria for UT of welded joints where any of the members are less than 5/16 inch thick or where tubular sections are less than 13 inches in diameter shall conform to the requirements in AWS D1.1, Clause 6.13.3.1. A written procedure approved by the Engineer shall be used when performing this UT. These written procedures shall conform to the requirements in AWS D1.1, Annex K. The acceptance and repair criteria for other welded joints receiving UT shall conform to the requirements in AWS D1.1, Clause, Table 6.3 for cyclically loaded nontubular connections.
3. The acceptance and repair criteria for radiographic or real time image testing shall conform to the requirements of AWS D1.1 for tensile stress welds.
4. For longitudinal seam welds, the random locations for NDT will be selected by the Engineer. The cover pass shall be ground smooth at the locations to be tested. If repairs are required in a portion of a tested weld, the repaired portion shall receive NDT, and additional NDT shall be performed on untested portions of the weld. The additional NDT shall be performed on 25 percent of that longitudinal seam weld. After this additional NDT is performed and if more repairs are required, then that entire longitudinal seam weld shall receive NDT.

Circumferential welds and base plate to post welds may be repaired only one time without written permission from the Engineer.

Full compensation for furnishing anchor bolt templates and for testing of welds shall be considered as included in the contract price paid per pound for furnish sign structure, and no additional compensation will be allowed therefor.

10-1.96 ROADSIDE SIGNS

Roadside signs shall be furnished and installed at the locations shown on the plans or where designated by the Engineer and in conformance with the provisions in Section 56-2, "Roadside Signs," of the Standard Specifications and these special provisions.

The Contractor shall furnish roadside sign panels in conformance with the provisions in "Furnish Sign" of these special provisions.

Wood posts shall be pressure treated after fabrication in conformance with the provisions in Section 58, "Preservative Treatment of Lumber, Timber and Piling," of the Standard Specifications and AWP A Use Category System: UC4A, Commodity Specification A or B.Type N (CA), Type P (CA), and Type R (CA) marker panels mounted on a post with a roadside sign shall be considered to be sign panels and will not be paid for as markers.

10-1.97 INSTALL PANEL (BARRIER/WALL MOUNTED)

Sign panels shall be installed on barriers or walls as shown on the plans and in conformance with these special provisions.

The Contractor shall furnish sign panels in conformance with the provisions in "Furnish Sign" of these special provisions.

Self-plugging blind rivets for installing sign overlays shall have a 3/16" x 5/8" shank. A No. 10 drill shall be used for drilling the rivet holes. If the overlay is not pre-punched, maximum rivet spacing shall be 16 inches.

Installing panels (barrier/wall mounted) will be measured by actual unit count.

The contract unit price paid for install panel (barrier/wall mounted) shall include full compensation for furnishing all labor, materials (except sign panels), tools, equipment, and incidentals, and for doing all the work involved in installing panels on barrier or wall (including fastening hardware), as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.98 INSTALL BRIDGE MOUNTED VERTICAL CLEARANCE SIGN

Bridge mounted vertical clearance signs shall be installed on bridges as shown on the plans and in conformance with these special provisions.

The Contractor shall furnish sign panels in conformance with the provisions in "Furnish Sign" of these special provisions.

Installing bridge mounted vertical clearance signs will be measured by actual unit count.

The contract unit price paid for install bridge mounted vertical clearance sign shall include full compensation for furnishing all labor, materials (except signs), tools, equipment, and incidentals, and for doing all the work involved in installing bridge mounted vertical clearance signs (including fastening hardware), as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.99 FURNISH SIGN

Signs shall be fabricated and furnished in accordance with details shown on the plans, the Traffic Sign Specifications, and these special provisions.

Traffic Sign Specifications for California sign codes are available for review at:

<http://www.dot.ca.gov/hq/traffops/signtech/signdel/specs.htm>

Traffic Sign Specifications for signs referenced with Federal MUTCD sign codes can be found in Standard Highway Signs Book, administered by the Federal Highway Administration, which is available for review at:

http://mutcd.fhwa.dot.gov/ser-shs_millennium.htm

Information on cross-referencing California sign codes with the Federal MUTCD sign codes is available at:

<http://www.dot.ca.gov/hq/traffops/signtech/signdel/specs.htm>

Temporary or permanent signs shall be free from blemishes that may affect the serviceability and detract from the general sign color and appearance when viewing during daytime and nighttime from a distance of 25 feet. The face of each finished sign shall be uniform, flat, smooth, and free of defects, scratches, wrinkles, gel, hard spots, streaks, extrusion marks, and air bubbles. The front, back, and edges of the sign panels shall be free of router chatter marks, burns, sharp edges, loose rivets, delaminated skins, excessive adhesive over spray and aluminum marks.

QUALITY CONTROL FOR SIGNS

The requirements of "Quality Control for Signs" in this section shall not apply to construction area signs.

No later than 14 days before sign fabrication, the Contractor shall submit a written copy of the quality control plan for signs to the Engineer for review. The Engineer will have 10 days to review the quality control plan. Sign fabrication shall not begin until the Engineer approves the Contractor's quality control plan in writing. The Contractor shall submit to the Engineer at least 3 copies of the approved quality control plan. The quality control plan shall include, but not be limited to the following requirements:

- A. Identification of the party responsible for quality control of signs,
- B. Basis of acceptance for incoming raw materials at the fabrication facility,
- C. Type, method and frequency of quality control testing at the fabrication facility,
- D. List (by manufacturer and product name) of process colors, protective overlay film, retroreflective sheeting and black non-reflective film,
- E. Recommended cleaning procedure for each product, and
- F. Method of packaging, transport and storage for signs.

No legend shall be installed at the project site. Legend shall include letters, numerals, tildes, bars, arrows, route shields, symbols, logos, borders, artwork, and miscellaneous characters. The style, font, size, and spacing of the legend shall conform to the Standard Alphabets published in the FHWA Standard Highway Signs Book. The legend shall be oriented in the same direction in accordance with the manufacturer's orientation marks found on the retroreflective sheeting.

On multiple panel signs, legend shall be placed across joints without affecting the size, shape, spacing, and appearance of the legend. Background and legend shall be wrapped around interior edges of formed panel signs as shown on plans to prevent delamination.

The following notation shall be placed on the lower right side of the back of each sign where the notation will not be blocked by the sign post or frame:

- A. PROPERTY OF STATE OF CALIFORNIA,
- B. Name of the sign manufacturer,
- C. Month and year of fabrication,
- D. Type of retroreflective sheeting, and
- E. Manufacturer's identification and lot number of retroreflective sheeting.

The above notation shall be applied directly to the aluminum sign panels in 1/4-inch upper case letters and numerals by die-stamp and applied by similar method to the fiberglass reinforced plastic signs. Painting, screening, or engraving the notation will not be allowed. The notation shall be applied without damaging the finish of the sign.

Signs with a protective overlay film shall be marked with a dot of 3/8 inch in diameter. The dot placed on white border shall be black, while the dot placed on black border shall be white. The dot shall be placed on the lower border of the sign before application of the protective overlay film and shall not be placed over the legend and bolt holes. The application method and exact location of the dot shall be determined by the manufacturer of the signs.

For sign panels that have a minor dimension of 48 inches or less, no splice will be allowed in the retroreflective sheet except for the splice produced during the manufacturing of the retroreflective sheeting. For sign panels that have a minor dimension greater than 48 inches, only one horizontal splice will be allowed in the retroreflective sheeting.

Unless specified by the manufacturer of the retroreflective sheeting, splices in retroreflective sheeting shall overlap by a minimum of one inch. Splices shall not be placed within 2 inches from edges of the panels. Except at the horizontal borders, the splices shall overlap in the direction from top to bottom of the sign to prevent moisture penetration. The retroreflective sheeting at the overlap shall not exhibit a color difference under the incident and reflected light.

Signs exhibiting a significant color difference between daytime and nighttime shall be replaced immediately.

Repairing sign panels will not be allowed except when approved by the Engineer.

The Department will inspect signs at the Contractor's facility and delivery location, and in accordance with Section 6, "Control of Materials," of the Standard Specifications. The Engineer will inspect signs for damage and defects before and after installation.

Regardless of kind, size, type, or whether delivered by the Contractor or by a common carrier, signs shall be protected by thorough wrapping, tarping, or other methods to ensure that signs are not damaged by weather conditions and during transit. Signs shall be dry during transit and shipped on pallets, in crates, or tier racks. Padding and protective materials shall be placed between signs as appropriate. Finished sign panels shall be transported and stored by method that protects the face of signs from damage. The Contractor shall replace wet, damaged, and defective signs.

Signs shall be stored in dry environment at all times. Signs shall not rest directly on the ground or become wet during storage. Signs, whether stored indoor or outdoor, shall be free standing. In areas of high heat and humidity signs shall be stored in enclosed climate-controlled trailers or containers. Signs shall be stored indoor if duration of the storage will exceed 30 days.

Screen processed signs shall be protected, transported and stored as recommended by the manufacturer of the retroreflective sheeting.

When requested, the Contractor shall provide the Engineer test samples of signs and materials used at various stages of production. Sign samples shall be 12" x 12" in size with applied background, letter or numeral, and border strip.

The Contractor shall assume the costs and responsibilities resulting from the use of patented materials, equipment, devices, and processes for the Contractor's work.

SHEET ALUMINUM

Alloy and temper designations for sheet aluminum shall be in accordance with ASTM Designation: B 209.

The Contractor shall furnish the Engineer a Certificate of Compliance in conformance with Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the sheet aluminum.

Sheet aluminum shall be pretreated in accordance to ASTM Designation: B 449. Surface of the sheet aluminum shall be cleaned, deoxidized, and coated with a light and tightly adherent chromate conversion coating free of powdery residue. The conversion coating shall be Class 2 with a weight between 10 milligrams per square foot and 35 milligrams per square foot, and an average weight of 25 milligrams per square foot. Following the cleaning and coating process, the sheet aluminum shall be protected from exposure to grease, oils, dust, and contaminants.

Sheet aluminum shall be free of buckles, warps, dents, cockles, burrs, and defects resulting from fabrication.

Base plate for standard route marker shall be die cut.

RETROREFLECTIVE SHEETING

The Contractor shall furnish retroreflective sheeting for sign background and legend in conformance with ASTM Designation: D 4956 and "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Retroreflective sheeting shall be applied to sign panels as recommended by the retroreflective sheeting manufacturer without stretching, tearing, and damage.

Class 1, 3, or 4 adhesive backing shall be used for Type II, III, IV, VII, VIII, and IX retroreflective sheeting. Class 2 adhesive backing may also be used for Type II retroreflective sheeting. The adhesive backing shall be pressure sensitive and fungus resistant.

When the color of the retroreflective sheeting determined from instrumental testing is in dispute, the Engineer's visual test will govern.

PROCESS COLOR AND FILM

The Contractor shall furnish and apply screened process color, non-reflective opaque black film, and protective overlay film of the type, kind, and product that are approved by the manufacturer of the retroreflective sheeting.

The Contractor shall furnish the Engineer a Certificate of Compliance in accordance to Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the screened process color, non-reflective opaque black film, and protective overlay film.

The surface of the screened process color shall be flat and smooth. When the screened process colors determined from the instrumental testing in accordance to ASTM Designation: D 4956 are in dispute, the Engineer's visual test will govern.

The Contractor shall provide patterns, layouts, and set-ups necessary for the screened process.

The Contractor may use green, red, blue, and brown reverse-screened process colors for background and non-reflective opaque black film or black screened process color for legend. The coefficient of retroreflection for reverse-screened process colors on white retroreflective sheeting shall not be less than 70 percent of the coefficient of retroreflection specified in ASTM Designation: D 4956.

The screened process colors and non-reflective opaque black film shall have the same outdoor weatherability as that of the retroreflective sheeting.

After curing, screened process colors shall withstand removal when tested by applying 3M Company Scotch Brand Cellophane Tape No. 600 or equivalent tape over the color and removing with one quick motion at 90° angle.

SINGLE SHEET ALUMINUM SIGN

Single sheet aluminum signs shall be fabricated and furnished with or without frame. The Contractor shall furnish the sheet aluminum in accordance to "Sheet Aluminum" of these special provisions. Single sheet aluminum signs shall be fabricated from sheet aluminum alloy 6061-T6 or 5052-H38.

Single sheet aluminum signs shall not have a vertical splice in the sheet aluminum. For signs with depth greater than 48 inches, one horizontal splice will be allowed in the sheet aluminum.

Framing for single sheet aluminum signs shall consist of aluminum channel or rectangular aluminum tubing. The framing shall have a length tolerance of $\pm 1/8$ inch. The face sheet shall be affixed to the frame with rivets of 3/16-inch diameter. Rivets shall be placed within the web of channels and shall not be placed less than 1/2 inch from edges of the sign panels. Rivets shall be made of aluminum alloy 5052 and shall be anodized or treated with conversion coating to prevent corrosion. The exposed portion of rivets on the face of signs shall be the same color as the background or legend where the rivets are placed.

Finished signs shall be flat within a tolerance of $\pm 1/32$ inch per linear foot when measured across the plane of the sign in all directions. The finished signs shall have an overall tolerance within $\pm 1/8$ inch of the detailed dimensions.

Aluminum channels or rectangular aluminum tubings shall be welded together with the inert gas shielded-arc welding process using E4043 aluminum electrode filler wires as shown on the plans. Width of the filler shall be equal to wall thickness of smallest welded channel or tubing.

FIBERGLASS REINFORCED PLASTIC PANEL SIGN

The Contractor shall furnish fiberglass reinforced plastic panel sign in accordance with ASTM Designation: D 3841 and "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Fiberglass reinforced plastic shall be acrylic modified and ultraviolet stabilized for outdoor weatherability. The plastic shall contain additives designed to suppress fire ignition and flame propagation. When tested in accordance with the requirements in the ASTM Designation: D 635, the extent of burning shall not exceed one inch.

Fiberglass reinforced plastic shall be stabilized to prevent the release solvents and monomers. The front and back surfaces of the laminate shall be clean and free of constituents and releasing agents that can interfere with the bonding of retroreflective sheeting.

The fiberglass reinforced plastic panel sign shall be weather resistant Grade II thermoset polyester laminate.

The fiberglass reinforced plastic panels shall be minimum 0.135-inch thick. Finished fiberglass reinforced plastic panel signs shall be flat within a tolerance of $\pm 1/32$ inch per linear foot when measured across the plane of the sign in all directions. The finished signs shall have an overall tolerance within $\pm 1/8$ inch of the specified dimensions.

Color of fiberglass reinforced plastic panels shall be uniform gray within Munsel color range of N7.5 to N8.5.

Fiberglass reinforced plastic panels shall be cut from a single piece of laminate. Bolt holes shall be predrilled. The predrilled bolt holes, panel edges, and the front and back surfaces of the panels shall be true and smooth. The panel surfaces shall be free of visible cracks, pinholes, foreign inclusions, warping and wrinkles that can affect performance and serviceability.

LAMINATED PANEL SIGN

Laminated panel signs shall consist of two sheet aluminum laminated to a honeycomb core and extruded aluminum frame to produce flat and rigid panels of one-inch or 2-1/2-inch nominal thickness.

The face of laminated panel signs shall be fabricated from sheet aluminum alloy 6061-T6 or 5052-H32 of 0.063-inch thickness. The back of laminated panel signs shall be fabricated from sheet aluminum alloy 3003-H14 of 0.040-inch thickness. The Contractor shall furnish sheet aluminum as provided in "Sheet Aluminum" of these special provisions.

The core material shall be phenolic impregnated kraft paper honeycomb and fungus resistant in accordance to Military Specification MIL-D-5272. The honeycomb cell size shall be 1/2 inch. Weight of the kraft paper shall be 80 pounds and impregnated minimum 18 percent by weight.

A laminating adhesive that can produce a resilient oil and water-resistant bond shall be used to adhere the extruded aluminum frame and the honeycomb core to the sheet aluminum. Edge and interior delamination occur when a 0.010-inch thick feeler gauge of 1/2 inch in length can be inserted into a depth of more than 1/2 inch between the extruded aluminum frame and the sheet aluminum. Laminated panel sign with delamination will be rejected.

Laminated panels shall be able to resist a wind load of 33 pounds per square foot for the following simple span lengths with a bending safety factor of 1.25:

Panel Type	Nominal Panel Thickness	Simple Span Length
A	one inch	9 feet 0 inch
B	one inch	9 feet 0 inch
	2-1/2 inch	14 feet 6 inches
H	2-1/2 inch	14 feet 6 inches

The tensile strength of laminated panels shall be at least 20 pounds per square inch when tested in accordance with the following modification and with ASTM Designations: C 297 and C 481, Cycle B after aging. Instead of spraying with hot water, the specimen shall be totally immersed in 158° F hot water. When requested by the Engineer or the Transportation Laboratory, at least one test sample of 12" x 12" in size shall be taken for every 2,000 square feet of the panel production cycle or of the total factory production order, whichever occurs first.

Rivets used to secure the sheet aluminum to the perimeter frame shall be fabricated from aluminum alloy 5052 and anodized or treated with a conversion coating to prevent corrosion. Size of the aluminum rivets shall be

3/16 inch in diameter and placed at the corners of the laminated panels. Color of the exposed portion of the rivets shall be the same color as the sign background or legend on which the rivets are placed. Rivets or stainless steel screws shall be placed in holes drilled during fabrication in the perimeter frame.

On laminated multiple panel signs, a closure H-Section shall be placed in the top channel of the bottom panel. Perimeter frame of adjoining panel shall accommodate the closure H-Section in the closed position.

For signs with a depth of 5 feet 0 inch or less, the laminated panels shall be fabricated with no horizontal joints, splices or seams. For signs with a depth of greater than 5 feet 0 inch, the laminated panels may be fabricated in two panels.

The face of laminated panels shall be flat with a tolerance of $\pm 3/32$ inch per linear foot when measured across the plane of each panel in all directions. Where laminated panels adjoin, the gap between adjoining edges from one corner to the other corner shall not deviate by more than 1/32 inch. Non-adjoining edges from one corner to the other corner shall not deviate by more than 1/8 inch from a straight plane. The front and back sheet aluminum shall be flush with the perimeter frame. The panel edges shall be smooth.

Laminated panel signs shall be within +1/8 inch or -1/2 inch of the detailed dimensions. The difference in length between adjoining panels of multiple panel signs shall not be greater than 1/2 inch.

Roadside laminated panel signs shall be Type B. Type B panels shall have a nominal thickness of one inch or 2-1/2 inches.

The perimeter frame of Type B panels shall consist of extruded channel edges. The interior and exterior sides of the channels, except the sides touching the face and back sheet aluminum, shall be welded at the joint. Sealant shall be placed at the corners of the perimeter frame to prevent moisture penetration.

Each side of the vertical tube spacers of Type B panels shall be welded to the perimeter frame, except the sides touching the front and back sheet aluminum.

The Contractor shall furnish mounting hardware for roadside laminated panel signs, such as closure H-sections, lags, bolts, nuts, and washers.

Overhead laminated panel signs shall be Type A and have a nominal thickness of one inch.

For overhead laminated signs with a length of 24 feet or less, the laminated panels shall be fabricated with no vertical joints, splices or seams. For signs with a length of greater than 24 feet, the length of each adjoining panel shall be as determined by the Engineer or as shown on the plans.

The perimeter frame of Type A overhead laminated panels shall be connected by self-tapping hex head stainless steel screws. Sealant shall be placed at the corners of the perimeter frame to prevent moisture penetration. The perimeter frame of Type A panels shall consist of extruded channel edges on the vertical sides and consist of modified "H" section extrusion on the horizontal sides. The modified "H" section extrusion acts as an integral retainer track for affixing the bolts to provide blind fastening of panels to the structure support.

The Contractor shall furnish mounting hardware for overhead laminated panel signs, such as closure H-sections, clamps, bolts, nuts, and washers. The clamps shall be cast aluminum alloy with a minimum tensile strength of 25 kips per square inch. Bolt torque used for installing clamps shall not exceed 100 inch-pounds.

FORMED PANEL SIGN

Formed panel signs shall be fabricated from one continuous sheet aluminum alloy 5052-H32 of 0.063-inch thickness. The Contractor shall furnish sheet aluminum as provided in "Sheet Aluminum" of these special provisions.

The aluminum frame shall be affixed to the panel with aluminum rivets through the face of the sign panels. Color of the exposed portion of the rivets shall be the same color as the sign background or legend on which the rivets are placed.

The face of finished formed panel sign shall be flat with a tolerance of 1/8 inch per linear foot when measured across the plane of each panel in all directions.

The Contractor shall furnish mounting hardware for overhead formed panel signs. Hardware for the overhead formed panel signs shall include bolts, nuts, and washers.

The length and depth of the overhead formed panel signs shall be within $\pm 1/16$ inch of the detailed dimension.

The formed edges of the overhead panel signs shall be square. The mounting holes shall be straight and perpendicular to the front and back surfaces of the formed edges at the spacing shown on the plans. Holes that are improperly spaced and placed at the wrong angle will be rejected.

MEASUREMENT AND PAYMENT

Furnishing signs (except for construction area signs) will be measured by the square foot and the quantity to be paid for will be the total area, in square feet, of the sign panel types installed in place.

The contract price paid per square foot for furnish sign of the types specified in the Bid Item List shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work

involved in fabricating and furnishing the signs, including fastening hardware, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for furnishing and installing protective overlay on signs shall be considered as included in the contract price paid per square foot for furnish sign of the various types and no separate payment will be made therefor.

10-1.100 REINFORCED CONCRETE PIPE

Reinforced concrete pipe shall conform to the provisions in Section 65, "Reinforced Concrete Pipe," of the Standard Specifications and these special provisions.

GENERAL

Where embankment will not be placed over the top of the pipe, a relative compaction of not less than 85 percent shall be required below the pipe spring line for pipe installed using Method 1 backfill in trench, as shown on Standard Plan A62D. Where the pipe is to be placed under the traveled way, a relative compaction of not less than 90 percent shall be required unless the minimum distance between the top of the pipe and the pavement surface is the greater of 4 feet or one half of the outside diameter of the pipe.

Except as otherwise designated by classification on the plans or in the specifications, joints for culvert and drainage pipes shall conform to the plans or specifications for standard joints.

MATERIALS

Special reinforced concrete pipe, having concrete cover over the steel reinforcement greater than the cover specified in AASHTO Designation: M 170, shall conform to the provisions in Section 65-1.02, "Materials," and Section 65-1.02A, "Circular Reinforced Concrete Pipe," of the Standard Specifications, except the width of crack produced by the D-load test specified in AASHTO Designation: M 170 shall be the width determined by the following formula:

$$b = \frac{t - 3/8d}{t - 3/8d - C} \times 0.01 \text{ inch}$$

Where:

- b = Width of crack to be produced in lieu of the 0.01-inch crack specified in AASHTO Designation: M 170
- t = Wall thickness of pipe, inches
- d = Effective depth of the section to be tested, feet
- C = Concrete cover over steel reinforcement in excess of cover specified in AASHTO Designation: M 170

Reinforced concrete pipe that is to be hydrostatically tested shall be strength tested by the 3-edge bearing method to a maximum D-load of 10 percent greater than the 0.01-inch cracking D-load specified in AASHTO Designation: M 170 or to the actual D-load required to produce a 0.01-inch crack, whichever is the lesser.

Special oval shaped reinforced concrete pipe, having concrete cover over the steel reinforcement greater than the cover specified in AASHTO Designation: M 207, shall conform to the provisions in Section 65-1.02, "Materials," and Section 65-1.02B, "Oval Shaped Reinforced Concrete Pipe," of the Standard Specifications, except the width of crack produced by the D-load test specified in AASHTO Designation: M 207 shall be the width determined by the following formula:

$$b = \frac{t - 3/8d}{t - 3/8d - C} \times 0.01 \text{ inch}$$

Where:

- b = Width of crack to be produced in lieu of the 0.01-inch crack specified in AASHTO Designation: M 207
- t = Wall thickness of pipe, inches
- d = Effective depth of the section to be tested, feet
- C = Concrete cover over steel reinforcement in excess of cover specified in AASHTO Designation: M 207

Oval shaped reinforced concrete pipe that is to be hydrostatically tested shall be strength tested by the 3-edge bearing method to a maximum D-load of 10 percent greater than the 0.01-inch cracking D-load specified in AASHTO Designation: M 207 or to the actual D-load required to produce a 0.01-inch crack, whichever is the lesser.

MEASUREMENT AND PAYMENT

The Department does not pay any additional cost for use of optional supplementary cementitious material.
The Department does not pay any additional cost for excess concrete cover over steel reinforcement.

10-1.101 CORRUGATED METAL PIPE

Corrugated steel pipes shall conform to the provisions in Section 66, "Corrugated Metal Pipe," of the Standard Specifications and these special provisions.

Asphaltic mastic coating or polymeric sheet coating substituted for bituminous coating shall be placed on the outside and inside surfaces of the pipe.

10-1.102 SLOTTED CORRUGATED STEEL PIPE

Slotted corrugated steel pipe must comply with Section 66-3.09, "Slotted Pipe," of the Standard Specifications and these special provisions.

MATERIALS

Concrete Backfill

Where plans show cement treated structure backfill use minor concrete for backfill or Class 3 concrete conforming to the provisions of Section 90, "Portland Cement Concrete," of the Standard Specifications, except that minor concrete shall contain not less than 525 pounds of cementitious material per cubic yard.

Slotted corrugated steel pipe

Slotted corrugated steel pipe drain must have a 6-inch vertical dimension for grate and tapered spacers.

CONSTRUCTION

Excavation must comply with Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications.

MEASUREMENT AND PAYMENT

The length of slotted corrugated steel pipe to be paid will be the slope length measured along the centerline of the pipe as designated by the Engineer. Slotted corrugated steel pipe cut to fit a structure will be the length of pipe necessary to be placed before cutting, measured in 2-foot increments. Slotted corrugated steel pipe placed in excess of the length designated will not be paid for.

The contract price paid per linear foot for the different sizes of slotted corrugated steel pipe includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all of the work involved in installing slotted corrugated steel pipe, complete in place, including structure excavation and cement treated or concrete backfill and connecting slotted corrugated steel pipe to new or existing facilities, including concrete collars, reinforcement, or other connecting devices, specified in the Standard Specifications and these special provisions, as shown on the plans, and as directed by the Engineer.

10-1.103 UNDERDRAIN

Underdrains at bridge abutments, wing walls, and retaining walls shall conform to the provisions in Section 68-1, "Underdrains," of the Standard Specifications and these special provisions.

Filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," of the Standard Specifications and these special provisions. Filter fabric shall be Class A.

Welded steel covers conforming to the provisions in Section 68-1.023, "Underdrain Outlets and Risers," of the Standard Specifications shall be installed on underdrains terminating under ground.

Permeable material used at bridge abutments and wing walls shall be placed in horizontal layers and thoroughly consolidated along with and by the same methods specified for structure backfill in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications. Ponding and jetting of permeable material or structure backfill adjacent to permeable material will not be permitted.

At the option of the Contractor, Class 1 or Class 2 permeable material shall be used. Filter fabric shall be placed between Class 1 permeable material and backfill. No filter fabric will be required with Class 2 permeable material.

At the option of the Contractor, permeable material may be substituted for structure backfill material when the required width of backfill material adjacent to the neat lines of the permeable material as shown on the plans is approximately one foot or less. The quantity of permeable material substituted for structure backfill material will be measured and paid for by the cubic yard as structure backfill (bridge).

Underdrains used at bridge abutments and wing walls will be measured and paid for at the contract price per linear foot for 8" perforated plastic pipe underdrain.

Full compensation for filter fabric when required shall be considered as included in the contract price paid per cubic yard for structure backfill (bridge) and no additional compensation will be allowed therefor.

10-1.104 PERMEABLE MATERIAL (AUSTIN VAULT)

MATERIALS

Permeable material (austin vault) must comply with Section 68, "Subsurface Drains," of the Standard Specifications and consist of hard, durable, clean sand, gravel or crushed stone, and shall be free from organic material, clay balls, or other deleterious materials. The permeable material must be class three in accordance with provisions of these special provisions and shall be washed, so the effluent from washing is below 200 NTU prior to placement and washed again once installed, so that the effluent from the BMP is less than 200 NTU.

Permeable Material must conform to the following grading requirements.

Grading Requirements

Sieve Sizes	Percentage Passing
3/4"	100
1/2"	95-100
3/8"	70-100
No. 4	0-55
No. 8	0-10
No. 100	0-3
No. 200	0

Filter Fabric for use with permeable material shall conform to the provisions in Section 88-1.02, "Filtration" of the standard Specifications and the following:

- A. Remove loose or extraneous material and sharp objects immediately before placing filter fabric.
- B. The subgrade and trench to receive the filter fabric must comply with the compaction and elevation tolerance specified for the material involved.
- C. Handle and place filter fabric under the manufacturer's instructions.
- D. Align and place filter fabric without wrinkles.
- E. Overlap adjacent roll ends of filter fabric at least 18 inches.
- F. The preceding roll must overlap the following roll in the direction that the permeable material is being spread.
- G. Completely replace torn or punctured sections damaged during placement or repair by placing a piece of filter fabric that is large enough to cover the damaged area and comply with the overlap specified.
- H. Cover filters fabric with the thickness of overlying material shown within 72 hours of placing the fabric.

MEASUREMENT AND PAYMENT

Permeable Material (austin vault) is measured by the cubic yard. Quantities of permeable material to be paid for by the cubic yard will be determined from the dimensions shown on the plans or the dimensions directed by the Engineer and permeable material placed in excess of the these dimensions will not be paid for.

The contract price paid per cubic yard for permeable material (austin vault) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the permeable material, complete in place, including washing the permeable material and disposing of the water, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.105 PLASTIC PIPE UNDERDRAIN (AUSTIN VAULT)

Perforated underdrain plastic pipe specified for filter underdrain systems must conform to these special provisions.

Perforated underdrain pipe must have round perforations of the size and spacing shown on the plans.

Plastic underdrain pipe must be polyvinyl chloride (PVC) plastic pipe, Schedule 40, conforming to the provisions for pipe for edge drains and edge drain outlets in Section 68-3.02, "Materials," of the Standard Specifications.

Riser support brackets for clean-outs must conform to the provisions for Miscellaneous Metal (Austin Vault) of these special provisions.

MEASUREMENT

Perforated plastic pipe underdrain will be measured by linear foot along the line of each type of pipe without deductions for couplers, tees, elbow, and cross connectors. Cleanout pipe will be measured and paid for as plastic pipe underdrain of the sizes shown on the plans.

PAYMENT

The contract prices paid per linear foot for plastic pipe underdrain (austin vault) of the size or sizes shown in the Bid Item List, must include full compensation for furnishing all labor, materials (including cleanout riser support brackets), tools, equipment, and incidentals and for doing all the work involved in installing the plastic pipe underdrain system, complete in place, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

10-1.106 FILTER FABRIC (AUSTIN VAULT)

MATERIALS

Filter fabric (austin vault) must comply with Section 88, "Geosynthetics," of the Standard Specifications and be a permeable, nonwoven geotextile. Filter fabric consists of 1 of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

When tested under the referenced ASTMs, the properties of filter fabric must have the values shown in the following table:

Filter Fabric (austin vault)

Property	ASTM	Specification
Grab breaking load, lb 1-inch grip, min. in each direction	D 4632	120x120
Apparent elongation, percent min., in each direction	D 4632	50x50
Permittivity, sec ⁻¹ , minimum and maximum	D 4491	1.6-1.8
Apparent opening size, U.S. Standard sieve size maximum and minimum	D 4751	60-80
Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr.	D4355	70

MEASUREMENT AND PAYMENT

Filter fabric (austin vault) is measured by the square yard of the actual area covered. Measurement does not include additional filter fabric needed for overlaps.

The contract price paid per square yard for filter fabric (austin vault) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and placing filter fabric, complete, in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.107 DUCTILE-IRON PIPE AND FITTINGS

GENERAL

Summary

This work consists of furnishing and installing pipes and fittings in accordance with the details shown on the plans and these special provisions. Pipe and fittings shall include, but not limited to piping accessories and appurtenances, that are required for the proper installation and operation of the piping systems.

The pipe sizes shown on the plans are nominal inside diameter. No change in the pipe size shown on the plans shall be permitted without written permission from the Engineer.

The pipe and fitting classes and material descriptions shall be as specified herein. No change in class or description shall be permitted without written permission from the Engineer.

Submittal

Affidavits of compliance with standards referenced in this specification, e.g., AWWA C-151, shall be provided. Layout drawings showing the locations and dimensions of pipe and fittings shall be submitted. Include laying lengths of valves and other equipment determining piping dimensions. For pipe sizes larger than 20 inches in diameter, label or number each fitting or piece of pipe. Lining, coating and wall thickness for all piping shall be provided. Joint details for all types of joints used, e.g., push-on joints shall be submitted. Calculations and test data proving that each proposed restrained joint arrangement can transmit the required forces shall be submitted.

MATERIALS

Ductile-Iron Pipe

Ductile-iron pipe shall be manufactured in accordance with ANSI/AWWA C-151/A-21.51. Gray-iron fittings will not be substituted for ductile-iron.

The minimum wall thickness for ductile-iron pipe shall correspond to pressure Class 350 for pipe 12" and smaller and Class 250 for pipe 14" and larger.

Unless otherwise called out on the plans or these special provisions, a "push-on" joint shall be used. The joint dimension and gasket shall be as specified in ANSI/AWWA C-111/ A-21.11.

Flanges for ductile-iron pipe, when required, shall be "screwed-on" type in accordance with ANSI/AWWA C-115/A-21.15.

Where restrained joints are called for on 8-inches in diameter and smaller pipe, push-on joints shall be restrained with locking gasket rated for 250 psi operating pressure. Joint restraint shall be push-on joint with "Fast-Grip" as manufactured by American Cast Iron Pipe Company, "Sure-Stop" as manufactured by Pacific States Cast Iron Company, "Field-Lok" gaskets as manufactured by U.S. Pipe, or equal.

Where restrained joints are called for on 10-inches in diameter and larger pipe, use a "Flex-Ring" as manufactured by American Cast iron Pipe Company, "Thrust-Lok" as manufactured by Pacific Cast Iron Pipe Company, "TR-Flex" restrained joint pipe as manufactured by U.S. Pipe, or equal. The restrained joint shall be a boltless restrained push-on joint design and shall contain a positive axial locking restrained system and be capable of deflection after assembly. Field cut pipe (used only for connections to pipe joints) shall be restrained by using "Field-Flex" Rings as manufactured by American Cast Iron Pipe Company, "Field-Lok" Adaptor Rings as manufactured by Pacific Cast Iron Pipe Company, "TR Flex" Gripper Rings as manufactured by U.S. Pipe, or equal, as long as field weldments are not required. Restraint of field cut pipe shall be kept to a minimum.

Ductile -iron restrained joint pipe shall be as manufactured by American Cast Iron Pipe Company, Pacific Cast Iron Pipe Company, U.S. Pipe, or equal.

Ductile-Iron Fittings

Ductile-iron fittings shall be manufactured in accordance with ANSI/AWWA C-110/A-21.10. Ductile iron compact body fittings may be used for fitting sizes 4 inches through 12 inches in diameter and shall be manufactured in accordance with ANSI/AWWA C153/A21.53.

For pipe sizes 8-inches in diameter and smaller, push-on joint fittings shall be restrained with locking gasket rated for 250 psi operating pressure. Joint restraint shall be push-on joint fittings with "Fast-Grip" as manufactured by American Cast Iron Pipe Company, "Sure-Stop" as manufactured by Pacific States Cast Iron Pipe Company, "Field-Lok" gaskets as manufactured by U.S. Pipe, or equal.

For pipe sizes 10-inches in diameter and larger, restrained joint fittings shall be "Flex-Ring" as manufactured by American Cast Iron Pipe Company, "Thrust-Lok" as manufactured by Pacific States Cast Iron Pipe Company, "TR-Flex" restrained joint fitting as manufactured by U.S. Pipe or mechanical joint ductile iron fittings fitted with joint restraints. Mechanical joint restraint shall be incorporated with the design of the follower gland and shall include a restraining mechanism which, when activated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. The joint shall maintain flexibility after burial. Follower glands shall be manufactured of ductile iron conforming to ASTM A536-80. The mechanical joint restraint shall be EBBA IRON, Inc., MEGALUG, UNIFLANGE Series 1400, or The Ford Meter Box Co., Inc. Any restrained joint fitting which will require a pipe field weldment will not be permitted.

Each fitting shall be tested before lining to one and one-half times the operating pressure for a duration of 10 seconds. Suitable controls and recording devices shall be provided so that the test pressure and duration may be adequately ascertained. Any fitting that does not withstand the test pressure shall be rejected. The Contractor shall notify the Engineer in advance of the date, time, and place of inspection and testing of the fittings in order that the Engineer may be represented at the tests.

Unless otherwise shown on the plans, all fittings with flanged ends shall comply with ANSI/AWWA C110/A21.10, with a pressure rating of 150 psi. The gasket surface shall have a serrated finish of approximately 16 serrations per inch, approximately 1/32-inch deep, with serrations in either a concentric or spiral pattern. Flanges shall meet the following tolerances:

1. Bolt circle drilling..... +1/16 inch
2. Bolt hole spacing..... +1/32 inch
3. Eccentricity of bolt-circle & facing with respect to bore center..... +1/32 inch
4. Manufacturers: Fittings shall be manufactured by American Pipe, Sigma, or U.S. Pipe, or equal.

Gaskets

Gaskets for flanged joints shall be 1/8 inch thick, cloth-inserted rubber. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 180°F.

Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.

Gaskets for mechanical and restrained joints shall be synthetic or natural rubber in accordance with AWWA C-111. Gaskets shall be manufactured by John Crane Company, Style 777, Johns Manville No. 109, Specification Rubber Products, Inc., or equal.

Bolts, Nuts, and Washers

Bolts and nuts for all flanges (including mechanical joints) and flanges located in structures shall be Type 316 stainless steel conforming to ASTM A-193, Grade B8M for bolts, and ASTM A-194, Grade 8M for nuts. Provide one Type 316 stainless steel washer for each nut. Washer shall be the same material as the nuts. The length of each bolt or stud shall be such that between 1/4 inch and 3/8 inch will project through the nut when drawn tight. All buried nuts and bolts shall be coated with bituminous mastic per Painting and Coating in these special provisions.

Grooved-End Fittings and Couplings

Grooved-end fittings shall conform to AWWA C-606, rigid radius-cut groove. Grooved-end couplings shall be ductile iron, ASTM A-536, Grade 65-45-12. Bolts shall be Type 316 stainless steel and conform to ASTM A-183, minimum tensile strength of 110,000 psi. Gaskets shall be EPDM and shall conform to ASTM D-2000. Coupling shall be Victaulic Style 31, Anvil Gruvlok, Grinnell, or equal. All of the threaded parts shall be Type 316 stainless steel and shall be lubricated with anti-seize compound. Where the restrained joint is of the grooved type, the wall thickness beneath the groove shall be equal to or greater than the minimum specified wall thickness.

Lining For Pipe and Fittings

The interior of all pipe and fittings shall be lined with cement-mortar per ANSI/AWWA C-104/A-21.4. Lining shall be the double thickness listed in AWWA C-104, Section 4.8. Lining materials shall conform to ASTM C-150, Type II.

Coating For Pipe and Fittings

Buried pipe and fittings shall be coated with an asphaltic material in conformance with ANSI/AWWA C-110/A-21.10, and ANSI/AWWA C-151/A-21.51. The coating shall be free from blisters and holes; shall adhere to the metal surface at ambient temperatures encountered in the field.

Buried bolts, nuts and glands, and restrained joint bolts for field-cut closure pipe shall be coated specified in the section "Painting and Coating" of these special provisions. Stainless steel parts shall not be coated except for the threaded portion, which shall be assembled with a liberal coat of anti-seize compound.

Polyethylene Encasement

Unless specified otherwise, pipe and fittings shall be polyethylene encased in accord with ANSI/AWWA C-105/A-21.5. The Contractor shall encase the pipe and fittings in two layers of polyethylene.

Lubricants

Lubricants for pipe insertion shall be food grade and biodegradable.

CONSTRUCTION

General

Ductile-iron pipe and ductile iron fittings shall be installed in accordance with the applicable sections of AWWA C-600 and as specified herein.

Installation

For restrained joints, deflection of the joint shall not exceed the manufacturer's recommended maximum deflection. The pipe shall be laid true to the line and grade shown on the plans within acceptable tolerances. The tolerance on grade is 1-inch. The tolerance on line is 2 inches.

All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly specified in the section "Painting and Coating" of these special provisions. Stainless steel bolts shall not be coated.

Handling of Pipe

Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Cable slings shall not be used. Pipe shall be handled in a manner to avoid damage to the pipe. Pipe shall not be dropped or dumped from trucks or into trenches under any circumstances.

The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

Placement of Pipe in Trench

Dewatering, excavation, shoring, sheeting, bracing, backfilling material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with the section "Trenching, Backfilling and Compacting" of these special provisions.

During laying operations, tools, clothing, or other materials shall not be placed in the pipe. When pipe laying is not in progress, including lunch-hour, the ends of the pipe shall be closed using plugs constructed in a manner to prevent entry by any debris, animal or vermin.

Pipes shall be laid uphill with the bell or collared joints on the uphill end of each pipe length, whenever the grade exceeds five (5) percent. Pipe base thickness shall be as specified in "Trenching, Backfilling, and Compacting" of these special provisions.

Depressions shall be dug into pipe base material to accommodate the pipe bell and external joint filler form ("diapers"), and to permit removal of the pipe handling slings.

Pipe shall be lowered onto the bedding and installed to line and grade its full length on firm bearing except at the bell and at sling depressions. Unless specified otherwise, the tolerance on grade shall be 1/4-inch; the tolerance on line shall be 1 inch. Grade shall be measured along the pipe invert. Pipe shall be installed without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Precautions shall be taken to prevent pipe from being displaced by water entering trench. Damaged or displaced pipe shall be replaced to specified condition and grade.

The radius of curvature of the trench shall be determined by the maximum length of pipe section that can be used without exceeding the allowable deflection at each pipe joint and without causing deviation from the trench width requirements. Refer to the various referenced sections on pipe by type for allowable deflection. The deflection at any joint shall not exceed the manufacturer's recommended maximum deflection. The manufacturer's

printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various lengths shall be followed.

Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Cutting and machining of the pipe shall be accomplished in accord with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or produce ragged, uneven edges.

Assembling Rubber-Gasketed Joints

The ends of the pipe to be joined shall be cleaned of foreign material. After placing pipe in trench, a nontoxic water soluble vegetable soap solution shall be applied to the inside of the bell of the pipe in the trench and to the rubber gasket and spigot of the pipe to be installed. The rubber gasket shall be stretched into the groove in the bell-end of the pipe and distributed uniformly around the circumference.

Without tilting the pipe to be installed, the spigot shall be inserted into the bell of the pipe. Come-a-longs or pipe jacks shall be used to drive spigot end into the bell until properly seated. The joint recess recommended by pipe manufacturer for made-up joints shall be maintained. Where deflections at joints are required for curved alignment, the manufacturer's recommended allowable joint opening on one side shall not be exceeded. A feeler gauge shall be used to verify proper placement of each gasket.

Flanged Connections

Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C-115 and shall be individually fitted and machine tightened in the shop.

Pipe shall be set with flange boltholes straddling the pipe horizontal and vertical centerlines. Nuts and bolts shall be lubricated with anti-seize prior to installation. Flanges shall be wrapped with sheet polyethylene film. The wrap shall be extended over the flanges and bolts and secured around the adjacent pipe circumference with tape.

Joints

Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, threads shall be lubricated with oil and graphite, and nuts shall be tightened uniformly and progressively. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket shall be reseated or replaced, the bolts and nuts shall be reinstalled or re-tightened, and the joint retested. Joints shall be watertight.

Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

Installation of Bends, Tees, and Reducers

Fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fittings interior for handling. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

Pipeline Closure Assemblies

Pipeline closure assemblies shall be employed to unite sections of pipeline laid from opposite directions; to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations; and to close areas left open to accommodate temporary test bulkheads for hydrostatic testing. The ring design shall be used. Follower ring closures shall be installed as recommended by the pipe manufacturer.

Operations Incidental to Joint Completion

Joint completion shall be planned to accommodate temporary test bulkheads for hydrostatic testing.

Above-ground Piping Installation/Support

All exposed pipe shall be adequately supported with devices of appropriate design. Where details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all piping shall be complete and adequate as herein specified, whether or not supporting devices are specifically called for.

Grooved-end pipe and fittings shall be installed in accordance with the coupling manufacturer's recommendations and the following:

1. Loose scale, rust, oil, grease, and dirt shall be cleaned from the pipe or fitting groove. Lubricate the coupling gasket in accord with the manufacturer's recommendations.
2. Coupling shall be tightened alternately and evenly until coupling halves are seated properly.

Testing

The ductile iron pipe shall be hydrostatically pressure tested in accordance with Hydrostatic Testing of Pressure Pipelines as specified in these special provisions.

Wrapping Pipe with Polyethylene Encasement

All ductile-iron pipe and fittings buried underground shall be protected with a double layer of polyethylene encasement wrap in accordance with AWWA C105. Wrap shall be a loose 8-mil-thick polyethylene tube. All joints between plastic tubes shall be wrapped with 2-inch-wide, 10-mil thick, polyethylene adhesive tape, Polyken 900, Scotchwrap 50, Grainger, or equivalent. Installation of plastic film shall conform to the following procedure, and wrapping shall be applied to the pipe in the field in the following manner:

1. Using a sling, the pipe shall be picked up with a crane at the side of the trench and raised about 3 feet off the ground. The polyethylene tube, cut approximately 2 feet longer than the length of pipe, shall be slipped over the spigot end of the pipe and bunched up, accordion fashion, between end of the pipe and the sling.
2. The pipe shall be lowered into the trench. The spigot shall be seated into the bell of the adjacent installed pipe, and the pipe lowered into the trench bottom. A shallow bell hole shall be provided in the trench bottom to facilitate the wrapping of the joint.
3. The pipe joint shall then be made up as described herein.
4. The sling shall be removed from the center of the pipe and hooked into the bell cavity. The bell shall be raised approximately 12 inches and the tube of polyethylene film slipped along the full length of the pipe barrel. Enough of the film shall be left bunched up, accordion fashion, at each end of the pipe to overlap the adjoining pipe about 1 foot. The Contractor shall ensure that soil that adheres to the pipe is removed as the polyethylene film is placed around the pipe.
5. To make the overlapped joint wrap, the film shall be pulled over the bell of the pipe, folded around the adjacent spigot, and wrapped with about three circumferential turns of the plastic adhesive tape in order to seal the tube of film to the pipe. The tube on the adjacent pipe shall be then pulled over the first wrap on the pipe bell and sealed in place behind the bell, using about three circumferential turns of the polyethylene adhesive tape.
6. The resulting loose wrap on the barrel of the pipe shall be pulled snugly around the barrel of pipe, the excess material folded over the top and the fold held in place by means of short strips of the 2-inch wide, 10-mil thick adhesive tape at intervals 3 feet apart along the pipe barrel.

Flanged Connections

Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C-115 and shall be individually fitted and machine tightened in the shop.

Joints

Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, threads shall be lubricated with oil and graphite, and nuts shall be tightened uniformly and progressively. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket shall be resealed or replaced, the bolts and nuts shall be reinstalled or re-tightened, and the joint retested. Joints shall be watertight.

Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

MEASUREMENT AND PAYMENT

The contract price paid per linear foot for various sizes of ductile iron pipes shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all work involved in the installation of various sizes of ductile iron pipe complete in place, as shown on the plans, specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.108 HYDROSTATIC TESTING OF PRESSURE PIPELINES

GENERAL

Summary

This work includes pressure and leakage testing of all pressure pipelines, in accordance with ANSI/AWWA C600 and as specified herein.

Job Conditions

Submit request for use of water from City of Burbank Water and Power 48 hours in advance.

Testing Company

All testing shall be performed by independent testing companies with a Class A license, or who are certified and approved by the Engineer to perform the required pressure testing. Testing companies require to provide the Engineer with certified testing results. The testing companies must provide gauges and meters which have been calibrated and certified annually.

MATERIALS

Manual Air-Release Valves

Temporary manual air-release valves shall be provided where necessary for pipeline test. The number and location of release valves shall be subject to the review and approval of the Engineer. The pipe outlet shall be constructed in the same manner as for a permanent air valve. After use, the connection shall be sealed with a blind flange, pipe cap, or plug in a manner and with the fittings satisfactory to the Engineer.

CONSTRUCTION

General

All labor, materials, tools, and equipment for testing shall be furnished by the Contractor. The test shall be conducted with valves in the test section open. Ends of each test section, open ends of pipes, valves, and fittings shall be suitably closed. Valves in the test section shall be operated during the test period.

The water necessary to maintain test pressure shall be measured through a meter. The leakage shall be considered as the amount of water entering the pipe during the test, less the measured leakage through valves and fittings. Leakage shall not exceed the rate specified. Any noticeable leaks shall be stopped, and any defective pipe shall be replaced with new sections.

The test shall further be conducted with valves open, and the open ends of pipes, valves, and fittings suitably closed. Valves shall be operated during the test period.

Requirements Prior to Testing

Before testing, the pipe trench shall be backfilled and compacted to the ground surface per "Trenching, Backfilling and Compacting" in these special provisions. All concrete anchor blocks shall be allowed to cure a sufficient time to develop the designed minimum strength of 2,000 psi, but not less than 5 days, before testing. Cement-mortar lined pipe shall not be filled with water until a minimum period of eight hours has elapsed after the last joint in any section has been made. All pipelines shall be satisfactorily pressure tested prior to the placement of final paving.

Field Test Procedure

The pipeline shall be filled so the average velocity of flow is no greater than 2 fps. At no time shall the maximum velocity of flow exceed 2 fps. The following table is provided to relate the velocity filling rate to an equivalent volume flow rate.

FILLING RATES FOR 2 FPS VELOCITY	
Nominal Pipe Size (Inches)	Filling Rates to (gpm)
4	80
16	1,250
24	2,820

All air must be purged from the pipeline before checking for leaks or performing pressure tests on the system. To accomplish this, if air valves or other outlets are not available at high points, taps shall be made to expel the air, and these taps shall be tightly plugged after testing.

After the pipeline has been filled and allowed to sit a minimum of 48 hours (72 hours for mortar-lined pipelines), the pressure in the pipeline shall then be pumped up to the specified test pressure. If a large quantity of water is required to increase the pressure during testing, entrapped air, leakage at joints, or a broken pipe can be suspected. Tests must be discontinued until the source of trouble is identified and corrected.

The pipeline shall be subjected to a field hydrostatic pressure of 100 psi or 50 psi in excess of the anticipated working pressure of the pipe being tested whichever is greater, for a period of four hours.

Allowable Leakage

When the test pressure has been reached, pumping shall be discontinued until the pressure in the line has dropped 25 psi, at which time the pressure shall again be pumped up to the specified test pressure. This procedure shall be repeated until four hours have elapsed from the time the specified test pressure was first applied. At the end of the 4-hour period, the pressure shall be pumped up to the test pressure for the last time.

The leakage shall be considered as the total amount of water pumped into the pipeline during the four-hour period, including the amount required in reaching the test pressure for the final time. Leakage shall not exceed the rate in the table below. If the size, pipe material, or pressure fall outside of the table listed below, the leakage amount will be determined by the Engineer.

LEAKAGE ALLOWANCE		
Nominal Pipe Size (Inches)	Test Pressure (psi)	Allowable Leakage Gallons per four hours per 1,000 feet of pipe
4	100	.67
24	100	3.96

Flanged, welded, and grooved-end joints shall show zero leakage. The test period shall be four hours for 24-inches in diameter and smaller pipe.

Repetition of Test

Any noticeable leak shall be stopped and all defective pipe, fittings, valves and other accessories discovered in consequence of the test shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until the total leakage during a test of 4 hours duration does not exceed the rate specified above.

MEASUREMENT AND PAYMENTS

Full compensation for conforming to these special provisions shall be considered as included in the contract prices paid for the various items of work involved, and no additional compensation will be allowed.

10-1.109 SLOPE PAVING

Slopes under the ends of bridges, where shown on the plans, shall be paved in conformance with the provisions in Section 72-6, "Slope Paving," of the Standard Specifications and these special provisions.

The location of construction joints shall be subject to the approval of the Engineer. Placement of slope paving shall be scheduled so that the work, including placement, finishing, and application of curing, is completed in any section bounded by permissible construction joints on the same day that the work is started in that section.

Prior to placing the permanent slope paving, the Contractor shall construct a test panel at least 4' x 6' at the site for approval by the Engineer. The test panel shall be constructed of the same materials as are proposed for the permanent work and shall be finished and cured as specified for the permanent work. Additional test panels shall be constructed as necessary until a panel is produced which conforms to the requirements herein, before constructing other slope paving.

10-1.110 GABION (AUSTIN VAULT)

Gabion (austin vault) shall be constructed as shown on the plans and in conformance with these special provisions.

Gabion (austin vault) shall consist of wire mesh, cubical-celled or mattress-styled baskets that are filled on the project site with hard, durable rock.

Standard gabion sizes and the overall plan and profile dimensions of the gabion structures shall be as shown on the plans. Each standard gabion size shall be divided into 36-inch long cells by diaphragm panels. The width, height or length of the standard gabions shall not vary more than 5 percent from the dimensions specified in these special provisions or as shown on the plans.

Empty gabion baskets shall be assembled individually and joined successively. Individual gabion mesh panels (base, front, ends, back, diaphragms, and lid) and successive gabions shall be assembled so that the strength and flexibility along the joints is comparable to a single panel.

MATERIALS

All materials for the gabions and gabion assembly shall conform to the provisions in these special provisions. Each shipment of gabion baskets to the project site shall be accompanied by a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Mesh

At the Contractor's option, either twisted mesh or welded mesh shall be used, in conformance with Table 1 and Table 2 herein. For each standard gabion size, the same mesh style shall be used for the base, front, ends, back, diaphragms, and lid panels. Individual wires of either the twisted-mesh style or the welded-mesh style shall conform to the definitions and requirements in ASTM Designation: A 641/A 641M.

Mattress-style gabion baskets that are 12 inches and 18 inches high shall be manufactured from either 11-gage welded mesh or twisted mesh. Cubical-celled gabion baskets that are 36 inches high by 36 inches wide shall be fabricated from 11-gage twisted mesh or welded mesh gages between 11-gage and 9-gage, inclusive.

Table 1

CUBICAL-CELLED FACILITIES	
USA WIRE GAGE	MESH STYLE
11	Twisted Mesh
11 Min to 9 Max	Welded Mesh

Table 2

MATTRESS-STYLE FACILITIES	
USA WIRE GAGE	MESH STYLE
11	Twisted Mesh
11	Welded Mesh

GABION MESH MATERIAL PROPERTIES

Characteristic	Test Designation	Requirement
Minimum tensile strength	ASTM A 370	60 ksi
Wire Size	USA Steel Wire Gage	11
Wire Diameter (Minimum)	ASTM A 641/A 641M	0.120 in.
Galvanizing, Zinc	ASTM A 641/A 641M, Class 3 and ASTM A 90/A 90M	0.116 in. 0.80 oz/ft ²
Wire Size	USA Steel Wire Gage	9
Wire Diameter (Minimum)	ASTM A 641/A 641M	0.148 in.
Galvanizing, Zinc	ASTM A 641/A 641M, Class 3 and ASTM A 90/A 90M	0.144 in. 0.85 oz/ft ²

Twisted-mesh wires shall form a uniform hexagonal pattern and shall be formed with a nonraveling twist. The area of the hexagonal opening shall not exceed the dimensions shown on the plans. Twisted-mesh gabion panels shall be manufactured from 11 gage wires with 9 gage selvage wires.

Welded-mesh wires shall form a grid pattern as shown on the plans. Welds shall be made by resistance welding. Welds and panels shall conform to the requirements in ASTM Designation: A 185, except weld shears shall be 600 pounds minimum for 11 gage wires and 800 pounds minimum for 9 gage wires. Resistance welding after coating the wire with zinc will be acceptable if there are no large splashes, flakes or flashes of zinc at the weld.

Joints

Standard tie wire and standard spiral binder shall conform to the definitions and requirements in ASTM Designation: A 641/A 641M and shall conform to the following provisions:

Characteristic	Test Designation	Requirement
Minimum Tensile Strength	ASTM A 370	60 ksi
Tie Wire		
Wire Size (Minimum)	USA Steel Wire Gage	13.5
Wire Diameter (Minimum)	ASTM A 641/A 641M	0.086 in.
Zinc Coating	ASTM A 641/A 641M, Class 3 and ASTM A 90/A 90M	0.082 in. 0.70 oz/ft ²
Spirals		
Wire Size (Maximum)	USA Steel Wire Gage	9
Wire Diameter (Minimum)	ASTM A 641/A 641M	0.148 in.
Zinc Coating	ASTM A 641/A 641M, Class 3 and ASTM A 90/A 90M	0.144 in. 0.85 oz/ft ²

Spiral binders shall have a 3-inch separation between continuous, successive loops.

Alternative fasteners shall have the configurations, wire diameters, and other dimensions shown on the plans. Alternative fasteners shall conform to the definitions and requirements in ASTM Designation: A 764 for "Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs." Interlocking fasteners shall conform to Tensile Requirement Class I, Finish 2 and shall have a Class 3 zinc coating, Overlapping fasteners shall conform to Tensile Requirement Class II, Finish 1 and shall have a Class 3 zinc coating.

Internal Connecting Wire

Internal connecting wires shall be 13.5-gage minimum. Each wire shall conform to the minimum requirements for standard tie wire in these special provisions and shall be installed in conformance with the provisions in these special provisions and as shown on the plans. Alternatively, at the Contractor's option, preformed stiffeners may be substituted for internal connecting wires. Preformed stiffener wire shall meet the requirements specified for standard tie wire and shall be installed in conformance with these special provisions and the manufacturer's recommendations.

Rock Slope Protection Fabric

Rock slope protection fabric for use with gabions shall conform to the provisions for Class 8 fabric in Section 88-1.06, "Channel and Shore Protection," of the Standard Specifications and these special provisions.

Where gabions are used for downdrains, woven tape fabric shall be used in place of the rock slope protection fabric. The woven tape fabric shall conform to the requirements in ASTM Designation: D 4491, with a maximum permittivity of 7.5 gallons per minute per square foot.

Rock

Rock for filling gabions, which are greater than or equal to 18 inches in height, shall vary in size and shall conform to the following:

Screen Size (inches)	Percentage Passing
12	100
4	0-5

Rock for filling gabions, which are equal to 12 inches in height, shall vary in size and shall conform to the following:

Screen Size (inches)	Percentage Passing
8	100
4	0-5

Rock shall conform to the material provisions for rock slope protection in Section 72-2.02, "Materials," of the Standard Specifications.

The minimum unit weight of a rock-filled gabion shall be 110 pounds per cubic foot. Verification of the 110 pounds per cubic foot shall be performed when ordered by the Engineer. Verification shall be performed on the smallest standard gabion size to be used on the project. The rock supplied for the project shall be used for verification. Filling shall be done using the same method intended for actual construction. The weight of a rock-filled gabion shall be determined using available certified scales. The volume for calculating the unit weight shall be determined on the theoretical volume of the standard gabion which is rock-filled and weighed.

GRADING, EXCAVATION AND BACKFILL

Areas where gabions are to be placed shall be constructed to the lines and grades shown on the plans and as determined by the Engineer. Excavation or backfill for achieving the required grades shall conform to the provisions for structure excavation and backfill in Section 19, "Earthwork," of the Standard Specifications.

ROCK SLOPE PROTECTION FABRIC PLACEMENT

Rock slope protection fabric shall be placed in conformance with the provisions in Section 72-2.025, "Rock Slope Protection Fabric" of the Standard Specifications. Rock slope protection fabric shall be placed on the subgrade, backslope, and sides of excavations. If earth fill is to be placed over the gabions, rock slope protection fabric shall be placed on top of the gabions, before placing the earth fill.

CONSTRUCTION

Gabions shall be assembled individually as empty units. Each gabion shall be manufactured with the necessary panels, properly spaced and secured, so that the panels can be rotated into position at the construction site with no additional tying of the rotation joint. The panels and diaphragms shall be rotated into position and joined along the vertical edges.

For twisted mesh, the joint shall be constructed using alternating double and single half hitches (locked loops) of 13.5-gage standard tie wire at 4-inch nominal spacing. Joints shall not be constructed with simple spiraling (looping without locking) of the standard tie wires.

When standard tie wire is used as a joint connector for welded mesh, the joint shall be constructed using alternating double and single half hitches (locked loops) in every mesh opening along the joint. When 9 gage spiral binders are used, the spiral shall be placed so that the spiral binder passes through each mesh opening along the joint. Both ends of all 9 gage spiral binders shall be crimped to secure the spiral in place.

Temporary fasteners may be used to hold panels wherever gabion-to-gabion joints will be constructed. Temporary fasteners may remain in place.

At the Contractor's option, interlocking fasteners or overlapping fasteners may be used for assembly of either the twisted-mesh or welded-mesh gabions. A fastener shall be placed in each mesh opening along the joint (a minimum of 10 fasteners per 40 inches).

ASSEMBLY OF SUCCESSIVE GABION BASKETS (GABION-TO-GABION JOINTS)

Gabion baskets shall be set in place. Individually constructed gabion baskets shall then be joined successively to the next gabion baskets with 13.5-gage tie wire or 9 gage standard spiral binder before filling the basket with rock. The 13.5-gage standard tie wire or 9 gage standard spiral binder shall secure, in one pass, all selvage or end wires of the panels of all adjacent baskets along the joint.

When forming successive gabion-to-gabion joints with alternative fasteners, there shall be one alternative fastener in each mesh opening. The alternative fastener shall contain and secure all the wires along the joint.

Gabion baskets shall be joined along the front, back, and ends, including the tops and bottoms of the adjacent gabions.

ASSEMBLY OF MULTIPLE LAYERED GABIONS

Multi-layered gabion configurations shall be stepped and staggered as shown on the plans or as designated by the Engineer.

When constructing multi-layered gabion configurations, each layer of gabions shall be joined to the underlying layer along the front, back, and ends.

ASSEMBLY OF SHEAR KEY GABIONS

Shear key gabions, or counterforts, shall be spaced as shown on the plans. Shear key gabions shall be tied to adjacent gabions in the manner specified for "Assembly of Successive Gabion Baskets (Gabion-to-Gabion Joints)" of these special provisions.

ASSEMBLY OF TRANSITIONAL GABIONS

To match the geometry of the planned gabion configuration, or to meet specific conditions, panels shall be folded, cut and fastened as shown on the plans or as directed by the Engineer.

FILLING WITH ROCK

Before filling each gabion basket with rock, all kinks and folds in the wire fabric shall be straightened and all successive gabions shall be properly aligned.

Rock shall be placed in the baskets to provide proper alignment, avoid bulges in the wire mesh, and provide a minimum of voids. All exposed rock surfaces shall have a smooth and neat appearance. Sharp rock edges shall not project through the wire mesh.

Internal connecting wires or preformed stiffeners shall be used to produce a flat, smooth external surface, when constructing with 18-inch or 36-inch high gabions. If the Engineer determines that there is excessive bulging or dimpling of the outside panels, the unit shall be reconstructed at the Contractor's expense.

When filling 36-inch high gabions, rock shall be placed in 3 nominal 12-inch layers to allow placement of the 13.5-gage internal connecting wires. The wires shall be fastened as shown on the plans. Alternatively, preformed stiffeners may be installed at the one-third points in conformance with the recommendations of the manufacturer, to produce a smooth external surface.

When filling 18-inch high gabions, 2 nominal 9-inch layers of rock shall be placed to allow placement of a set of internal connecting wires or preformed stiffeners. The configuration of wires shall be similar to those used on the 36-inch high gabions, except there shall be only one set of internal connecting wires instead of the 2 sets of internal connecting wires or preformed stiffeners.

The last layer of rock shall slightly overfill the gabion baskets so that the lid will rest on rock when the lid is closed.

CLOSURE OF LIDS

Lids shall be tied along the front, ends, and diaphragms in conformance with the provisions in "Assembly of Successive Gabion Baskets (Gabion-to-Gabion Joints)" of these special provisions.

MEASUREMENT

Gabions will be measured by the cubic yard as determined from the dimensions shown on the plans or the dimensions directed by the Engineer and gabions placed in excess of these dimensions will not be paid for.

PAYMENT

The contract price paid per cubic yard for gabion (austin vault) shall include full compensation for furnishing all labor, materials (including gabion baskets, rock and rock slope protection fabric), tools, equipment, and incidentals, and for doing all the work involved in constructing gabions, complete, in place, including excavation and backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.111 MISCELLANEOUS CONCRETE CONSTRUCTION

Concrete curbs, driveways, gutters, island paving, sidewalks, textured paving, and curb ramps shall conform to the provisions in Section 73, "Concrete Curbs and Sidewalks," of the Standard Specifications and these special provisions.

Curb ramp detectable warning surface shall consist of raised truncated domes constructed or installed on curb ramps in conformance with the details shown on the plans and these special provisions. At the option of the Contractor, the detectable warning surface shall be prefabricated, cast-in-place, or stamped into the surface of the curb ramp. The color of the detectable warning surface shall be yellow conforming to Federal Standard 595B, Color No. 33538.

Prefabricated detectable warning surface shall be in conformance with the requirements established by the Department of General Services, Division of State Architect and be attached in conformance with the manufacturer's recommendations.

Cast-in-place and stamped detectable warning surfaces shall be painted in conformance with the provisions in Section 59-6, "Painting Concrete," of the Standard Specifications.

The finished surfaces of the detectable warning surface shall be free from blemishes.

Prior to constructing the cast-in-place or stamping the detectable warning surface, the Contractor shall demonstrate the ability to produce a detectable warning surface conforming to the details shown on the plans and these special provisions by constructing a 24" x 24" test panel.

The manufacturer shall provide a written 5-year warranty for prefabricated detectable warning surfaces, guaranteeing replacement when there is defect in the dome shape, color fastness, sound-on-cane acoustic quality, resilience, or attachment. The warranty period shall begin upon acceptance of the contract.

Full compensation for constructing or furnishing and installing curb ramp detectable warning surfaces shall be considered as included in the contract price paid per cubic yard for minor concrete (curb ramp) and no separate payment will be made therefor.

Aggregate for minor concrete (textured paving) shall conform to the grading specified for fine aggregate in Section 90-3.03, "Fine Aggregate Grading," of the Standard Specifications. Aggregate for grout shall conform to the following grading:

Sieve Sizes	Percentage Passing
No. 4	100
No. 8	90 - 100
No. 16	60 - 100
No. 30	35 - 70
No. 50	15 - 35
No. 100	2 - 15

Samples of the colors specified for textured paving are available for review by prospective bidders at the office of the Department of Transportation, District 7, 100 S Main St, 7th Floor, Los Angeles, California at the Landscape Architecture Department. Portland cement concrete closely conforming to the colors specified for textured paving are available through commercial concrete sources.

A sample of sufficient size, of each type and color of the textured paving, to demonstrate the textured paving, including color hardener, curing and finishing compounds, for both grouted and ungrouted finishes, shall be submitted to the Engineer for written approval.

Textured paving shall not be placed on the project prior to approval by the Engineer of the samples prepared and submitted by the Contractor. In the event more than one sample of each type and color of textured paving to be placed is required by the Engineer, each additional sample will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

Welded wire fabric, of the size and type shown on the plans and conforming to the provisions in Section 52, "Reinforcement," of the Standard Specifications, shall be placed in the textured paving areas as shown on the plans.

Aggregate base shall be Class 2 and shall conform to the provisions in Section 26, "Aggregate Bases," of the Standard Specifications.

The respective pattern types and colors of concrete for textured paving shall be placed at the locations shown on the plans, struck off and compacted until a layer of mortar is brought to the surface. The concrete shall be screeded to the required grade and cross section and floated to a uniform surface.

Floor color hardener shall be applied to the plastic surface of the concrete by the "dry-shake" method using a minimum of 60 pounds of hardener per 100 square feet. Hardener shall be applied in 2 applications, shall be wood-floated after each application, and shall be trowelled only after the final floating. The resultant color of the floor hardener shall closely conform to the colors specified on the plans for the respective areas.

The forming tools for the textured paving shall be applied to form the patterned surfaces while the concrete is still in the plastic stage of set.

Textured paving areas shall be cured by the curing compound method. The curing compound shall be curing compound (6) conforming to the provisions in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications.

The textured paving shall be grouted in the sidewalk areas shown on the plans. The grout shall be placed after initial curing of that portion of the textured paving. The grout shall be spread over the textured concrete surface and consolidated by methods recommended by the grout manufacturer and approved by the Engineer. Surplus grout shall be removed by a squeegee and damp burlap rag or by other approved methods before the curing seal is applied to the grouted areas.

Curing seal and other deleterious substances shall be removed from the impressions in the textured areas, to receive the grout, before the grout is placed. Cleaning and removal methods shall not stain or discolor those portions of the textured paving to remain exposed after grouting. Methods of cleaning the impressions in textured areas to be grouted shall be approved by the Engineer.

For payment purposes, the area in square feet of minor concrete (textured paving) will be determined from horizontal measurements of the finished textured paving, clarity

The contract price paid per square foot for minor concrete (textured paving) shall include full compensation for furnishing all labor, materials (including welded wire fabric, where required, and aggregate base), tools, equipment, and incidentals, and for doing all the work involved in constructing textured paving, including removal of asphalt concrete, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.112 MISCELLANEOUS METAL (AUSTIN VAULT)

Miscellaneous metal (austin vault) must conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Miscellaneous metal (austin vault) must conform to the requirements in Section 75-1.02 "Miscellaneous Iron and Steel," of the Standard Specifications and consist of the following items:

- A. Steel Ladders
- B. Steel Angles
- C. Stainless Steel Expansion Anchors
- D. Stainless Steel Components of Riser Support Brackets
- E. Steel Handrails
- F. Steel Trash Screen

Cast-in-place inserts must be the ferrule loop type.

Metal parts of concrete anchorage devices must be fabricated from stainless steel conforming to the requirements of ASTM Designation: A276, Type 316.

Miscellaneous metal (austin vault) will be measured and paid for by the pound in accordance with the Section 75-1.06, "Measurement," and 75-1.07, "Payment," of the Standard Specifications.

Miscellaneous metal (bridge) shall conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Miscellaneous metal (bridge) shall consist of the miscellaneous bridge metal items listed in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications and the following:

- A. 4" conduits
- B. 1/4" ballast restrainer steel cover plates and ballast restrainers
- C. Steel walkway assemblies (includes 3/8" stiffener, side and checker plates)

- D. ASTM F1554 Grade 55 anchor bolts
- E. Bearing pad restrainers
- F. ASTM A709 sole plates
- G. Sound wall cover plate

Full compensation for installing and painting sound wall cover plate including neoprene strip and anchors shall be considered as included in the contract price paid per pound for miscellaneous metal (bridge) and no additional compensation will be allowed therefor.

10-1.113 BRIDGE DECK DRAINAGE SYSTEM (RAILROAD)

Bridge deck drainage system (railroad) shall conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Self-tapping screws used for sleeve connections shall be hex-head stainless steel, installed in holes drilled to fit the self-tapping screws, conforming to the requirements of ASTM Designation: A 276, Type 304.

At the Contractor's option, fiberglass pipes and fittings with the same diameter and minimum bend radius as those shown on the plans may be substituted for welded steel pipe in deck drain systems.

Fiberglass pipe and fittings shall conform to the requirements in ASTM Designation: D 2996, and shall have a minimum short-term rupture strength of 30,000 psi. The adhesive type recommended by the manufacturer shall be used for joining pipe and fittings. Fiberglass pipe not enclosed in a box girder cell or encased in concrete shall be manufactured from ultraviolet-resistant resin pigmented with concrete-gray color, or be coated with a concrete-gray resin-rich exterior coating. Paint shall not be used. Fiberglass pipe treated with ultraviolet protection shall withstand a minimum of 2,500 hours of accelerated weathering when tested in conformance with the requirements in ASTM Designation: G 154. Lamps shall be UV-B (313 nm wavelength). The resting cycle shall be 4 hours of ultraviolet exposure at 140° F, and then 4 hours of condensate exposure at 120° F. After testing, the surface of the pipe shall exhibit no fiber exposure, crazing, or checking, and only a slight chalking or color change.

Support spacing for fiberglass pipe shall be the same as shown on the plans for welded steel pipe. Pipe supports shall have a width of not less than 1.5 inches.

A Certificate of Compliance for fiberglass pipe and fittings shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall include all laboratory test results conforming to the provisions specified herein.

For drainage piping NPS 8 or smaller, the Contractor shall have the option of substituting polyvinyl chloride (PVC) plastic pipe and fittings with the same diameter and minimum bend radius as shown on the plans for welded steel pipe, which is:

- A. Enclosed in a box girder cell and exposed for a length not greater than 20 feet within the cell, or
- B. encased in concrete.

The PVC plastic pipe and fittings shall be Schedule 40 conforming to the requirements of ASTM Designations: D 1785. The maximum support spacing for PVC plastic pipe shall be 6 feet.

Couplings used to connect PVC plastic pipe or fiberglass pipe to steel shall be threaded or flanged. The sleeve connections shown on the plans shall not be used for either PVC plastic pipe or fiberglass pipe.

If PVC plastic pipe or fiberglass pipe is substituted for welded steel pipe, the quantity of drainage piping will be computed on the basis of the dimensions and details shown on the plans, and no change in the quantities to be paid for will be made because of the use of PVC plastic pipe or fiberglass pipe.

For Buena Vista Street and Empire Avenue Underpasses install corrugated steel pipe deck drainage system as shown in the plans and in accordance with ASTM A798.

The contract price paid per linear foot for bridge deck drainage system (railroad) for Buena Vista Street and Empire Avenue underpasses shall include full compensation for furnishing all labor, materials (including half-round perforated corrugated steel drain pipe, steel pipe, bottom pans, non-perforated round corrugated steel drain pipes, all connections and closures, joints elbows, tools, equipment and incidentals, and for doing all work involved in constructing the deck drainage system, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for abandoning and installing new deck drains at Buena Vista-Winona UC, including concrete removal, coring hole, and furnishing and installing drain with pipe, shall be considered as included in the contract price paid for structural concrete bridge, and no separate payment will be allowed therefor.

10-1.114 MISCELLANEOUS METAL (RESTRAINER-CABLE TYPE)

Miscellaneous metal (restrainer-cable type) shall conform to the provisions for bridge joint restrainer units in Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications and these special provisions.

New concrete adjacent to restrainers shall be placed prior to installing restrainers.

Miscellaneous metal (restrainer-cable type) will be measured and paid for by the pound in the same manner specified for miscellaneous metal (restrainer) in Sections 75-1.06, "Measurement," and 75-1.07, "Payment," of the Standard Specifications.

10-1.115 HYDRODYNAMIC SEPARATOR

GENERAL

Summary

This work consists of furnishing and installing the hydrodynamic separator.

MATERIALS

General

The In-Line (Conventional) Hydrodynamic Separator has a 7,200 gallon storage capacity. The hydrodynamic separator has a treatment chamber diameter that shall not be less than 12 feet and the pipe invert to bottom of base slab shall not be less than 144 inches. The total capacity of the separator is 7,420 gallons. The dimensions of the separator shall not be less than what has been specified in the plans and these specifications.

The separator must remove oil and sediment from storm water during frequent wet weather events. It must treat a minimum of 75 to 90 percent of the annual runoff volume and be capable of removing 50 to 80 percent of the total suspended sediment load and more than 90 percent of floatable free oil. The separator must trap silt, clay size particles, and large particles. It must be installed underground as part of the storm system and be structurally designed for HS-20 minimum traffic loading at the surface, with the storage in the separator vertically oriented. The separator must be maintained from the surface via one access point.

The separator must be equipped with an internal high flow bypass that regulates the flow rate into the treatment chamber and conveys high flows directly to the outlet so the scour and re-suspension of material previously collected in the separator does not occur. External bypasses are not acceptable. The bypass area must be physically separated from the separation area to prevent mixing with the separator. The concrete separator is designed and manufactured in accordance with the ASTM C-478. The concrete joints are oil resistant, water tight and meet the design criteria according to ASTM C-443. In the concrete separator, a fiberglass (only) insert, bolted and sealed watertight to the inside of the bypass chamber, will divert low to normal storm water flows into the treatment chamber. A minimum of 12 inches of oil storage must be lined with fiberglass to provide secondary containment of hydrocarbon materials.

The difference between the separator inlet pipe elevation and the separator outlet pipe elevation must be 1 inch.

The separator must capture floating substance spills including free oil and must not be compromised by temporary backwater conditions (i.e., trapped pollutants must not be re-suspended and scoured from the separator during backwater conditions). The capabilities of the selected separator must be documented.

Concrete for the hydrodynamic separator shall be Class 520-C-2500 with Type V cement.

CONSTRUCTION

Excavation for the installation of the hydrodynamic separator shall conform to the Standard Specifications. Topsoil removed during the excavation of the separator must be stockpiled in designated areas and must not be mixed with subsoil or other materials.

Excavation must extend a minimum of 12 inches from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation is required. In areas with a high water table, continuous dewatering must be provided.

Backfill material must conform to the Standard Specifications. Backfill material must be placed in uniform layers not exceeding 12 inches in depth and compacted to Standard Specifications.

The concrete separator shall be installed in sections in the following sequence:

1. aggregate base
2. base slab
3. treatment chamber section(s)
4. transition slab (if required)
5. by-pass section
6. connect inlet and outlet pipes

7. riser section and/or transition slab (if required)
8. maintenance riser section(s) (if required)
9. frame and access cover

The precast base must be placed level at the specified grade. The entire base must be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, must be installed in accordance with the licensed precast concrete manufacturer's recommendations.

Adjustment of the separator can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets must be replaced.

Once the by-pass section has been attached to the lower treatment chamber, the inlet down pipe, and outlet riser pipe must be attached. Pipe installation instructions and required materials are provided with the insert.

Inlet and outlet pipes must be securely set into the by-pass chamber using grout, boots or pipe seals so that the structure is watertight. Boots are normally used and installed at the precast concrete plant prior to shipping. Boots are applicable for pipes with an outside diameter for up to 44-inches. Installation of boots must follow the manufacturer's recommendations.

The following procedure must be followed to attach the inlet and outlet pipes at the Separator:

1. Center the pipe in the boot opening.
2. Lubricate the outside of the pipe and inside of the boot if the pipe outside diameter is the same as the inside diameter of the boot.
3. Position the pipe clamp in the groove of the boot with the screw at the top.
4. Tighten the pipe clamp screw per manufacturer's requirement
5. On minimum outside diameter installations lift the boot such that it contacts the bottom of the pipe while tightening the pipe clamp to ensure even contraction of the rubber.
6. Move the pipe horizontally and/or vertically to bring it to grade.

Precast concrete adjustment units must set the frame and cover at the required elevation. The adjustment units must be laid in a dull bed of mortar with successive units being joined using sealant recommended by manufacturer. Frames for the cover must be set in full bed of mortar at the elevation specified. Orientation of the frame and cover must allow access to outlet riser pipe the oil inspection port.

Oil is removed through the 6-inch inspection/cleanout pipe and sediment is removed through the 24-inch diameter outlet riser pipe. Oil may be removed from the 24-inch opening if water is removed from the treatment chamber, lowering the oil level below the drop pipes.

The depth of sediment can be measured from the surface of the separator with a dipstick tube equipped with a ball valve (Sludge Judge). The recommended maintenance will be performed once the sediment depth exceeds 15 inches.

MEASUREMENT AND PAYMENT

The contract unit price paid for hydrodynamic separator shall include full compensation for furnishing all labor, tools, materials, equipment, and incidentals and for doing all the work involved in the installation of the hydrodynamic separator, complete in place, including excavation, backfill, compaction, as shown on the plans, as specified in these Special Provisions, and as directed by the Engineer.

10-1.116 CHAIN LINK WALK GATE

Chain link walk gates shall be Type CL-6 conforming to the provisions in Section 80, "Fences," of the Standard Specifications and these special provisions.

Gates shall be installed in existing fences at the locations shown on the plans. Gate installations shall be complete with gate post, latch post, concrete footings, braces, truss rods, and hardware. Gate and latch posts shall be braced to the next existing line post as shown on the plans.

At each gate location, an existing line post shall be removed and the new gate installed so that the gate is centered on the post hole of the removed post. Holes resulting from the removal of line posts shall be backfilled.

Gate mounting and latching hardware shall not contain open-end slots for the fastening bolts.

Chain link fabric for gates shall be of the same mesh size as the existing fence in which the gates are installed.

Openings made in existing fences for installation of gates shall be closed during the working day in which the openings are made and when work is not in progress. Temporary closures shall be made with the existing fence fabric or with additional 6-foot chain link fabric as directed by the Engineer.

Full compensation for making the openings in existing fences, for temporary closing of the openings (including furnishing additional fence fabric if necessary), and for new posts, footings, hardware, braces, and truss rods shall be

considered as included in the contract unit price paid for 4-foot chain link gate (Type CL-6) and no additional compensation will be allowed therefor.

10-1.117 MARKERS AND DELINEATORS

Markers and delineators shall conform to the provisions in Section 82, "Markers and Delineators," of the Standard Specifications and these special provisions.

Markers and delineators on flexible posts shall conform to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. Flexible posts shall be made from a flexible white plastic which shall be resistant to impact, ultraviolet light, ozone, and hydrocarbons. Flexible posts shall resist stiffening with age and shall be free of burns, discoloration, contamination, and other objectionable marks or defects which affect appearance or serviceability.

Retroreflective sheeting for metal and flexible target plates shall be the retroreflective sheeting designated for channelizers, markers, and delineators conforming to the requirements in ASTM Designation: D 4956-95 and in conformance with the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

10-1.118 INSTALL MEDIAN MILEAGE PANEL

Median mileage panels shall be installed at the locations as shown on the plans or where directed by the Engineer and in conformance with these special provisions.

Target plates will be furnished by the State as provided under "State-Furnished Materials" of these special provisions. Installation holes in target plates shall be drilled or punched by the Contractor, after determination of type of installation. Target plates shall have only the necessary holes for the specified installation indicated.

Appropriate letters and numerals shall be affixed to the target plates by the Contractor in conformance to the requirements in Section 82-1.04, "Marker Information," of the Standard Specifications.

Concrete anchorage devices for installing median mileage panels shall be cast-in-place or resin capsule type, conforming to the provisions of Section 75-1.03, "Miscellaneous Bridge Metal," and as shown on the plans.

Installing median mileage panels will be measured by the unit determined from actual count of median mileage panels in place.

The contract unit price paid for install median mileage panel shall include full compensation for furnishing all labor including the affixing of the appropriate letters and numerals to the target plates and providing traffic control necessary to allow accurate and safe determination of median mileage panel locations, materials (except State-furnished target plates), hardware, tools, equipment, and incidentals, and for doing all the work involved in installing median mileage panels as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.119 METAL BEAM GUARD RAILING

Metal beam guard railing shall be constructed in conformance with the provisions in Section 83-1, "Railings," of the Standard Specifications and these special provisions.

Attention is directed to "Order of Work" of these special provisions.

Line posts shall be wood. Blocks shall be wood.

ALTERNATIVE IN-LINE TERMINAL SYSTEM

Alternative in-line terminal system shall be furnished and installed as shown on the plans and in conformance with these special provisions.

The allowable alternatives for an in-line terminal system shall consist of one of the following or a Department approved equal.

- A. **TERMINAL SYSTEM (TYPE SKT)** - Terminal system (Type SKT) shall be a SKT 350 Sequential Kinking Terminal manufactured by Road Systems, Inc., located in Big Spring, Texas, and shall include items detailed for terminal system (Type SKT) shown on the plans. The SKT 350 Sequential Kinking Terminal can be obtained from the distributor, Universal Industrial Sales, P.O. Box 699, Pleasant Grove, UT 84062, telephone (801) 785-0505 or from the distributor, Gregory Highway Products, 4100 13th Street, S.W., Canton, OH 44708, telephone (330) 477-4800.
- B. **TERMINAL SYSTEM (TYPE ET)** - Terminal system (Type ET) shall be an ET-2000 PLUS (4-tube system) extruder terminal as manufactured by Trinity Industries, Inc., and shall include items detailed for terminal system (Type ET) shown on the plans. The ET-2000 PLUS (4-tube system) extruder terminal can

be obtained from the manufacturer, Trinity Industries, Inc., P.O. Box 99, 950 West 400S, Centerville, UT 84014, telephone (800) 772-7976.

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall certify that the terminal systems furnished conform to the contract plans and specifications, conform to the prequalified design and material requirements, and were manufactured in conformance with the approved quality control program.

Terminal systems shall be installed in conformance with the manufacturer's installation instructions and these requirements. Each terminal system installed shall be identified by painting the type of terminal system in neat black letters and figures 2 inches high on the backside of the rail element between system posts numbers 4 and 5.

For terminal system (Type ET) the steel foundation tubes with soil plates attached shall be, at the Contractor's option, either driven, with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. The wood terminal posts shall be inserted into the steel foundation tubes by hand and shall not be driven. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149° F or less. The edges of the wood terminal posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

For terminal system (Type SKT) the soil tubes shall be, at the Contractor's option, driven with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. Wood posts shall be inserted into the steel foundation tubes by hand. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149° F or less. The edges of the wood posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

Surplus excavated material remaining after the terminal system has been installed shall be disposed of in a uniform manner along the adjacent roadway where designated by the Engineer.

The contract unit price paid for alternative in-line terminal system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing alternative in-line terminal system, complete in place, including excavation, backfill and disposal of surplus material, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

ALTERNATIVE FLARED TERMINAL SYSTEM

Alternative flared terminal system shall be furnished and installed as shown on the plans and in conformance with these special provisions.

The allowable alternatives for a flared terminal system shall consist of one of the following or a Department approved equal.

- A. **TERMINAL SYSTEM (TYPE FLEAT)** - Terminal system (Type FLEAT) shall be a Flared Energy Absorbing Terminal 350 manufactured by Road Systems, Inc., located in Big Spring, Texas, and shall include items detailed for terminal system (Type FLEAT) shown on the plans. The Flared Energy Absorbing Terminal 350 can be obtained from the distributor, Universal Industrial Sales, P.O. Box 699, Pleasant Grove, UT 84062, telephone (801) 785-0505 or from the distributor, Gregory Highway Products, 4100 13th Street, S.W., Canton, OH 44708, telephone (330) 477-4800.
- B. **TERMINAL SYSTEM (TYPE SRT)** - Terminal system (Type SRT) shall be an SRT-350 Slotted Rail Terminal (8-post system) as manufactured by Trinity Industries, Inc., and shall include items detailed for terminal system (Type SRT) shown on the plans. The SRT-350 Slotted Rail Terminal (8-post system) can be obtained from the manufacturer, Trinity Industries, Inc., P.O. Box 99, 950 West 400S, Centerville, UT 84014, telephone (800) 772-7976.

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall certify that the terminal systems furnished conform to the contract plans and specifications, conform to the prequalified design and material requirements, and were manufactured in conformance with the approved quality control program.

Terminal systems shall be installed in conformance with the manufacturer's installation instructions and these requirements. Each terminal system installed shall be identified by painting the type of terminal system in neat black letters and figures 2 inches high on the backside of the rail element between system posts numbers 4 and 5.

For terminal system (Type SRT), the steel foundation tubes with soil plates attached shall be, at the Contractor's option, either driven, with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. The wood terminal posts shall be inserted into the steel foundation tubes by hand and shall not be driven. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149° F or less. The edges of the wood terminal posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

For terminal system (Type FLEAT), the soil tubes shall be, at the Contractor's option, driven with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. Wood posts shall be inserted into the steel foundation tubes by hand. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149° F or less. The edges of the wood posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

Surplus excavated material remaining after the terminal system has been installed shall be disposed of in a uniform manner along the adjacent roadway where designated by the Engineer.

The contract unit price paid for alternative flared terminal system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing alternative flared terminal system, complete in place, including excavation, backfill and disposal of surplus material, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.120 CHAIN LINK RAILING

Chain link railing shall conform to the provisions in Section 83-1, "Railings," of the Standard Specifications and these special provisions.

The chain link fabric shall be 9-gage (0.148-inch diameter), Type IV, Class B, bonded vinyl coated fabric, conforming to the requirements in AASHTO Designation: M 181.

The strength of the bond between the coating material and steel of the bonded vinyl coated chain link fabric shall be equal to or greater than the cohesive strength of the polyvinyl chloride (PVC) coating material.

10-1.121 TUBULAR HANDRAILING

Handrailing shall conform to the provisions in Section 83-1, "Railings," of the Standard Specifications and these special provisions.

Handraining shall be galvanized after fabrication. Galvanizing shall conform to the provisions in Section 75-1.05, "Galvanizing," of the Standard Specification.

10-1.122 CONCRETE BARRIER

Concrete barriers shall conform to the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

If reinforcement is encountered during drilling before the specified depth is attained, the Engineer shall be notified. Unless the Engineer approves coring through the reinforcement, the hole will be rejected and the Contractor shall drill a new hole adjacent to the rejected hole to the depth shown on the plans.

10-1.123 TRANSITION RAILING (TYPE WB)

Transition railing (Type WB) shall be furnished and installed in conformance with details shown on the plans, the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

The 10-gage rail elements shall conform to the requirements of Class B, Type 1 thrie beam guard railing as shown in AASHTO Designation: M 180. End caps shall conform to the requirements of Class A, Type 1 thrie beam guard railing as shown in AASHTO Designation: M 180.

The contract unit price paid for transition railing (Type WB) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing transition railing (Type WB), complete in place, including drilling holes for wood posts, driving posts, backfill, and disposal of surplus material, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.124 CRASH CUSHION (REACT)

Crash cushion (REACT) shall be furnished and installed as shown on the plans and in conformance with the provisions in the Standard Specifications and these special provisions.

Crash cushion (REACT) shall be a multiple recoverable type, manufactured by Energy Absorption Systems, Inc. Crash cushion (REACT) and additional components shall conform to the descriptions as follows:

Contract Item Description	Manufacturer's Product Description
Crash Cushion (REACT 9CBB)	REACT 350.9 Concrete Side Mount

The successful bidder can obtain from the following distributors the crash cushion (REACT) manufactured by Energy Absorption Systems, Inc. at 35 East Wacker Drive, Suite 1100, Chicago, IL 60601:

1. Northern California: Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828, telephone (800) 884-8274, FAX (916) 387-9734
2. Southern California: Traffic Control Service, Inc., 1818 E. Orangethorpe, Fullerton, CA 92831-5324, telephone (800) 222-8274, FAX (714) 526-9501

The price quoted by the manufacturer for Crash Cushion (REACT 9CBB), FOB Pell City, Alabama is \$32,000, not including freight fee and sales tax.

The above prices will be firm for orders placed within 30 days of contract award, and provided delivery is accepted within 90 days after the order is placed.

The price quoted for crash cushion (REACT 9CBB) includes the concrete anchorage devices, but does not include the concrete anchor slab or the concrete backup block.

Crash cushion shall be installed in conformance with the manufacturer's recommendations.

Concrete anchorage devices used for attaching the crash cushion to the base slab shall be limited to those which have been provided by the manufacturer.

The concrete anchor slab and backup block shall conform to the provisions in Section 51, "Concrete Structures," and Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

The concrete anchor slab and backup block shall be constructed of concrete containing not less than 590 pounds of cementitious material per cubic yard.

The Contractor shall furnish the Engineer one copy of the manufacturer's plan and parts list for each model installed.

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall certify that crash cushion conforms with the contract plans and specifications, and conforms to the prequalified design and material requirements.

Crash cushion will be measured by the unit as determined from actual count in place in the completed work.

The contract unit prices paid for crash cushion (REACT 9CBB) shall include full compensation for furnishing all labor, materials (including anchor bolts, nuts, washers, and marker panels), tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing the crash cushions, complete in place, including structure excavation, structure backfill, and concrete anchor slab and backup block with bar reinforcing steel, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.125 THERMOPLASTIC TRAFFIC STRIPE AND PAVEMENT MARKING

Thermoplastic traffic stripes (traffic lines) and pavement markings shall be applied in conformance with the provisions in Section 84, "Traffic Stripes and Pavement Markings," of the Standard Specifications and these special provisions.

For each batch of thermoplastic material for traffic stripes and pavement markings, the Contractor shall submit to the Engineer:

1. Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications
2. Department's Materials Engineering and Testing Services notification letter stating that the material is approved for use
3. Material Safety Data Sheet

Thermoplastic material shall be free of lead and chromium, and shall conform to the requirements in State Specification PTH-02ALKYD.

Within 14 days of applying a thermoplastic traffic stripe or pavement marking, the retroreflectivity of the traffic stripe or pavement marking shall be a minimum of 250 millicandelas per square meter per lux for white, and 150 millicandelas per square meter per lux for yellow. The Contractor shall test the retroreflectivity under ASTM E 1710.

Where striping joins existing striping, as shown on the plans, the Contractor shall begin and end the transition from the existing striping pattern into or from the new striping pattern a sufficient distance to ensure continuity of the striping pattern.

Thermoplastic traffic stripes shall be applied at the minimum thickness and application rate as specified below. The minimum application rate is based on a solid stripe of 4 inches in width.

Minimum Stripe Thickness (inch)	Minimum Application Rate (lb/ft)
0.098	0.34

Thermoplastic traffic stripes and pavement markings shall be free of runs, bubbles, craters, drag marks, stretch marks, and debris.

At the option of the Contractor, permanent traffic striping and pavement marking tape conforming to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions may be placed instead of the thermoplastic traffic stripes and pavement markings specified herein. Permanent tape, if used, shall be installed in conformance with the manufacturer's specifications.

If permanent tape is placed instead of thermoplastic traffic stripes and pavement markings, the tape will be measured and paid for by the linear foot as thermoplastic traffic stripe and by the square foot as thermoplastic pavement marking.

10-1.126 PAINT TRAFFIC STRIPE AND PAVEMENT MARKING

Painted traffic stripes (traffic lines) and pavement markings shall be applied in conformance with the provisions in Section 84, "Traffic Stripes and Pavement Markings," of the Standard Specifications and these special provisions.

For each batch of paint for traffic stripes and pavement markings, the Contractor shall submit to the Engineer:

1. Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications
2. Department's Materials Engineering and Testing Services notification letter stating that the material is approved for use
3. Material Safety Data Sheet

Traffic stripe and pavement marking paint shall conform to the requirements in State Specification No. PTWB-01.

The color of the painted traffic stripes and pavement markings shall conform to the requirements in ASTM Designation: D 6628-01.

Within 14 days of applying a painted traffic stripe or painted pavement marking, the retroreflectivity of the traffic stripe or pavement marking shall be a minimum of 250 millicandelas per square meter per lux for white, and 150 millicandelas per square meter per lux for yellow. The Contractor shall test the retroreflectivity under ASTM E 1710.

At the option of the Contractor, permanent traffic striping and pavement marking tape conforming to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions may be placed instead of painted traffic stripes and pavement markings. Permanent tape, if used, shall be placed in conformance with the manufacturer's specifications.

If permanent tape is placed instead of painted traffic stripes and pavement markings, the tape will be measured and paid for by the linear foot as paint traffic stripe and by the square foot as paint pavement marking of the number of coats designated in the Bid Item List.

10-1.127 PAVEMENT MARKERS

Pavement markers shall be placed in conformance with the provisions in Section 85, "Pavement Markers," of the Standard Specifications and these special provisions.

Attention is directed to "Traffic Control System For Lane Closure" of these special provisions regarding the use of moving lane closures during placement of pavement markers with bituminous adhesive.

The Contractor shall furnish the Engineer certificates of compliance for the pavement markers in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Retroreflective pavement markers shall be marked as abrasion resistant on the body of the markers.

10-1.128 PAINTING AND COATING

GENERAL

Summary

This work consists of materials and application of painting and coating systems for submerged metal surfaces, exposed metal surfaces, buried metal surfaces, and metal surfaces in contact with concrete related only with pumping station construction.

Submittals

Submit manufacturer's data sheets showing the following information:

1. Recommended surface preparation.
2. Minimum recommended dry-film thicknesses per coat for prime, intermediate, and finish coats.
3. Percent solids by volume.
4. Recommended thinners.
5. Statement that the selected prime coat is recommended by the manufacturer for use with the selected intermediate and finish coats.
6. Application instructions including recommended application, equipment, humidity, and temperature limitations and Material Safety Data Sheets (MSDS).
7. NSF or UL certifications of coatings for use in potable water supply systems.
8. Volatile Organic Compound (VOC) limitations

Submit certification that all coatings conform to South Coast Air Quality Management District Rules and Regulations for products and application.

MATERIALS

Submerged Metal Coating Systems

System No. B-1--Submerged Metal, Raw Water or Raw Sewage

1. Type: Coal-tar epoxy having a minimum volume solids of 70%, conforming to MIL-P-23236.
2. Service Conditions: Shall be used on metal structures or pipes (such as tanks, clarifier mechanisms, scum troughs, slide gates and other miscellaneous metal) submerged in raw water or raw sewage.
3. Surface Preparation: SSPC SP-10
4. Prime Coat: Apply to a dry-film thickness of 8 mils:

Kop-coat Bitumastic 300-M;
Ameron Amercoat 78 HB;
Tnemec 46H-413;
International Intertuf 132;
or equal.

5. Finish Coat: Apply same as prime coat to give a total dry-film thickness of 16 mils.

System No. B-2--Submerged Metal, Potable Water

1. Type: Two part epoxy-polyamide having a minimum volume solids content of $54 \pm 2\%$, or two-part amido-amine epoxy having a minimum volume solids content of 83%.
2. Service Conditions: Shall be used on structural steel, tank interiors and piping exposed to fresh potable water.
3. Performance Requirement: Coating materials used in conjunction with potable water supply systems shall be listed by the NSF International as in compliance with NSF Standard 61 or certified to UL 3P83.
4. Surface Preparation: SSPC SP-10

5. Prime Coat: Apply to a dry-film thickness of 5 mils:

Tnemec Series 20, or 140 Pota Pox;
Kop-coat 340 Gold Primer;
Ameron Amerlock 400 Epoxy;
International Interline 785 HS;
or equal.

6. Finish Coats: Two coats of 5 mil dry-film thickness for each coat:

Tnemec Series 20, or 140 Pota Pox;
Kop-coat Super Hi-gard Epoxy;
Ameron Amerlock 400 Epoxy;
International Interline 785 HS;
or a total dry-film thickness of system equal to 15 mils.

Exposed Metal Coating Systems

System No. C-1--Exposed Metal, Severely Corrosive Environment

1. Type: Inorganic zinc prime coat with polyamide cured epoxy paint finish coat.
2. Service Conditions: Shall be used on metal structures, piping, fittings, and appurtenances subjected to continuous water condensation, or occasional immersion or splashing.
3. Surface Preparation: SSPC SP-10.
4. Prime Coat: Two-component inorganic zinc rich primer recommended by the manufacturer to be coated with polyamide epoxy paint finish coating. Minimum zinc content shall be 14 pounds per gallon. Apply to a dry-film thickness of 3 mils.
5. Products:

Kop-coat Carbo Zinc II HS;
Ameron Dimetcote 9;
Tnemec 90-96 Tneme-Zinc;
International Interzinc 437 WB;
or for contracts between District and Contractor, approved equal.

6. Intermediate Coat: Apply to a dry-film thickness of 3 mils:

Kop-coat Super Hi-gard Epoxy;
Ameron Amerlock 400 Epoxy;
Tnemec 69 Hi-build Epoxoline II;
International Interseal 670 HS;
or for contracts between District and Contractor, approved equal.

7. Finish Coat: Two coats of 4 mil dry-film thickness for each coat:

Kop-coat Hi-gard;
Ameron Amerlock 400 Epoxy;
Tnemec Series 69 Hi-build Epoxoline II;
International Interseal 670 HS;
or equal.

System No. C-2--Exposed Metal, Atmospheric Weathering Environment

1. Type: Aliphatic Polyurethane having a minimum volume solids content of 73% with amido-amine epoxy primer.
2. Service Conditions: Shall be used on exterior steel and piping, fittings, and appurtenances subject to sunlight and weathering.
3. Surface Preparation: SSPC SP-6.

4. Prime Coat: Apply to a dry-film thickness of 5 mils:

Ameron Amerlock 400 Epoxy;
Tnemec Series 135 Chembuild;
International Interseal 670 HS,
or equal.
Minimum volume solids shall be 75%.

5. Finish Coats: One coat of 5 mil dry-film thickness:

Ameron Amershield;
Tnemec Series 75 Endura-shield;
International Interthane 870;
or a total dry film thickness of system equal to 10 mils.

System No. C-3--Exposed Non-ferrous Metal and Galvanized Steel

1. Type: High solids epoxy coating having a minimum volume solids of 83%, with aliphatic polyurethane finish coat having a minimum volume solids of 73%.
2. Service Conditions: Shall be used to coat non-ferrous and galvanized steel pipe, fittings, and appurtenances.
3. Surface Preparation: SSPC SP-1. Aluminum and galvanized surfaces shall be brush blasted or acid etched to provide an etched surface prior to application of prime coat.
4. Prime Coat: Apply to a dry-film thickness of 5 mils:

Tnemec Series 135 ChemBuild;
Ameron Amerlock 400 Epoxy;
International - no primer required;
or for contracts between District and Contractor, approved equal.

5. Finish Coat: Apply to a dry-film thickness of 5 mils:

Tnemec Series 75 Endura-Shield;
Ameron Amershield;
International Interthane 870;
or equal.

Buried Metal Coating Systems

System No. D-1--Buried Metal, Corrosive Groundwater Exposure

1. Type: Coal-tar epoxy having a minimum volume solids of 78% and complying with MIL-P-23236.
2. Service Conditions: Shall be used to coat buried metal (flanges, bolts and nuts, fittings, flexible pipe couplings, structural steel etc.) especially subject to corrosive groundwater (low pH, high sulfate and chloride concentrations.)
3. Surface Preparation: SSPC SP-10.
4. Prime Coat: Apply to a dry-film thickness of 8 mils:

Kop-coat 300-M;
Ameron Amercoat 78 HB;
Tnemec 46H-413 Tneme-Tar;
International Intertuf 132;
or equal.

5. Finish Coats: Two coats of 8 mils dry-film thickness for each coat:

Kop-coat 300-M;
Ameron Amercoat 78 HB;
Tnemec 46H-413 Tneme-Tar;
International Intertuf 132;
or equal.

Coating System for Metal in Contact with Concrete

System No. E-1--Aluminum and Concrete Insulation

1. Type: Bituminous paint having a minimum volume solids of 68% coal-tar pitch based.
2. Service Conditions: Shall be used to coat areas of aluminum grating, gates, stairs, or structural members in contact with concrete.
3. Surface Preparation: SSPC SP-1.
4. Prime Coat: Apply synthetic resin wash primer (phosphoric acid or vinyl butyral acid) to surface as prime coat. Products:

Kop-coat 40 Passivator;
Tnemec 32-1210;
International - no primer required;
or equal.

5. Finish Coats: Two coats of 12 mil dry-film thickness each coat:

Kop-coat Bitumastic Super Service Black;
Tnemec 46-465 Tnemecol;
International Intertuf 100;
or equal.

Air Quality Requirements

Materials shall comply with South Coast Air Quality Management District's Rule 1107 for shop coating and Rule 1113 for field coating.

EXECUTION

Surface Preparation

General: Sandblast or prepare only as much surface area as can be coated in one day. All sharp edges, burrs, and weld spatter shall be removed. Epoxy coated pipe that has been factory coated shall not be sandblasted.

SSPC Specifications: Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," or "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structures Painting Council, Surfaces Preparation Specifications, ANSI A159.1) specifications listed below:

SP-1	Solvent Cleaning
SP-2	Hand Tool Cleaning
SP-3	Power Tool Cleaning
SP-5	White Metal Blast Cleaning
SP-6	Commercial Blast Cleaning
SP-7	Brush-Off Blast Cleaning
SP-8	Pickling
SP-10	Near White Blast Cleaning

The Contractor shall provide suitable enclosure, exhaust system, and bag house for sandblasting operations to prevent violations of applicable air quality requirements.

Painting Systems

All paints shall be delivered to the jobsite in the original, unopened containers. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

Paint Mixing

Multiple-component coatings shall be prepared using all the contents of each component container as packaged by the paint manufacturer. Partial batches shall not be used. Multiple-component coatings that have been mixed beyond their pot life shall not be used. Small quantity kits for touch-up painting and for painting other small areas shall be provided. Only the components specified and furnished by the paint manufacturer shall be mixed. For reasons of color or otherwise, additional components shall not be intermixed, even within the same generic type of coating.

Surfaces Not To Be Painted

Unless noted otherwise, the following surfaces shall not be painted and shall be fully protected when adjacent areas are painted:

1. Mortar-coated pipe and fittings
2. Stainless Steel
3. Metal letters
4. Nameplates and grease fittings
5. Aluminum grating
6. Brass and copper tubing, submerged
7. Buried pipe, unless specifically required in the piping specifications

Protection of Surfaces Not To Be Painted

Hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent paint materials from falling on or marring adjacent surfaces. Working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and painting process. Openings in motors shall be safely masked to prevent paint and other materials from entering the motors. All masking materials shall be completely removed and surfaces cleaned at completion of painting operations.

Surfaces To Be Coated

Surfaces shall be coated as described below:

1. Buried Items: Buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar from thrust blocks, and valve boxes shall be coated per System No. D-1 unless otherwise specified in the particular specifications for these items.

Definitions:

1. At Grade (AtG): Facilities that are flush with streets, sidewalks, parking lots, green belts or graded areas.
2. Above Grade/Exposed (AG/E): Pipelines and other facilities that are protruding through and are located above finished grade, out of doors and not enclosed by a shelter, cover, vault or housing.
3. Enclosed (E): Pipeline and other facilities that are located above or below grade and are enclosed within a shelter, covers, or vaults.

PAYMENT

Full compensation for painting and coating shall be considered as included in the contract prices paid per linear foot for ductile iron pipes and no additional compensation will be allowed therefor.

SECTION 10-2 HIGHWAY PLANTING AND IRRIGATION SYSTEMS

10-2.01 GENERAL

The work performed in connection with highway planting and irrigation systems shall conform to the provisions in Section 20, "Erosion Control and Highway Planting," of the Standard Specifications and these special provisions.

The Contractor shall notify the Engineer not less than 72 hours prior to requiring initial access to the existing irrigation controllers. When the Engineer determines that access to the controllers is required at other times, arrangements will be made to provide this access.

When fluctuations of water pressure and water supply are encountered during normal working hours, plants shall be watered at other times, as often, and in sufficient amounts as conditions may require to keep the soil and plant roots moist during the life of the contract.

Full compensation for watering plants outside normal working hours shall be considered as included in the contract lump sum prices paid for highway planting and plant establishment work and no additional compensation will be allowed therefor.

PROGRESS INSPECTIONS

Progress inspections will be performed by the Engineer for completed highway planting and irrigation system work at designated stages during the life of the contract.

Progress inspections will not relieve the Contractor of responsibility for installation in conformance with the special provisions, plans and Standard Specifications. Work within an area shall not progress beyond each stage until the inspection has been completed, corrective work has been performed, and the work is approved, unless otherwise permitted by the Engineer.

The requirements for progress inspections will not preclude additional inspections of work by the Engineer at other times during the life of the contract.

The Contractor shall notify the Engineer, in writing, at least 4 working days prior to completion of the work for each stage of an area and shall allow a minimum of 3 working days for the inspection.

Progress inspections will be performed at the following stages of work:

- A. During pressure testing of the pipelines on the supply side of control valves.
- B. During testing of low voltage conductors.
- C. Before planting begins and after completion of the work specified for planting in Section 20-4.03, "Preparing Planting Areas," of the Standard Specifications.
- D. Before plant establishment work begins and after completion of the work specified for planting in Section 20-4.05, "Planting," of the Standard Specifications.
- E. At intervals of one month during the plant establishment period.

COST BREAK-DOWN

The Contractor shall furnish the Engineer a cost break-down for the contract lump sum items of highway planting and irrigation system. Cost break-down tables shall be submitted to the Engineer for approval within 30 working days after the contract has been approved. Cost break-down tables will be approved, in writing, by the Engineer before any partial payment will be made for the applicable items of highway planting and irrigation system involved.

Attention is directed to "Time-Related Overhead" of these special provisions regarding compensation for time-related overhead.

Cost break-downs shall be completed and furnished in the format shown in the samples of the cost break-downs included in this section. Line item descriptions of work shown in the samples are the minimum to be submitted. Additional line item descriptions of work may be designated by the Contractor. If the Contractor elects to designate additional line item descriptions of work, the quantity, value and amount for those line items shall be completed in the same manner as for the unit descriptions shown in the samples. The line items and quantities given in the samples are to show the manner of preparing the cost break-downs to be furnished by the Contractor.

The Contractor shall determine the quantities required to complete the work shown on the plans. The quantities and their values shall be included in the cost break-downs submitted to the Engineer for approval. The Contractor shall be responsible for the accuracy of the quantities and values used in the cost break-downs submitted for approval.

The sum of the amounts for the line items of work listed in each cost break-down table for highway planting and for irrigation system work shall be equal to the contract lump sum price bid for Highway Planting and Irrigation System, respectively. Overhead and profit, except for time-related overhead, shall be included in each individual line item of work listed in a cost break-down table.

No adjustment in compensation will be made in the contract lump sum prices paid for highway planting and irrigation system due to differences between the quantities shown in the cost break-downs furnished by the Contractor and the quantities required to complete the work as shown on the plans and as specified in these special provisions.

Individual line item values in the approved cost break-down tables will be used to determine partial payments during the progress of the work and as the basis for calculating an adjustment in compensation for the contract lump sum items of highway planting and irrigation system due to changes in line items of work ordered by the Engineer. When the total of ordered changes to line items of work increases or decreases the lump sum price bid for either

Highway Planting or Irrigation System by more than 25 percent, the adjustment in compensation for the applicable lump sum item will be determined in the same manner specified for increases and decreases in the total pay quantity of an item of work in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications.

HIGHWAY PLANTING COST BREAK-DOWN

Contract No. 07-1218W4

UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
ROADSIDE CLEARING	LS	LUMP SUM		
MULCH	CY	5914		
PLANT (GROUP A)	EA	2888		
PLANT (GROUP B)	EA	293		
PLANT (GROUP F)	EA	16138		
PLANT (GROUP H)	EA	55307		
PLANT (GROUP I)	EA	1656		
PLANT (GROUP U)	EA	220		
COMMERICAL FERTILIZER (PACKETS)	EA	4867		
COMMERICAL FERTILIZER (SLOW RELEASE)	LB	598		
SOIL AMENDMENT	CY	284		

TOTAL _____

IRRIGATION SYSTEM COST BREAK-DOWN

Contract No. 07-1218W4

UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
CHECK AND TEST EXISTING IRRIGATION FACILITIES	LS	LUMP SUM		
12 STATION IRRIGATION CONTROLLER (WALL MOUNTED)	EA	2		
24 STATION IRRIGATION CONTROLLER (WALL MOUNTED)	EA	4		
IRRIGATION CONTROLLER ENCLOSURE CABINET	EA	3		
CONTROL AND NEUTRAL CONDUCTORS	LS	LUMP SUM		
1" ELECTRIC REMOTE CONTROL VALVE	EA	35		
1-1/2" ELECTRIC REMOTE CONTROL VALVE	EA	42		
2" ELECTRIC REMOTE CONTROL VALVE	EA	3		
3" ELECTRIC REMOTE CONTROL VALVE	EA	2		
3/4" PLASTIC PIPE (PR200) (SUPPLY LINE)	LF	18899		
1" PLASTIC PIPE (PR200) (SUPPLY LINE)	LF	5863		
1 1/4" PLASTIC PIPE (PR200) (SUPPLY LINE)	LF	6340		
1 1/2" PLASTIC PIPE (PR200) (SUPPLY LINE)	LF	3724		
2" PLASTIC PIPE (SCHEDULE 40) (SUPPLY LINE)	LF	12427		
3" PLASTIC PIPE (SCHEDULE 40) (SUPPLY LINE)	LF	3436		
4" PLASTIC PIPE (SCHEDULE 40) (SUPPLY LINE)	LF	380		
6" PLASTIC PIPE (SCHEDULE 40) (SUPPLY LINE)	LF	300		
1/2" PLASTIC FLEX PIPE (SUPPLY LINE)	LF	390		
5/8" PLASTIC FLEX PIPE (SUPPLY LINE)	LF	160		
3/4" PLASTIC FLEX PIPE (SUPPLY LINE)	LF	160		
1" PLASTIC FLEX PIPE (SUPPLY LINE)	LF	300		
3" GALVANIZED STEEL PIPE (SUPPLY LINE)	LF	150		
SPRINKLER (TYPE A-5)	EA	437		
SPRINKLER (TYPE B-5)	EA	434		
SPRINKLER (TYPE C-2)	EA	1090		

UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
1-1/2" BALL VALVE	EA	23		
2" GATE VALVE	EA	8		
3" GATE VALVE	EA	6		
1-1/2" PRESSURE REDUCING VALVE	EA	8		
RECYCLED WATER WARNING SIGNS	LS	LUMP SUM		
LOCATE EXISTING CROSSOVERS AND CONDUITS	LS	LUMP SUM		
IRRIGATION SYSTEM FUNCTIONAL TEST	LS	LUMP SUM		
REMOVE EXISTING IRRIGATION FACILITIES	LS	LUMP SUM		

TOTAL _____

10-2.02 EXISTING HIGHWAY PLANTING

In addition to the provisions in Section 20, "Erosion Control and Highway Planting," of the Standard Specifications, work performed in connection with existing highway planting shall conform to the provisions in "Existing Highway Facilities," of these special provisions.

10-2.03 EXISTING HIGHWAY IRRIGATION FACILITIES

The work performed in connection with the various existing highway irrigation system facilities shall conform to the provisions in "Existing Highway Facilities," of these special provisions.

Water shall be maintained in conformance with the provisions in Section 20-5.025, "Maintain Existing Water Supply," of the Standard Specifications.

LOCATE EXISTING CROSSOVERS AND CONDUITS

Existing crossovers and conduits shown on the plans to be incorporated in the new work shall be located in conformance with the provisions for locating conduits in Section 20-5.03B, "Conduit for Irrigation Crossovers," of the Standard Specifications.

Unless otherwise directed by the Engineer, existing crossovers and conduits shown on the plans to be incorporated in the new work shall be located prior to performing work on irrigation systems.

If debris is encountered in the ends of conduits, the debris shall be removed prior to performing other work in the conduits. Removal of debris within the first 3 feet in these conduits shall be at the Contractor's expense. If debris is encountered in the conduits more than 3 feet from the ends of the conduits, the additional debris shall be removed as directed by the Engineer and the removal work will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

CHECK AND TEST EXISTING IRRIGATION FACILITIES

Existing irrigation facilities that are to remain or to be relocated, and that are within those areas where clearing and grubbing or earthwork operations are to be performed, shall be checked for missing or damaged components and proper operation prior to performing clearing and grubbing or earthwork operations. Existing irrigation facilities outside of work areas that are affected by the construction work shall also be checked for proper operation.

A written list of existing irrigation system deficiencies shall be submitted to the Engineer within 5 working days after checking the existing facilities.

Deficiencies found during checking of the existing facilities shall be corrected as directed by the Engineer. Corrective work ordered by the Engineer will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

When existing irrigation facilities are checked, existing backflow preventers shall be tested for proper operation in conformance with the provisions in Section 20-5.03J, "Check and Test Backflow Preventers," of the Standard Specifications.

Existing backflow preventers shall be retested one year after the satisfactory completion of the previous test, and each year thereafter until the plant establishment period is completed. An additional test shall be provided not more than 10 days prior to acceptance of the contract.

Length of watering cycles for use of potable water from water meters for checking or testing existing irrigation facilities shall be as determined by the Engineer.

Additional repairs required for the existing irrigation system as ordered by the Engineer, except as otherwise provided for in "Maintain Existing Irrigation Facilities" of these special provisions, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

10-2.04 HIGHWAY PLANTING

The work performed in connection with highway planting shall conform to the provisions in Section 20-4, "Highway Planting," of the Standard Specifications and these special provisions.

HIGHWAY PLANTING MATERIALS

Mulch

Mulch must be green material and must comply with the following:

1. The mulch provider must be a compost producer and a participant in the United States Composting Council (USCC) Seal of Testing Assurance (STA) program.
2. The green material producer must be fully permitted as a compost producer in accordance with requirements of the California Department of Resources Recycling and Recovery, Local Enforcement Agencies (LEA) and any other State and Local Agencies that regulate solid waste facilities. If exempt from State permitting requirements, the composting facility must certify that it follows all guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.
3. Green material may be derived from any single or mixture of chipped, shredded, or ground vegetation; or clean processed recycled wood products.
4. Compost green materials such that weed seeds, pathogens and deleterious materials are reduced as specified under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3.
5. Green material must not contain paint, petroleum products, herbicides, fungicides or other chemical residues harmful to animal life or plant growth. Compost must possess no objectionable odors.
6. Metal concentrations in green material must not exceed the maximum metal concentrations listed in Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.
7. Green material must comply with the following table:

Physical and Chemical Requirements		
Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.5
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0–10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	N/A
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–100
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	N/A N/A
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO ₂ -C/g OM per day	N/A
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 3 99% 3/8 < 25% Max. Length 4 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

NOTE: TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

8. Before mulch application, submit a copy of the green material producer's Compost Technical Data Sheet and a copy of the compost producers STA certification. The Compost Technical Data Sheet must include laboratory analytical test results, directions for product use, and a list of product ingredients.
9. Before mulch application, submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Commercial Fertilizer (Slow Release)

Commercial fertilizer (slow release) shall be a pelleted or granular form, shall be slow or controlled release with a nutrient release over an 8-month to 12-month period, and shall fall within the following guaranteed chemical analysis range:

Ingredient	Percentage
Nitrogen	16-21
Phosphoric Acid	6-8
Water Soluble Potash	4-10

Commercial Fertilizer (Packets)

Commercial fertilizer (packet) shall be slow or controlled release and shall be in a biodegradable packet form. The packet shall gradually release nutrients over a 12-month period. Each packet shall have a weight of 10 g ± 1 g and shall have the following guaranteed chemical analysis:

Ingredient	Percentage
Nitrogen	20
Phosphoric Acid	10
Water Soluble Potash	5

ROADSIDE CLEARING

Before preparing planting areas and wild flower seeding areas, or commencing irrigation trenching operations for planting areas, trash and debris shall be removed from these areas as required under Construction Site Management of these special provisions.

The project area shall be cleared as specified herein:

- A. Existing plants, where shown on the plans to be removed, shall be removed and disposed of. Removal of existing trees and shrubs regardless of size shall be at ground level and include treating the remaining stumps and roots with an herbicide (stump killer) approved by the Engineer.
- B. Weeds shall be killed and removed within proposed ground cover areas and within the area extending beyond the outer limits of the proposed ground cover areas to the adjacent edges of shoulders, dikes, curbs, sidewalks, walls, existing planting and fences. At those locations where proposed ground cover areas are 12 feet or more from the adjacent edges of shoulders, dikes, curbs, sidewalks, walls, and fences, the clearing limit shall be 6 feet beyond the outer limits of the proposed ground cover areas.
- C. Weeds shall be killed and removed within proposed mulch areas and within the area extending beyond the outer limits of the proposed mulch areas to the adjacent edges of shoulders, dikes, curbs, sidewalks, walls, existing planting and fences. At those locations where proposed mulch areas are 12 feet or more from the adjacent edges of shoulders, dikes, curbs, sidewalks, walls, and fences, the clearing limit shall be 6 feet beyond the outer limits of the proposed mulch areas.
- D. Weeds shall be killed and removed within planting areas where plants are to be planted in groups or rows 15 feet or less apart and from within an area extending 6 feet beyond the outer limits of the groups or rows of plants.
- E. Weeds shall be killed and removed from within areas where asphalt concrete surfacing, portland cement concrete surfacing, rock blankets, graveled or decomposed granite areas are to be placed, and from within unpaved gore areas between the edge of pavement and planting areas as shown on the highway planting plans.

After the initial roadside clearing is complete, additional roadside clearing work shall be performed as necessary to maintain the areas, as specified above, in a neat appearance until the start of the plant establishment period. This work shall include the following:

- A. Trash and debris shall be removed.
- B. Rodents shall be controlled.
- C. Weed growth shall be killed before the weeds reach the seed stage of growth or exceed 6 inches in length, whichever occurs first, except for weeds in wild flower seeding areas to be mowed.
- D. Existing ground cover shall be killed and removed from within the 6-foot diameter areas specified for each proposed plant location within the existing ground cover areas.
- E. Weeds in plant basins, including basin walls, shall be removed by hand pulling, after the plants have been planted.

Weed Control

Weed control shall also conform to the following:

- A. Stolon type weeds shall be killed with glyphosate.
- B. Removed weeds and ground cover shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.
- C. At the option of the Contractor, weed growth in mowed areas may be controlled by growth regulators. Growth regulators shall be applied before weeds exceed 12 inches in height.

Roadside clearing work shall not include work required to be performed as clearing and grubbing as specified in Section 16, "Clearing and Grubbing," of the Standard Specifications.

PESTICIDES

Pesticides used to control weeds shall conform to the provisions in Section 20-4.026, "Pesticides," of the Standard Specifications. Except as otherwise provided in these special provisions, pesticide use shall be limited to the following materials:

Aminopyralid
Diquat
Dithiopyr
Clopyralid MEA
Fluazifop-P-Butyl
Flumioxazin
Glyphosate
Imazapyr
Isoxaben (Preemergent)
Oryzalin (Preemergent)
Oxyfluorfen (Non-odor type)
Pendimethalin (Preemergent)
Prodiamine (Preemergent)
Sethoxydim
Melfluidide (Growth regulator)

A granular preemergent may be used when applied to areas that will be covered with mulch, excluding plant basins. Granular preemergent shall be limited to the following material:

Oxadiazon

Granular preemergent shall be applied prior to the application of mulch. Mulch applications shall be completed in these areas on the same working day.

Glyphosate shall be used to kill stolon type weeds.

Prior to the application of preemergents, ground cover plants shall have been planted a minimum of 3 days and shall have been thoroughly watered.

A minimum of 100 days shall elapse between applications of preemergents.

Except for ground cover plants, preemergents shall not be applied within 18 inches of plants or within wild flower seeding areas.

Growth regulators shall not be applied within 6 feet of trees, shrubs or vines.

If the Contractor elects to request the use of other pesticides on this project, the request shall be submitted, in writing, to the Engineer not less than 15 days prior to the intended use of the other pesticides. Except for the pesticides listed in these special provisions, no pesticides shall be used or applied without prior written approval of the Engineer.

Pesticides shall not be applied within the limits of the plant basins. Pesticides shall not be applied in a manner that allows the pesticides to come in contact with the foliage and woody parts of the plants.

PREPARING PLANTING AREAS

Plants adjacent to drainage ditches shall be located so that after construction of the basins, no portion of the basin walls shall be less than the minimum distance shown on the plans for each plant involved.

PLANTING

Backfill material for plant holes must be a mixture of soil and soil amendment. The quantity of soil amendment shall be as shown on the Plant List. Thoroughly mix backfill material and uniformly distribute throughout the entire depth of the plant hole without clods and lumps.

Apply or place commercial fertilizer (granular and slow release) and iron sulfate at the time of planting and at the rates shown on the Plant List.

Place commercial fertilizer packets in the backfill of each plant at the time of planting and at the rate shown on the Plant List to within 6 inches to 8 inches of the soil surface and approximately one inch from the roots. When more than one fertilizer packet is required per plant, the packets must be distributed evenly around the root ball.

A granular preemergent must be applied to areas to be covered with mulch outside of plant basins.

Mulch placed in areas outside of plant basins shall be spread to a uniform depth of 4".

Spread mulch from the outside of the proposed plant basin to the adjacent edges of shoulders, dikes, curbs, sidewalks, walls, fences, and existing plantings. If the proposed plant material is 12 feet or more from the adjacent edges of shoulders, dikes, curbs, sidewalks, walls, fences, and other existing plantings, the mulch must be spread 6 feet beyond the outside edge of the proposed plant basins.

Do not place mulch within 4 feet of the centerline of earthen drainage ditches, within 4 feet of the edge of paved ditches, and within 4 feet of the centerline of drainage flow lines.

Attention is directed to "Irrigation Systems Functional Test" of these special provisions regarding functional tests of the irrigation systems. Do not perform planting in an area until the functional test has been completed for the irrigation system serving that area.

PLANT ESTABLISHMENT WORK

The plant establishment period shall be Type 2 and shall not be less than 250 working days.

Attention is directed to "Relief From Maintenance and Responsibility" in these special provisions regarding relief from maintenance and protection.

Commercial fertilizer (slow release) shall be applied to trees, shrubs, vines and ground cover not more than 5 days prior to the completion of the plant establishment period. Commercial fertilizer shall be applied at the rates shown on the plans and shall be spread with a mechanical spreader wherever possible.

The center to center spacing of replacement plants for unsuitable ground cover plants shall be determined by the number of completed plant establishment working days at the time of replacement and the original spacing in conformance with the following:

ORIGINAL SPACING (Inches)	SPACING OF REPLACEMENT GROUND COVER PLANTS (Inches)		
	Number of Completed Plant Establishment Working Days		
	1-125	126-190	191-End of Plant Establishment
9	9	6	6
12	12	9	6
18	18	12	9
24	24	18	12
36	36	24	18

Weeds within plant basins, including basin walls and ground cover, shall be controlled by hand pulling.

Weeds within mulched and ground cover areas and outside of plant basins shall be controlled by killing.

Vines shall be trained onto walls.

At the option of the Contractor, plants of a larger container size than those originally specified may be used for replacement plants during the first 125 working days of the plant establishment period.

After 125 working days of the plant establishment period have been completed, replacement of plants, except for ground cover plants, shall be one-gallon size for seedlings, pot and liner size plants; 5-gallon size for one-gallon size plants; 15-gallon size for 5-gallon size plants; and other plant replacement plants shall be the same size as originally specified.

When ordered by the Engineer, one application of a preemergent pesticide conforming to the provisions in "Pesticides" of these special provisions, shall be applied between 40 working days and 50 working days prior to completion of the plant establishment period. This work will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Wye strainers shall be cleaned at least 15 days prior to the completion of the plant establishment period.

The final inspection shall be performed in conformance with the provisions in Section 5-1.13, "Final Inspection," of the Standard Specifications and shall be completed a minimum of 20 working days before the estimated completion of the contract.

10-2.05 IRRIGATION SYSTEMS

Irrigation systems shall be furnished and installed in conformance with the provisions in Section 20-5, "Irrigation Systems," of the Standard Specifications, except materials containing asbestos fibers shall not be used.

Method A pressure testing shall conform to the provisions in Section 20-5.03H(1), "Method A", of the Standard Specifications, except leaks that develop in the tested portion of the system shall be located and repaired after each test period when a drop of more than 5 pounds per square inch is indicated by the pressure gage. After the leaks have been repaired, the one hour pressure test shall be repeated and additional repairs made until the drop in pressure is 5 pounds per square inch or less.

Pipe supply lines shall be pressure tested in conformance with the provisions in Section 20-5.03H, "Pressure Testing," of the Standard Specifications, except the pipe (supply line) on the discharge side of the control valve shall be tested by Method B as specified in Section 20-5.03H(2), "Method B," of the Standard Specifications.

Only pipeline trenches and excavation pits for supply lines being supplied from one water service point shall be open at one time. After pressure testing is complete, trenches and pits excavated for pipe supply lines, being supplied from one water service point, shall be backfilled prior to commencing excavations for pipe supply lines being supplied from another water service point.

VALVE BOXES

Valve boxes shall conform to the provisions in Section 20-2.24, "Valve Boxes," of the Standard Specifications, except as otherwise provided herein.

Covers for concrete valve boxes shall be glass fiber reinforced plastic, plastic, concrete, cast iron or steel. Cast iron and steel covers shall be hinged with brass hinge pins for valve boxes containing valves smaller than 2 inches.

Valve boxes shall be identified on the top surface of the covers by labels containing the appropriate abbreviation for the irrigation facility contained in the valve box as shown on the plans. Valve boxes that contain remote control valves shall be identified by the appropriate letters and numbers (controller and station numbers). Labels for valve boxes shall conform to the provisions in Section 20-5.03F, "Valves and Valve Boxes," of the Standard Specifications.

Label material shall be plate plastic.

BALL VALVES

Ball valves shall be furnished and installed as shown on the plans and in conformance with these special provisions.

Ball valves shall have a two-piece brass or bronze body, full port opening, and shall conform to the following:

Specification	Minimum Requirement
Non-shock cold water working pressure	400 psi
Seats	TFE (Teflon)
O-Ring Seals	TFE (Teflon)

Ball valves shall be of the same size as the pipeline which the valves serve, unless otherwise noted on the plans. Ball valves shall be installed in a valve box.

GATE VALVES

Gate valves shall be as shown on the plans and in conformance with the provisions in Section 20-2.28, "Gate Valves," of the Standard Specifications and these special provisions.

Gate valves, smaller than 3 inches in size, shall be furnished with a cross-handle.

Gate valves, 3 inches and larger in size, shall be flanged type gate valves. Pipe flanges used to connect plastic or metal pipe to gate valves shall be plastic or metal.

Gate valves shall have a solid bronze or brass wedge.

ELECTRIC AUTOMATIC IRRIGATION COMPONENTS

Irrigation Controllers

Irrigation controllers shall be single, solid-state independent controllers conforming to the following:

- A. Irrigation controllers shall be fully automatic and shall operate a complete 14-day or longer irrigation program.
- B. A switch or switches shall be provided on the face of the control panel that will turn the irrigation controller "on" or "off" and provide for automatic or manual operation. Manual operation shall allow cycle start at the desired station and shall allow activation of a single station.
- C. The watering time of each station shall be displayed on the face of the control panel.
- D. The irrigation controller and the low voltage output source shall be protected by fuses or circuit breakers.
- E. The irrigation controller mechanism, panel and circuit board shall be connected to the low voltage control and neutral conductors by means of plug and receptacle connectors located in the irrigation controller enclosure.
- F. Each station shall have a variable or incremental timing adjustment with a range of 720 minutes to a minimum of one minute.
- G. Irrigation controllers shall be capable of a minimum of 2 program schedules.
- H. Irrigation controllers shall have an output that can energize a pump start circuit or a remote control valve (master).
- I. When 2 or more irrigation controllers operate the same electric remote control valve (master), an isolation relay shall be provided and installed per the controller manufacturer's instructions.
- J. Irrigation controllers shall be manufactured by the same company.
- K. Where direct burial conductors are to be connected to the terminals strip, the conductors shall be connected with the proper size open-end crimp-on wire terminals. No exposed wire shall extend beyond the crimp of the terminal and the wires shall be parallel on the terminal strip.

Attention is directed to the provisions in "Electric Service (Irrigation)" of these special provisions regarding electrical power for irrigation controllers and irrigation controller enclosure cabinets.

Attention is directed to the provisions in "Booster Pumps" of these special provisions, regarding electrical power for irrigation controllers.

Electric Remote Control Valves

Electric remote control valves shall conform to the provisions in Section 20-2.23, "Control Valves," of the Standard Specifications and the following:

- A. Valves shall be brass, bronze construction.
- B. Valves shall be angle pattern (bottom inlet) or straight pattern (side inlet) as shown on the plans.

Pull Boxes

Pull box installations shall conform to the provisions in Section 20-5.027I, "Conductors, Electrical Conduits and Pull Boxes," of the Standard Specifications.

Conductors

Low voltage, as used in this section "Conductors," shall mean 36 V or less.

Low voltage control and neutral conductors in pull boxes and valve boxes, at irrigation controller terminals, and at splices shall be marked as follows:

- A. Conductor terminations and splices shall be marked with adhesive backed paper markers or adhesive cloth wrap-around markers, with clear, heat-shrinkable sleeves sealed over the markers.
- B. Non-spliced conductors in pull boxes and valve boxes shall be marked with clip-on, "C" shaped, white extruded polyvinyl chloride sleeves. Marker sleeves shall have black, indented legends of uniform depth with transparent overlays over the legends and "chevron" cuts for alignment of 2 or more sleeves.

Markers for the control conductors shall be identified with the appropriate number or letter designations of irrigation controllers and station numbers. Markers for neutral conductors shall be identified with the appropriate number or letter designations of the irrigation controllers.

New control and neutral conductors that are to replace existing control and neutral conductors shall be the same size and color as the existing control and neutral conductors being connected to.

The color of low voltage neutral and control conductor insulation, except for the striped portions, shall be homogeneous throughout the entire thickness of the insulation.

Insulation for conductors may be UL listed polyethylene conforming to UL44 test standards with a minimum insulation thickness of 41 mils for wire sizes 10AWG and smaller.

Relief from maintenance and responsibility for electric automatic irrigation components will be granted in conformance with "Relief from Maintenance and Responsibility" of these special provisions. Before the Engineer grants relief from maintenance and responsibility, the functional test specified in Section 20-5.027J, "Testing," of the Standard Specifications shall be satisfactorily completed, and the manufacturer's written instructions shall be provided to the Engineer on the use and adjustment of the installed irrigation controllers.

IRRIGATION CONTROLLER ENCLOSURE CABINET

Irrigation controller enclosure cabinets shall be constructed and equipment installed in the cabinets in conformance with the details shown on the plans, the provisions of Section 86-3.04A, "Cabinet Construction," of the Standard Specifications, and these special provisions.

Electric service shall be installed in accordance with "Electric Service (Irrigation)" of these special provisions.

Irrigation controller enclosure cabinets shall be provided with cross ventilation, roof ventilation or a combination of both. The ventilation shall not compromise the weather resistance properties of the irrigation controller enclosure cabinets and shall be fabricated by the manufacturer.

The anchorage arrangement shall be inside the cabinet as shown on the plans. Dimensions of the cabinet shall be suitable for the equipment to be installed as shown on the plans and specified in these special provisions.

Irrigation controller enclosure cabinet dimensions for double irrigation controller shall be 36 inches (Height) x 23 inches (Width) x 11 inches (Depth).

Irrigation controller enclosure cabinets shall be fabricated in conformance with the provisions in Section 86-3.04A, "Cabinet Construction," of the Standard Specifications.

Irrigation controller enclosure cabinets shall be fabricated of stainless steel.

Door locks for the irrigation controller enclosure cabinets shall be a removable-core mortise cam cylinder door lock that receives the State's lock core. The State's lock core is a "Best" construction core. Keys shall be removable from the locks in the locked position only. Door locks shall be installed in conformance with the manufacturer's written instructions and recommendations. Two keys for each door lock shall be delivered to the Engineer.

Mounting panels shall be fabricated of metal sheets with a minimum thickness of 10-gage for cold rolled steel or 3/16 inch for aluminum.

Mounting panels shall be fabricated of stainless steel metal sheets with a minimum thickness of 0.157 inch.

Inside of the doors shall have provisions for storage of the irrigation plans.

Solid-state automatic shut-off rain sensor units shall be installed for the irrigation controller enclosure cabinets. Rain sensor units shall automatically interrupt the master remote control valves when approximately 1/8 inch of rain has fallen. The irrigation system shall automatically be enabled again when the accumulated rainfall evaporates from the rain sensor unit collection cup. Rain sensor units shall be rated 24 V (ac) to 30 V (ac). Static charge protection shall be included to protect against lightning damage.

IRRIGATION SYSTEMS FUNCTIONAL TEST

Functional tests for the irrigation controllers and associated automatic irrigation systems shall conform to the provisions in Section 20-5.027J, "Testing," of the Standard Specifications and these special provisions.

Tests shall demonstrate to the Engineer, through one complete cycle of the irrigation controllers in the automatic mode, that the associated automatic components of the irrigation systems operate properly. If automatic components of the irrigation systems fail a functional test, these components shall be repaired at the Contractor's expense and the testing repeated until satisfactory operation is obtained.

Associated automatic components shall include, but not be limited to, remote control valves, and rain sensors.

Upon completion of work on an irrigation system, including correction of deficiencies and satisfactory functional tests for the systems involved, the plants to be planted in the area watered by the irrigation system may be planted provided the planting areas have been prepared as specified in these special provisions.

PIPE

Steel Pipe

Galvanized steel pipe supply lines installed between water meters and backflow preventer assemblies must be installed not less than 18 inches below finished grade, measured to the top of the pipe.

Plastic Pipe

Plastic pipe supply lines must be polyvinyl chloride (PVC) 1120 or 1220 pressure rated pipe with the minimum pressure rating (PR) shown on the plans.

Plastic pipe supply lines and fittings that are 3 inches or larger in diameter on the supply side of control valves must be the rubber ring gasket type, except when pressure rating (PR) 315 plastic pipe supply line is required.

Plastic pipe supply lines less than 3 inches in diameter must have solvent cemented type joints. Primers must be used on the solvent cemented type joints.

Plastic pipe supply lines (main) must have a minimum cover of 1.5 feet.

Plastic pipe supply lines downstream from the remote control valves for Type C sprinklers must have a minimum cover of 6 inches.

Fittings for plastic pipe supply lines with a pressure rating (PR) of 315 must be Schedule 80.

Recycled Water Supply Lines

New and exposed recycled water supply lines shall be marked with a permanently affixed purple warning tape bearing the continuous wording "CAUTION RECYCLED WATER." The tape shall be wrapped around the supply lines in a manner that produces a uniform and smooth fit, free of irregularities.

At the Contractor's option, purple colored polyvinyl chloride (PVC) supply lines may be used for recycled water supply lines in place of standard PVC supply line with affixed purple warning tape. Purple colored PVC supply lines shall conform to the following:

- A. Pipe shall be made of PVC 1120 with the minimum pressure ratings (PR) shown on the plans.
- B. Pipe shall conform to the requirements in one of the following Standards: ASTM Designation: D 1785, ASTM Designation: D 3139 and ASTM Designation: D 2241 or ASTM Designation: D 2672.
- C. Pipe shall have permanent wording "CAUTION RECYCLED WATER" in 2 rows, approximately 180 degrees apart, in the longitudinal direction of the pipe. The warning message shall be repeated every 24 inches continuously along the pipe.

THRUST BLOCK

Thrust blocks shall be installed in accordance with these special provisions. Thrust blocks shall be installed on the main supply line at all changes in direction and terminus run.

WATER METER

Water meters for the irrigation systems will be furnished and installed by the serving utility at the locations shown on the plans.

The Contractor shall make the arrangements and pay the costs and fees required by the serving utility.

The City of Burbank Water and Power has established a fee of \$5,000.00 for furnishing and installing a water meter. If, at the time of installation, this fee has been changed, the State will take a credit for the reduction in the fee, or the State will pay the difference for the increase in the fee. The credit or payment will be taken or paid on the first monthly progress payment made after the meter is installed. The Contractor shall furnish the Engineer with a copy of the invoice for the installation fee.

Attention is directed to Section 20-4.06, "Watering," of the Standard Specifications. The Contractor shall make the arrangements for furnishing and applying water until the water meters have been installed by the serving utility.

The quantity of water meters will be measured by the unit as determined from actual count in place.

The contract unit price paid for water meter shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing water meters, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

SPRINKLERS

Sprinklers shall conform to the type, pattern, material, and operating characteristics listed in the "Sprinkler Schedule" shown on the plans.

Flexible risers shall be ultraviolet (UV) resistant, brown in color and shall conform to the details shown on the plans.

Flow shutoff device on risers shall automatically and instantly stop the flow of water from a riser when the riser is broken on the downstream side of the device. The flow shutoff device shall be installed as recommended by the manufacturer of the device.

RECYCLED WATER WARNING SIGNS

Recycled water warning signs shall be furnished and installed at the locations shown on the plans, as specified in these special provisions, and as directed by the Engineer. Recycled water warning signs shall be affixed to the above ground irrigation facilities that use or are associated with recycled water.

Warning sign decals shall be commercially available, and shall include the following information: "Recycled Water, Do Not Drink" and the "Do Not Drink" drinking glass graphic symbol. Warning sign decals shall be UV fade resistant, purple in color with black text, manufactured from a flexible, vinyl based or flexible, vinyl based with mylar product. Warning sign decals shall be all-weather, self-adhesive with peel-off backs.

Aluminum sign plates shall be 1/16 inch aluminum.

Warning tags shall be purple, doubled sided, manufactured from polyurethane, incorporating an integral neck attachment and attachment hole. The attachment hole shall be capable of withstanding 178 pounds of pull out resistance. Tag lettering shall be hot-stamped in black and capable of withstanding outdoor usage. Warning tags shall include the following information: "Recycled Water, Do Not Drink" and the "Do Not Drink" drinking glass graphic symbol.

Warning signs on above ground irrigation facilities shall be placed in visible locations.

Warning sign decals shall be applied directly to clean smooth surfaces. The smooth surfaces shall be cleaned with alcohol, or an equivalent cleaner, before applying the decals.

Warning sign decals shall be applied directly to irrigation facilities with smooth surfaces or affixed to aluminum sign plates, which shall be attached to the various above ground irrigation facilities.

Warning sign decals or warning sign decals on aluminum sign plates shall be permanently affixed to backflow preventers, valve boxes, sprinkler risers, irrigation controller enclosure cabinets, gates, fences, and other irrigation facilities in conformance with the details shown on the plans.

Warning sign decals approximately 2.5 inches x 3 inches shall be permanently affixed to sprinkler risers.

A 4 inch x 4 inch warning sign decal shall be permanently affixed to irrigation controller enclosure cabinet doors, irrigation controller enclosures not in cabinets, backflow preventer assemblies, backflow preventer assembly enclosures, and valve box covers. Decals for valve box covers shall be affixed to aluminum sign plates and the plates affixed to the valve box cover with a silicon base adhesive. Decals for cabinets may be affixed to aluminum sign plates and the plates attached with commercial quality, cadmium plated, non-removable, self-tapping screws or commercial quality, cadmium plated bolts, nuts and washers.

A 12 inch x 12 inch warning sign decal on aluminum sign plate shall be permanently affixed to gates, fences and walls 5 feet above finished grade. Sign plates for gates and fences shall be attached with "S" hooks and "C" clips or 14-gage galvanized steel wire as shown on the plans. Sign plates for concrete walls or other rough surfaces shall be affixed with a silicon base adhesive.

Warning tags approximately 2 inch x 2 inch shall be attached to the remote control valves, remote control valves (master), inside the valve box in accordance with the manufacturers recommendations.

Marking underground pipe for recycled water shall conform to the provisions in "Pipe" of these special provisions.

FINAL IRRIGATION SYSTEM CHECK

A final check of existing and new irrigation facilities shall be performed not more than 40 working days and not less than 30 working days prior to acceptance of the contract.

The length of watering cycles using potable water measured by water meters for the final check of irrigation facilities will be determined by the Engineer.

Remote control valves connected to existing and new irrigation controllers shall be checked for automatic performance when the controllers are in automatic mode.

Unsatisfactory performance of irrigation facilities installed or modified by the Contractor shall be repaired and rechecked at the Contractor's expense until satisfactory performance is obtained, as determined by the Engineer.

Repair or replacement of existing irrigation facilities due to unsatisfactory performance shall conform to the provisions in "Existing Highway Irrigation Facilities" of these special provisions.

Nothing in this section "Final Irrigation System Check" shall relieve the Contractor of full responsibility for making good or repairing defective work or materials found before the formal written acceptance of the entire contract by the Director.

Full compensation for checking the irrigation systems prior to the acceptance of the contract shall be considered as included in the contract lump sum price paid for plant establishment work and no additional compensation will be allowed therefor.

SECTION 10-3. ELECTRICAL SYSTEMS

10-3.01 DESCRIPTION

Traffic signals and lighting, modify signal and lighting, interconnection conduit and cable, closed circuit television systems, changeable message sign systems, modify lighting and sign illumination, lighting (temporary), lighting (city street), electric service (irrigation), modify ramp metering systems, communication conduit, microwave vehicle detection system, sprinkler control conduit (bridge), and maintaining existing traffic management system elements during construction shall conform to the provisions in Section 86, "Electrical Systems," of the Standard Specifications and these special provisions.

Locations of sprinkler control conduit (bridge) installations are shown on the modify lighting and sign illumination plans.

Lighting equipment is included in the following structures:

- A. Burbank Boulevard Overcrossing Bridge No. 53-3057
- B. Empire Avenue Undercrossing Bridge No. 53-2920
- C. Victory Place Separation Bridge No. 53C-2171
- D. Buena Vista Street Undercrossing Bridge No. 53-1110

Communication conduit is included in the following structures:

- A. Burbank Boulevard Overcrossing Bridge No. 53-3057
- B. Empire Avenue Undercrossing Bridge No. 53-2920
- C. Buena Vista Street Undercrossing Bridge No. 53-1110

Sprinkler control conduit is included in the following structures:

- A. Burbank Blvd. Overcrossing Bridge No. 53-3057

Traffic signal work shall be performed at the following locations:

- A. Burbank Boulevard at Southbound On/Off Ramps
- B. Burbank Boulevard at Northbound On/Off Ramps
- C. Northbound Route 5 at Empire Avenue
- D. Southbound Route 5 at Empire Avenue
- E. Victory Place at Old Empire Avenue
- F. Northbound Route 5 at Buena Vista Street
- G. Victory Place at Lincoln Street

10-3.02 COST BREAK-DOWN

Cost break-downs shall conform to the provisions in Section 86-1.03, "Cost Break-Down," of the Standard Specifications and these special provisions.

The Engineer shall be furnished a cost break-down for each contract lump sum item of work described in this Section 10-3.

The cost break-down shall be submitted to the Engineer for approval within 15 days after the contract has been approved. The cost break-down shall be approved, in writing, by the Engineer before any partial payment for the items of electrical work will be made.

The cost break-down shall include the following items in addition to those listed in the Standard Specifications:

- A. Closed circuit television camera assemblies
- B. Communication pull box
- C. Splice vault
- D. Video transmitter/data transceiver.
- E. Video receiver/data transceiver
- F. Fiber optic traffic modem (FOTM)
- G. Fiber optic control modem (FOCM)
- H. Camera control modem (CCM)
- I. Fiber distribution unit (FDU)
- J. Video multiplexer

- K. Fiber optic cable
- L. Fiber optic splice closure
- M. Model 334-TV controller cabinet
- N. Local control unit (LCU)
- O. Microwave vehicle detection system
- P. Innerducts

10-3.03 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS

Traffic signal system shutdowns shall be limited to periods between the hours of 9:00 a.m. and 3:00 p.m. and 7:00 p.m. to 6:00 a.m.

CITY OF BURBANK LIGHTING SYSTEM

The Contractor shall notify the Engineer and the City of Burbank, Burbank Water and Power Naveed Sediq at (818) 238-3575 45 days prior to working, including modifying and removal, of existing City lighting systems.

10-3.04 MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION

Traffic Management System (TMS) elements include, but are not limited to ramp metering (RM) system, communication system, traffic monitoring stations, video image vehicle detection system (VIVDS), microwave vehicle detection system (MVDS), loop detection system, changeable message sign (CMS) system, extinguishable message sign (EMS) system, highway advisory radio (HAR) system, closed circuit television (CCTV) camera system, roadway weather information system (RWIS), visibility sensor, and fiber optic system.

Existing TMS elements, including detection systems, identified on the plans and located within the project limits shall remain in place and be protected from damage. If the construction activities require existing TMS elements to be nonoperational or off line, and if temporary or portable TMS elements are not shown on the plans, the Contractor shall provide for temporary or portable TMS elements. The Contractor shall receive the Engineer's approval on the type of temporary or portable TMS elements and installation method.

Before work is performed, the Engineer, the Contractor, and the Department's Traffic Operations Electrical representatives shall jointly conduct a pre-construction operational status check of all existing TMS elements and each element's communication status with the Traffic Management Center (TMC), including existing TMS elements that are not shown on the plans and elements that may not be impacted by the Contractor's activities. The Department's Traffic Operations Electrical representatives will certify the TMS elements' location and status, and provide a copy of the certified list of the existing TMS elements within the project limits to the Contractor. The status list will include the operational, defined as having full functionality, and the nonoperational components.

The Contractor shall obtain written approval from the Engineer at least 72 hours before interrupting existing TMS elements' communication with the TMC that will result in the elements being nonoperational or off line. The Contractor shall notify the Engineer at least 72 hours before starting excavation activities.

Traffic monitoring stations and their associated communication systems, which were verified to be operational during the pre-construction operational status check, shall remain operational on freeway/highway mainline at all times, except:

1. For a duration of up to 15 days on any continuous segment of the freeway/highway longer than 3 miles
2. For a duration of up to 60 days on any continuous segment of the freeway/highway shorter than 3 miles

If the construction activities require existing detection systems to be nonoperational or off line for a longer time period or the spacing between traffic monitoring stations is more than the specified criteria above, and temporary or portable detection operations are not shown on the plans, the Contractor shall provide provisions for temporary or portable detection operations. The Contractor shall receive the Engineer's approval on the type of detection and installation before installing the temporary or portable detection.

If existing TMS elements shown on the plans or identified during the pre-construction operational status check, except traffic monitoring stations, are damaged or fail due to the Contractor's activity, where the elements are not fully functional, the Engineer shall be notified immediately. If the Contractor is notified by the Engineer that existing TMS elements have been damaged, have failed or are not fully functional due to the Contractor's activity, the damaged or failed TMS elements, excluding structure-related elements, shall be repaired or replaced, at the Contractor's expense, within 24 hours. For a structure-related elements, the Contractor shall install temporary or portable TMS elements within 24 hours. For nonstructure-related TMS elements, the Engineer may approve temporary or portable TMS elements for use during the construction activities.

If fiber optic cables are damaged due to the Contractor's activities, the Contractor shall install new fiber optic cables from an original splice point or termination to an original splice point or termination, unless otherwise authorized in writing by the Engineer. Fiber optic cable shall be spliced at the splice vaults if available. The amount of new fiber optic cable slack in splice vaults and the number of new fiber optic cable splices shall be equivalent to the amount of slack and number of splices existing before the damage or as directed by the Engineer. Fusion splicing will be required.

The Contractor shall demonstrate that repaired or replaced elements operate in a manner equal to or better than the replaced equipment or as directed by the Engineer. If the Contractor fails to perform required repairs or replacement work, as determined by the Engineer, the State may perform the repair or replacement work and the cost will be deducted from monies due to the Contractor.

A TMS element shall be considered nonoperational or off line for the duration of time that active communications with the TMC is disrupted, resulting in messages and commands not transmitted from or to the TMS element.

The Contractor shall provide provisions for replacing existing TMS elements within the project limits, including detection systems, that were not identified on the plans or during the pre-construction operational status check that became damaged due to the Contractor's activities.

If the pre-construction operational status check identified existing TMS elements, then the Contractor, the Engineer, and the Department's Traffic Operations Electrical representatives shall jointly conduct a post construction operational status check of all existing TMS elements and each element's communication status with the TMC. The Department's Traffic Operations Electrical representatives will certify the TMS elements' status and provide a copy of the certified list of the existing TMS elements within the project limits to the Contractor. The status list will include the operational, defined as having full functionality, and the nonoperational components. TMS elements that cease to be functional between pre and post construction status checks shall be repaired at the Contractor's expense and as directed by the Engineer.

The Engineer will approve, in writing, the schedule for final replacement, the replacement methods and the replacement elements, including element types and installation methods before repair or replacement work is performed. The final TMS elements shall be new and of equal or better quality than the existing TMS elements.

PAYMENT

The contract lump sum price paid for maintaining existing traffic management system elements during construction shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in maintaining existing traffic management system elements as shown on the plans, specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

If no electrical work exists on the project and no TMS elements are identified within the project limits, the pre-construction operational status check will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Furnishing and installing temporary or portable TMS elements that are not shown on the plans, but are required when an existing TMS element becomes nonoperational or off line due to construction activities, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Furnishing and installing temporary or portable TMS elements and replacing TMS elements that are not shown on the plans nor identified during the pre-construction operational status check and were damaged by construction activities will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

If the Contractor is required to submit provisions for the replacement of TMS elements that were not identified, the provisions will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

10-3.05 CAST-IN-DRILLED-HOLE CONCRETE PILE FOUNDATIONS

GENERAL

Summary

This work includes constructing cast-in-drilled-hole concrete pile foundations for traffic signal and lighting standards.

Comply with Section 86-2.03, "Foundations," of the Standard Specifications, and "Piling" of these special provisions.

MATERIALS

Concrete must contain not less than 590 pounds of cementitious material per cubic yard.

CONSTRUCTION

For standards located in sidewalk areas, the pile foundation must be:

1. Placed to final sidewalk grade before the sidewalk is placed
2. Square for the top 4 inches

PAYMENT

Payment for cast-in-drilled-hole concrete pile foundations shall conform to the provisions in Section 86-8, "Payment," of the Standard Specifications.

10-3.06 STANDARDS, STEEL PEDESTALS, AND POSTS

Standards, steel pedestals, and posts for traffic signal and lighting standards shall conform to the provisions in Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, "Steel Structures" of these special provisions, and the following requirements.

Steel bolts not designated on the plans as high-strength (HS) or stainless steel shall be for general applications and shall conform to the requirements in ASTM Designation: A 307.

Anchor bolts shall conform to the requirements in ASTM Designation: F 1554, Grade 36. High-strength (HS) anchor bolts shall conform to the requirements in ASTM Designation: F 1554, Grade 105.

Where the plans refer to the side tenon detail at the end of the signal mast arm, the applicable tip tenon detail may be substituted.

The sign mounting hardware shall be installed at the locations shown on the plans.

Non-illuminated street name signs shall be installed on signal mast arms using a minimum 3/4" x 0.020" round edge stainless steel strap and saddle bracket. The strap shall be wrapped at least twice around the mast arm, tightened, and secured with a 3/4" stainless strap seal. The sign panel shall be leveled and hardware securely tightened.

Handhole reinforcement rings for standards, steel pedestals, and posts shall be continuous around the handholes.

Type 1 standards shall be assembled and set with the handhole on the downstream side of the pole in relation to traffic or as shown on the plans.

10-3.07 CONDUIT

Conduit to be installed underground shall be Type 1 unless otherwise specified.

The conduit in a foundation and between a foundation and the nearest pull box shall be Type 1.

When a standard coupling cannot be used for joining Type 1 conduit, a UL-listed threaded union coupling conforming to the provisions in Section 86-2.05C, "Installation," of the Standard Specifications, or a concrete-tight split coupling, or concrete-tight set screw coupling shall be used.

When Type 3 conduit is placed in a trench (not in pavement or under portland cement concrete sidewalk), after the bedding material is placed and the conduit is installed, the trench shall be backfilled to not less than 4 inches above the conduit with minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications, except the concrete shall contain not less than 421 pounds of cementitious material per cubic yard. The remaining trench shall be backfilled to finished grade with backfill material.

Conduit runs shown on the plans to be located behind curbs may be installed in the street, within 3 feet of, and parallel with the face of the curb, by the trenching in pavement method in conformance with the provisions in Section 86-2.05C, "Installation," of the Standard Specifications. Pull boxes shall be located behind the curb or at the locations shown on the plans.

In those areas where a jacking pit in a concrete shoulder is necessary to jack conduit across a roadway and the work has not been completed in a work shift, the Contractor shall cover the jacking pit with steel plates after each completed work day. When the work has been completed in a particular jacking area the surface must be restored to its original condition.

Conduits located within the same trench shall have not less than 2 inch separation.

After conductors have been installed, the ends of conduits terminating in pull boxes, splice vaults, service equipment enclosures, and controller cabinets shall be sealed with an approved type of sealing compound.

At those locations where conduit is required to be installed under pavement and underground facilities designated as high priority subsurface installation under Govt Code § 4216 et seq. exist, conduit shall be placed by the trenching in pavement method in conformance with the provisions in Section 86-2.05C, "Installation," of the Standard Specifications.

At other locations where conduit is required to be installed under pavement and if a delay to vehicles will not exceed 5 minutes, conduit may be installed by the "Trenching in Pavement Method."

At the option of the Contractor, the final 2 feet of conduit entering a pull box in a reinforced concrete structure may be Type 4.

10-3.08 TRAFFIC PULL BOXES

Grout shall not be placed in the bottom of traffic pull boxes.

10-3.09 PULL BOX

GENERAL

Summary

This work includes installing a non-traffic-rated pull box as shown on the plans and as specified in these special provisions. Comply with Section 86-2.06, "Pull Boxes," of the Standard Specifications.

Submittals

Before shipping pull boxes to the jobsite, submit a list of materials, Contract number, pull box manufacturer, manufacturer's instructions for pull box installation, and your contact information to the Transportation Laboratory.

Submit reports for pull box from an NRTL-accredited lab to the Engineer.

Quality Control and Assurance

Pull boxes may be tested by the Department. Deliver pull boxes and covers to the Transportation Laboratory and allow 30 days for testing. When testing is complete, you will be notified. You must pick up the boxes and covers from the test site and deliver it to the job site.

Any failure of the pull box or the cover that renders the unit noncompliant with these specifications will be a cause for rejection. If the unit is rejected, you must allow 30 days for retesting. Retesting period starts when the replacement pull box is delivered to the test site. You must pay for all retesting costs. Delays resulting from submittal of noncompliant materials does not relieve you from executing the contract within the allotted time.

If the pull box submitted for testing does not comply with the specifications, remove the unit from the test site within 5 business days after notification that it is rejected. If the unit is not removed within that period, it may be shipped to you at your expense.

You must pay for all shipping, handling, and transportation costs related to the testing and retesting.

Functional Testing

The pull box and cover must be tested under ANSI/SCTE 77, "Specifications for Underground Enclosure Integrity."

Warranty

Provide a 2-year manufacturer replacement warranty for pull box and cover from the date of installation of the pull box and cover. All warranty documentation must be submitted to the Engineer before installation.

Replacement parts must be provided within 5 business days after receipt of failed pull box, cover, or both at no cost to the Department and must be delivered to the Department's Maintenance Electrical Shop at 7310 East Bandini Boulevard, Commerce, CA 90040.

MATERIALS

The pull box and cover must comply with ANSI/SCTE 77, "Specifications for Underground Enclosure Integrity," for Tier 22 load rating and must be gray or brown in color.

Each pull box cover must have an electronic marker cast inside.

Extension for the pull box must be of the same material as the pull box and attached to the pull box to maintain the minimum combined depths as shown.

Include recesses for a hanger if a transformer or other device must be placed in a pull box.

The bolts, nuts, and washers must be a captive bolt design.

The captive bolt design must be capable of withstanding a torque range of 55 to 60 ft-lb and a minimum pull out strength of 750 lb. Perform the test with the cover in place and the bolts torqued. The pull box and cover must not be damaged while performing the test to the minimum pull out strength.

Stainless steel hardware must have an 18 percent chromium content and an 8 percent nickel content.

Galvanize ferrous metal parts under Section 75-1.05, "Galvanizing."

Manufacturer's instructions must provide guidance on:

1. Quantity and size of entries that can be made without degrading the strength of the pull box below Tier 22 load rating
2. Where side entries cannot be made
3. Acceptable method to be used to create the entry

Tier 22 load rating must be labeled or stenciled by the manufacturer on the inside and outside of the pull box and on the underside of the cover.

CONSTRUCTION

Do not place grout in the bottom of the pull box.

Do not install pull box in curb ramps or driveways.

A pull box for a post or a pole standard must be located within 5 feet of the standard. Place a pull box adjacent to the back of the curb or edge of the shoulder. If this is impractical, place the pull box in a suitable, protected, and accessible location.

If only the cover is to be replaced, anchor the cover to the pull box.

10-3.10 CONDUCTORS, CABLES, AND WIRING

Splices shall be insulated by "Method B."

Signal Interconnect Cable (SIC) shall be the 6-pair type.

10-3.11 TRAFFIC SIGNAL INTERCONNECT AND WIRELESS DATA SERVICE SYSTEM

GENERAL

You must provide all equipment necessary for installation and operation of the traffic signal interconnect and wireless data service system. The system includes, but not limited to, the list of submittals in these special provisions.

SUBMITTALS

You must furnish and install the Model 400B modem for the traffic signal interconnect system as shown on the plans.

You must furnish system manuals and also furnish and install the following equipment for the wireless data service system as shown on the plans:

1. Wireless modem device
2. Wireless modem AC adaptor
3. Wireless modem antenna
4. Wireless modem serial cable
5. Wireless modem mounting hardware
6. Wireless modem software tool
7. GPS Time Source Device
8. Cords and cables

Submit list of equipment and manufacturer's technical specifications within 30 working days to the Engineer for approval. You must receive submittal approval from the Engineer before you place the order for equipment.

Submit 5 copies of installation and test plan within 30 working days to the Engineer for approval.

Deliver equipment for quality assurance testing and telephone service connection to CTNET Office with email D7CTNET@dot.ca.gov and located at California Department of Transportation, Office of Intelligent Transportation Systems, CTNET Traffic Signals Branch, Mail Stop 15, 100 South Main Street – Suite 100, Room 04-031 (Signal Lab), Los Angeles, CA 90012.

Pick up the equipment and quality assurance test results from the CTNET Office after the Engineer notifies you or 30 days after you deliver the equipment.

You must receive approval from the Engineer before you install the equipment.

Present a copy of test results for all the tests conducted.

Present system schematic drawings that identify type and function of all equipment at each location. The drawings must also show how each equipment in the system is interconnected.

CONSTRUCTION

System must comply with rules and regulations of the Federal Communications Commission (FCC), with the provisions in Section 86, "Signals, Lighting and Electrical Systems," of the Standard Specifications, the Transportation Electrical Equipment Specifications (TEES), erratum, addendums, and release notes dated on or after March 12, 2009, and these special provisions.

Arrange to have licensed technicians, qualified to install, work and test the system, present at the time the system is turned on.

Prototype equipment is not acceptable. Equipment must be off the shelf, must be of current standard production units manufactured by original equipment manufacturer, and must have been in production for a minimum of 6 months. Rebuilt, modified, or reconditioned equipment is not allowed.

Install State-furnished equipment Model 2070-6B modems and C2 modem harness listed in "MATERIALS" of these special provisions. Model 2070-6B modems must be installed in slot A2 of Model 2070 controllers.

Before you install the C2 modem harness, identify and label terminals with a color code compliant with the connector details for C2 Modem harness specified in Appendix A3-Chapter 3 Details-Drawing A3-5 "C2 MODEM HARNESS," of the TEES. Connect the C2 modem harness to the controller's C2S port and to terminals A1 through A4 of terminal block TB-0 in the Model 332 controller cabinet. Harness installation must comply with the following:

TB-0 Terminal Block Connector	TB-0 terminal Block SIC Typical Color	Local Controller			Signal System Master Controller		
		C2S Port Function	C2S Port Pin	TEES 2009 Errata 1 Color Code	C2S Port Function	C2S Port pin	TEES 2009 Errata 1 Color Code
A1	White	Audio IN	A	White	--	--	
A2	Blue	Audio IN	B	Green	--	--	
A3	White	Audio OUT	C	Red	--	--	
A4	Orange	Audio OUT	E	Black	--	--	--
A1	White	--	--	--	Audio OUT	C	Red
A2	Blue	--	--	--	Audio OUT	E	Black
A3	White	--	--	--	Audio IN	A	White
A4	Orange	--	--	--	Audio IN	B	Green

All equipment you furnish must work with the existing CTNET and traffic signal software without modification in existing software.

Notify the Engineer at least 3 working days prior to system installation.

Follow the manufacturer's recommendations and install systems at the locations requested as detailed on the plans, as specified in these special provisions, and as directed by the Engineer. Model 400B and Model 2070-6B modems must be installed and connected to terminal block TB0 using port C2S in controller and C2 modem harness. Wireless modem device must be mounted, connected to port C20S of Model 170E controller used as signal system master, and connected to TNC connector of wireless modem antenna. GPS time source device must be mounted, connected to port C40S of Model 170E controller used as signal system master, and connected to BNC connector of wireless modem antenna. Wireless modem antenna must be surface mounted, and connected to GPS time source device and wireless modem device. Wireless modem AC adaptor must be connected to equipment outlet, not controller outlet, and to wireless modem device. Equipment installation must not affect the normal operation of the controller cabinet's doors.

Furnish metal filler plates to cover any unused channel slots or card slots for rack mounted equipment and card cage assemblies.

Equipment you furnish must comply with the latest TEES and the following:

Model 400B modem: The modem must comply with the specifications for Model 400B modem module specified in Chapter 2-Section 3 "MODEL 400, 400B, AND 400BE MODEM MODULE," of the TEES, and must support 9600 baud rate communications with Model 2070-6B modems. Install modem in modem slot 1 of Model 170E controllers.

System Manuals: The manuals must provide all of the information necessary to operate, maintain, and repair all of the equipment installed by you. Manuals must include master item index that describes the purpose of each manual and brief description to the directory. It must also reference manufacturer equipment manuals as required for additional support material. It must contain an overall description of the system with illustrative block diagrams including associated equipment and cables. It must identify all equipment and cables in the system stating the exact module and option number employed in the system. You must provide manufacturer contact information, technical data specification, parts lists, part description, and settings for every type of equipment or cable. Clearly describe any calibration, configuration, and modification done on any equipment. Manuals must document all changes to equipment manufacturer default settings. Manuals must include fault diagnostic and repair procedures to permit the location and correction of faults to the level of each replaceable module. The manual must include procedures for preventative maintenance in order to maintain the performance parameters of the system, equipment and cables within the requirements of the manufacturer and these special provisions.

1. **Wireless modem device:** The device must be rugged, have a 5 year memory battery back up, have a Subscriber Identity Module (SIM) Card slot, have dedicated light emitting diodes (LEDs) for status of network registration and functionality, support over-the-air remote configuration and programmable firmware updates, and reduce radio frequency (RF) transmit output power when near a base station. Wireless modem device must support TCP and UDP packet assembly/disassembly (PAD) of serial data frames and its operation must be transparent to existing CTNET and traffic signal software communications without requiring software modification. The wireless modem device must support circuit switched data network communications, and security configuration settings to allow access by IP address. Mount the wireless modem device using wireless modem mounting hardware. The status LEDs on the front panel must face upward. The wireless modem device must be compatible with the existing wireless data services used for other traffic signals, and must support TCP point to point communications with the existing CTNET CommServer hardware and software without modification. Wireless modem device must comply with the following:

Electrical Requirement	Input Voltage: From 9 V(dc) to 28 V(dc)
	Input Current: From 20 mA to 450 mA
	Maximum Idle/Transmit/Receive Load requirements: 414 mA at 12 V(dc)
	Transmit Power: 1.0 W at 1900 MHz, and 0.8 W at 850 MHz
Network/Interface	Serial Interface: EIA-232, from 300 bps to 115,200 bps
	Serial Port: DCE DB-9S socket
	Ethernet Interface: 10 Mbps 10-BASET and 100 Mbps 100-BASET, Ethernet: RJ-45 jack receptacle
	USB Interface: version 2.0, USB: Type B connector
	I/O Interface: 4 Digital Inputs, 3 Analog Inputs, and 2 Relay Outputs. I/O Ports: multiple pin connector
	Application Interfaces: TCP/IP, UDP/IP, Hypertext Transfer Protocol (HTTP), Telecommunications Network (Telnet), Short Message Service (SMS).
	Network: Multiple Band 850/1900 MHz HSUPA with Fallback to HSDPA, UMTS, EDGE, GPRS (MS-12), and GSM.
Power: multiple pin connector	
RF Requirement	Transmit Frequency Bands: From 1850 to 1910 MHz, and from 824 to 849 MHz
	Receiver Frequency Bands: From 1930 to 1990 MHz and from 869 to 894 MHz
	Receiver Sensitivity: -107 dBm typical (2.439 percent BER)
	RF Antenna Connector: 50 Ohm TNC receptacle, or 50 Ohm SMA receptacle with SMA to TNC low loss adapter
GPS Requirement	GPS Reporting Protocols: National Marine Electronic Association (NMEA)
	Receiver Frequency: 1.57542 GHz
	Satellite Tracking: Up to 8 simultaneously
	GPS Connector: 50 Ohm SMA receptacle straight connector
Environmental Requirement	Operating Temperature: -22 to +158 °F Humidity: From 5 to 95 percent non-condensing
Mechanical Requirement	Maximum Device Size: 13 inches perimeter Integrated mounting including either 4 keyhole screw mounts or mounting bracket.

2. Wireless modem AC adaptor: The adaptor must be UL Listed Class 2 power unit, support a 120 V(ac) at 60 Hz input, have a power connector plug that connects to and fits the power receptacle in the wireless modem device, have plug for 120 V(ac) 15R receptacle, and provide a 12 V(dc) at 800 mA output.
3. Wireless modem antenna: The antenna external surface must be Grey Color No. 36375 of Federal Standard 595B or be White coated with non-metallic polymer coating of the Grey color specified, be quad-band and quad-mode cellular/PCS/LTE radio (all carriers) with Global Positioning System (GPS), have a low profile design for outdoor surface mount on aluminum, stainless steel and cold rolled steel metallic surfaces, and be a weatherproof polycarbonate or polypropylene radome. You must use the wireless modem device to measure signal strength. Before antenna is permanently installed, conduct signal strength measurements and submit to the Engineer a copy of the signal strength measurements report for approval, verification and selection of the antenna to be installed. After approval, install the wireless modem, connect it to the antenna, measure the radio signal strength in dBm with the cabinet doors and panels closed, and verify that the radio signal exceeds the signal strength requirements. If the antenna does not comply with the signal strength requirements, you must verify that the wireless modem device falls back to EDGE or GPRS. You may use a serial cable, a laptop computer, and the wireless modem software tool to measure the signal strength. Antenna installation must be weatherproof and watertight. The center of the antenna must be placed at the same distance from the sides and a maximum of 5 inches from the back of the controller cabinet. Seal the cabinet after you install antenna. Water deflection assemblies must not be damaged and must be re-installed if removed during the installation of the wireless modem antenna. The installation of the wireless modem antenna must comply with the manufacturer's recommendations. Conduct signal strength measurements after installation and submit a copy of the report to the Engineer for approval. You must replace the antenna if it does not comply with the following signal strength

requirements: the signal strength measurements must exceed -90 dBm and the wireless modem device receiver sensitivity by 17 dB or more. Wireless modem antenna must comply with the following:

Electrical Requirement	Maximum Power Input: 10 W or more
	RF Nominal Input Impedance: 50 Ohm
	GPS Output Impedance: 50 Ohm
Cellular/PCS/LTE Requirement	PCS Frequency Range: From 1850 to 1990 MHz
	Cellular Frequency Range: From 824 to 894 MHz
	LTE Frequency range: From 704 to 787 MHz
	Optional WiFi Frequency Range: 2400 to 2484 Mhz
	Radiation Pattern: Omni Directional
	Minimum Gain: Unity
	Noise Figure: 2.0 dB maximum
GPS Requirement	VSWR: 2:1 maximum over frequency range
	GPS Axial Ratio: 3.0 dB maximum
	GPS Gain: 27 with 5 dBi antenna gain
	Radiation Pattern: Omni Directional
	GPS Center frequency: 1575.42 MHz
	Noise Figure: 2.0 dB maximum
	VSWR: 2:1 maximum over frequency range
	Polarization: Right Hand Circular Polarization
	Voltages: 3.3 Volts and 5 Volts
Bandwidth: 2 MHz minimum	
Environmental Requirement	Operating Temperature: -22 to +158 °F
	Humidity: From 5 to 95 percent non-condensing
Mechanical Requirement	Maximum Height: 2 inches, Maximum Diameter: 7 inches
	Radio Cable and Connector: 15 feet RG-58 with TNC Plug Connector
	GPS Cable and Connector: 15 feet RG-174/U cable with SMA Plug Straight Connector, and SMA Socket to BNC Plug Adapter.
	Threaded lug and weatherproof watertight bolt mount including mounting hardware, locknut, foam pad and sealing gasket.

- Wireless modem serial cable: The cable must be 4 twisted pair No. 24 AWG stranded tinned copper with polyethylene insulation, color coded, low capacitance computer communications (CM) cable for use in EIA RS-232 applications. The cable must comply with UL-1581 test requirements. The core must be covered with an overall aluminum-polyester foil tape for 100 percent shield coverage, and with an outer chrome PVC jacket. The cable must have stranded tinned copper drain wire, have an operating temperature range of -22 to +176 degrees F and its nominal impedance must be 100 ohm. The serial cable must be 12 feet in length, must have a C2 plug connector with 6 pins to connect to Model 170E and 2070L controllers, must have a DB-9P plug connector to connect to a modem device, must not establish contact between modem and controller chassis, and must use the wiring shown in the table below:

C2 Plug Connector		Wiring	Modem (DCE) RS-232 Signal	DB-9P	Color Code
DTE RS-232 Signal	Pin			Pin	Color
RD	L	Connected	RD	2	White/Blue Stripe
TD	K	Connected	TD	3	Blue/White Stripe
RTS	J	Connected	RTS	7	White/Orange Stripe
CTS	M	Connected	CTS	8	Orange/White Stripe
DC GND	N	Connected	Signal GND	5	White/Green Stripe
DCD	H	Connected	DCD	1	Green/White Stripe
		Jumpered to DSR	DTR	4	White/Brown Stripe
		Jumpered to DTR	DSR	6	Brown/White Stripe

5. Wireless modem mounting hardware: The mounting hardware must include 4 self-tapping screws and washers that match the keyhole screw mounts or mounting bracket of the wireless modem device. The mounting hardware must secure in place the wireless modem device to a mounting plate above terminal block TB0 of the controller cabinet, or to a mounting plate at the location shown on the plans, or to a mounting plate as directed by the Engineer. Mounting screws must not touch the cabinet walls.
6. Wireless modem software tool: The software tool must include user's manual, multiple site license, and software tools on compact discs at no additional cost. The wireless software tool must access wireless modem devices in the field from the Los Angeles Regional TMC or the CTNET Office. The wireless modem software tool must support local and remote configuration, firmware upgrades, diagnostics, monitoring of signal level at receiver, and reset of the wireless modem device. The user's manual and system manual must describe the function of all configuration parameters accessed by the wireless modem software, describe default values, and provide valid range or values for all configuration settings.
7. GPS time source device: The device must be designed for use with the controller model assigned. The device must include user's manual containing full description of ASCII time code formats, reporting protocols, set and query commands, and configurable settings. The device must support serial communications with the existing traffic signal controller hardware and software without modification. The GPS time source device must connect to the wireless modem antenna.

GPS time source device for Model 170E controllers must be stand alone or a card for mounting inside the controller unit and must include a SMA receptacle to BNC plug straight adapter. The device must use a GPS receiver and a microprocessor controlled circuit to get time from GPS satellites and provide accurate time to traffic controllers. The device must have a maximum drift of 0.3 seconds per day when the GPS signal is lost, must have a rechargeable super capacitor for back-up power of the real time clock and memory for up to 24 hours during power outages. The device must support command and response messages for user queries and for configurable settings via serial communications interface used to establish communications with controller unit. The device must be connected to the wireless modem antenna's SMA plug straight connector by using the SMA receptacle to BNC plug straight adapter if the device has a BNC receptacle connector. The device must comply with the GPS receiver, default configurations, QS command set, data output, protocols, LED indicators, GPS tracking, and environmental specifications for Model 2070-7G Universal Time Base (UTB) module specified in Chapter 10-Section 9 "MODEL 2070-7G UNIVERSAL TIME BASE MODULE," of the TEES. A stand alone device must include an industrial grade cable with a DB-9S socket connector and a C2 plug to connect the device's DB-9 port to port C40S of a Model 170E controller for serial data communications and power. A stand alone GPS time source device's status LEDs must face upward, and must be mounted on the controller cabinet's rack at the same side as terminal block TB0 and close to the top of the rack and to the back of the cabinet, or at the rack location shown on the plans, or at the rack location directed by the Engineer. A GPS time source device designed for card cage mounting inside the Model 170E controller unit must comply with the form factor, component side connector, and circuit side connector specifications for Model 400 modem module specified in Chapter 2-Section 3 "MODEL 400, 400B, AND 400BE MODEM MODULE," of the

TEES, must be mounted in modem slot 2 of Model 170E controllers, must support user selectable configuration for channel 2, and must use serial port 4 or C40S of the Model 170E controller unit to accept Query and Set (QS) commands and send data output.

The GPS time source device for Model 170E controllers must comply with the following:

Serial Interface GPS Time Source Requirements	Serial Interface: EIA-232, from 300 to 19,200 bps Serial Interface Time Source: Data Accuracy +/- 10 milliseconds adjusted to compensate for data transmission according to data rate setting.
Power Requirements	DB-9 pin 9 for power input from Model 170E Traffic Controller C2 socket connector. DB-9 pin 9 Input Voltage: +5 V(dc) regulated, DB-9 pin 9 Input Current: 200 mA at +5 V(dc) Optional input Voltage: 24 V(dc) unregulated
GPS Requirements	Satellite Tracking: Minimum 1 satellite tracking for time and 4 satellites tracking for location. Track up to 8 satellites simultaneously Receiver Frequency: 1575.42 MHz
Mechanical Requirements	Serial Port: DCE DB-9P plug connector. GPS Connector: 50 Ohm BNC or SMA receptacle straight connector Dimensions: Maximum combined length, width, and height: 12 inches, Two mounting flanges with 2 keyhole screw mounts Optional power connector for optional input voltage.

8. Cords and cables: You must use cable ties, wire mounting devices, non-metallic cable strain relief, and fixed diameter clamps in the controller cabinet and equipment rack. You must use wire management brackets every 2 feet at the cabinets to route cable. You must use cables and wire management system components to avoid physical interference between cables and adjacent equipment, to allow equipment to be removed from cabinets without physical interference, and to keep terminal blocks clearly visible.

TESTING

Pick up the quality assurance test results from the CTNET Office.

Replace equipment that fails quality assurance testing and telephone service connection within 7 days after the Engineer notifies you. Resubmit technical specifications and replace non-compliant equipment with equipment from another manufacturer within 10 days after the Engineer notifies you.

You must test the equipment after installation in the presence of the Engineer. You must verify at each traffic signal controller location that local controllers receive the AB3418 and AB3418E status request messages sent by the signal system master controller. You must verify at each signal system master location that the signal system master controller receives AB3418 and AB3418E status response messages sent by local controllers. You must verify that an existing CTNET computer at the Los Angeles Regional TMC or CTNET Office receives AB3418 and AB3418E status response messages from each of the local controllers.

Testing must comply with the testing requirements specified in "System Testing" of these special provisions. You must notify Engineer and CTNET Office when you complete system testing, and you must provide location type, route name, county, route, and post mile for each location tested.

System Testing

System testing must include test plan, pre-installation testing, acceptance testing, and final acceptance as specified in these special provisions.

Test Plan

Develop and submit installation and test plan. The test plan must detail the method of installation and testing for each equipment in the system, and the associated schedule of activities. The test plan must be based on these special provisions, project plans, the manufacturer's recommended test procedures, and industry standard practices.

Pre-installation Testing

Test all equipment and components prior to installation of the system, and document test results.

Perform a physical inspection of all equipment for quality of workmanship free of manufacturing defects and provide documentation to prove delivery of equipment.

Acceptance Testing

The acceptance testing must comply with the approved test plan. The acceptance testing must include conducting acceptance tests and subsequent retests, and documentation of the test results.

Perform functional tests of complete system functions to demonstrate that the system satisfies the functional requirements of these special provisions. The connectivity of each communication link must be demonstrated including all links from local controllers to signal system masters, all communication links from signal system masters to communication devices, and all communication links from signal system master controllers to the Los Angeles Regional TMC or CTNET Office.

Document all functional test results. Submit documentation for review and approval to the Engineer, no later than 2 weeks after completion of the acceptance tests and incorporate all comments made during the approval stage.

If any aspect of the functional tests is determined by the Engineer to have failed, cease all acceptance testing and determine the cause of the failure and make repairs to the satisfaction of the Engineer. Acceptance testing must, at the discretion of the Engineer, be repeated from the start of functional tests. You are responsible for delay caused by replacement of non-compliant equipment.

Final Acceptance

Final acceptance will not occur until you comply with the following conditions:

1. All testing has been completed and the Engineer has approved all of the test results.
2. System manuals have been approved and submitted to the Engineer.
3. All connections that were changed to perform tests were restored and tested.

PAYMENT

Full compensation for traffic signal interconnect and wireless data service system is included in the contract lump sum price paid for traffic signal and lighting, modify signal and lighting, modify ramp metering systems, and no additional compensation will be allowed therefor.

10-3.12 WIRELESS DATA SERVICE SYSTEM FOR MICROWAVE VEHICLE DETECTION SYSTEM (MVDS)

GENERAL

This work consists of installing and maintaining wireless data service system for microwave vehicle detection system (MVDS). The work also consists of removing wireless data service system except wireless modem antenna after the Engineer notifies you before the end of the project. You must provide all equipment necessary for installation and operation of the wireless data service system. The system includes, but not limited to, the list of submittals in these special provisions.

SUBMITTALS

You must furnish and install the following equipment for the wireless data service system as shown on the plans:

1. Wireless modem device
2. Wireless modem AC adaptor
3. Wireless modem antenna
4. Wireless modem serial cable or Ethernet cable
5. Wireless modem mounting hardware
6. Wireless modem software tool
7. Cords and cables

Submit list of equipment and manufacturer's technical specifications within 30 working days to the Engineer for approval. You must receive submittal approval from the Engineer before you place the order for equipment.

Submit 5 copies of installation and test plan within 30 working days to the Engineer for approval.

Deliver equipment for quality assurance testing, configuration, and telephone service connection to ATMS Support Office with telephone (323) 259-1833 and located at California Department of Transportation, Office of Intelligent Transportation Systems, Hardware and Software Support Branch, 2901 West Broadway Street, Los Angeles, CA 90041-1002.

Pick up the equipment and quality assurance test results from the ATMS Support Office after the Engineer notifies you or 30 days after you deliver the equipment.

You must receive approval from the Engineer before you install the equipment.

Present a copy of test results for all the tests conducted.

Present system schematic drawings that identify type and function of all equipment at each location. The drawings must also show how each equipment in the system is interconnected.

CONSTRUCTION

System must comply with rules and regulations of the Federal Communications Commission (FCC), with the provisions in Section 86, "Signals, Lighting and Electrical Systems," of the Standard Specifications, the Transportation Electrical Equipment Specifications (TEES), erratum, addendums, and release notes dated on or after March 12, 2009, and these special provisions.

Arrange to have licensed technicians, qualified to install, work and test the system, present at the time the system is turned on.

Prototype equipment is not acceptable. Equipment must be off the shelf, must be of current standard production units manufactured by original equipment manufacturer, and must have been in production for a minimum of 6 months. Rebuilt, modified, or reconditioned equipment is not allowed. Equipment that meets these specifications and has been used on other Department projects is allowed.

All equipment you furnish must work with the existing Transportation Management Center (TMC), Advanced Transportation Management System (ATMS), Front End Processor (FEP), and TMC, ATMS, FEP, Traffic Operation System (TOS) software without modification in existing software.

Notify the Engineer at least 3 working days prior to system installation.

Follow the manufacturer's recommendations and install systems at the locations requested as detailed on the plans, as specified in these special provisions, and as directed by the Engineer. Wireless modem device must be mounted using wireless modem mounting hardware, connected to port C2S of Model 170E controller using wireless modem serial cable, connected to MVDS using Ethernet cable, connected to SMA connector of wireless modem antenna for GPS, and connected to TNC connector of wireless modem antenna for cellular. Wireless modem antenna must be surface mounted to controller cabinet, and connected to wireless modem device. Wireless modem AC adaptor must be connected to equipment outlet, not controller outlet, and to wireless modem device. Equipment installation must not affect the normal operation of the controller cabinet's doors.

Furnish metal filler plates to cover any unused channel slots or card slots for rack mounted equipment and card cage assemblies.

Equipment you furnish must comply with the latest TEES and the following:

1. Wireless modem device: The device must be rugged, have a 5 year memory battery back up, have a Subscriber Identity Module (SIM) Card slot, have dedicated light emitting diodes (LEDs) for status of network registration and functionality, support over-the-air remote configuration and programmable firmware updates, and reduce radio frequency (RF) transmit output power when near a base station. Wireless modem device must support TCP and UDP packet assembly/disassembly (PAD) of serial data frames and its operation must be transparent to existing TMC, ATMS, FEP, Traffic Operation System (TOS) software communications without requiring software modification. The wireless modem device must support circuit switched data network communications, and security configuration settings to allow access by IP address. Mount the wireless modem device using wireless modem mounting hardware. The status LEDs on the front panel must face upward. The wireless modem device must be compatible with the existing wireless data services used for other traffic signals, and must support TCP point to point communications with the existing TMC, ATMS, FEP, Traffic Operation System (TOS) hardware and software without modification. Wireless modem device must comply with the following:

Electrical Requirement	Input Voltage: From 9 V(dc) to 28 V(dc)
	Input Current: From 20 mA to 450 mA
	Maximum Idle/Transmit/Receive Load requirements: 414 mA at 12 V(dc)
	Transmit Power: 1.0 W at 1900 MHz, and 0.8 W at 850 MHz
Network/Interface	Serial Interface: EIA-232, from 300 bps to 115,200 bps
	Serial Port: DCE DB-9S socket
	Ethernet Interface: 10 Mbps 10-BASET and 100 Mbps 100-BASET, Ethernet: RJ-45 jack receptacle
	USB Interface: version 2.0, USB: Type B connector
	I/O Interface: 4 Digital Inputs, 3 Analog Inputs, and 2 Relay Outputs. I/O Ports: multiple pin connector
	Application Interfaces: TCP/IP, UDP/IP, Hypertext Transfer Protocol (HTTP), Telecommunications Network (Telnet), Short Message Service (SMS).
	Network: Multiple Band 850/1900 MHz HSPA with Fallback to HSUPA, HSDPA, UMTS, EDGE, GPRS (MS-12), and GSM.
Power: multiple pin connector	
RF Requirement	Transmit Frequency Bands: From 1850 to 1910 MHz, and from 824 to 849 MHz
	Receiver Frequency Bands: From 1930 to 1990 MHz and from 869 to 894 MHz
	Receiver Sensitivity: -107 dBm typical (2.439 percent BER)
	RF Antenna Connector: 50 Ohm TNC receptacle, or 50 Ohm SMA receptacle with SMA to TNC low loss adapter
GPS Requirement	GPS Reporting Protocols: National Marine Electronic Association (NMEA)
	Receiver Frequency: 1.57542 GHz
	Satellite Tracking: Up to 8 simultaneously
	GPS Connector: 50 Ohm SMA receptacle straight connector
Environmental Requirement	Operating Temperature: -22 to +158 °F Humidity: From 5 to 95 percent non-condensing
Mechanical Requirement	Maximum Device Size: 13 inches perimeter Integrated mounting including either 4 keyhole screw mounts or mounting bracket.

2. Wireless modem AC adaptor: The adaptor must be UL Listed Class 2 power unit, support a 120 V(ac) at 60 Hz input, have a power connector plug that connects to and fits the power receptacle in the wireless modem device, have plug for 120 V(ac) 15R receptacle, and provide a 12 V(dc) at 800 mA output.
3. Wireless modem antenna: The antenna external surface must be Grey Color No. 36375 of Federal Standard 595B or be White coated with non-metallic polymer coating of the Grey color specified, be quad-band and quad-mode cellular/PCS/LTE radio (all carriers) with Global Positioning System (GPS), have a low profile design for outdoor surface mount on aluminum, stainless steel and cold rolled steel metallic surfaces, and be a weatherproof polycarbonate or polypropylene radome. You must use the wireless modem device to measure signal strength. Before antenna is permanently installed, conduct signal strength measurements and submit to the Engineer a copy of the signal strength measurements report for approval, verification and selection of the antenna to be installed. After approval, install the wireless modem, connect it to the antenna, measure the radio signal strength in dBm with the cabinet doors and panels closed, and verify that the radio signal exceeds the signal strength requirements. If the antenna does not comply with the signal strength requirements, you must verify that the wireless modem device falls back to HSUPA, HSDPA, UMTS, EDGE or GPRS. You may use a serial cable, a laptop computer, and the wireless modem software tool to measure the signal strength. Antenna installation must be weatherproof and watertight. The center of the antenna must be placed at the same distance from the sides and a maximum of 5 inches from the back of the controller cabinet. Seal the cabinet after you install antenna. Water deflection assemblies must not be damaged and must be re-installed if removed during the installation of the wireless modem antenna. The installation of the wireless modem antenna must comply with the manufacturer's recommendations. Conduct signal strength measurements after installation and submit a copy of the report to the Engineer for approval. You must replace the antenna if it does not comply with the following signal strength

requirements: the signal strength measurements must exceed -90 dBm and the wireless modem device receiver sensitivity by 17 dB or more. Wireless modem antenna must comply with the following:

Electrical Requirement	Maximum Power Input: 10 W or more
	RF Nominal Input Impedance: 50 Ohm
	GPS Output Impedance: 50 Ohm
Cellular/PCS/LTE Requirement	PCS Frequency Range: From 1850 to 1990 MHz
	Cellular Frequency Range: From 824 to 894 MHz
	LTE Frequency range: From 704 to 787 MHz
	Optional WiFi Frequency Range: 2400 to 2484 Mhz
	Radiation Pattern: Omni Directional
	Minimum Gain: Unity
	Noise Figure: 2.0 dB maximum
GPS Requirement	VSWR: 2:1 maximum over frequency range
	GPS Axial Ratio: 3.0 dB maximum
	GPS Gain: 27 with 5 dBi antenna gain
	Radiation Pattern: Omni Directional
	GPS Center frequency: 1575.42 MHz
	Noise Figure: 2.0 dB maximum
	VSWR: 2:1 maximum over frequency range
	Polarization: Right Hand Circular Polarization
	Voltages: 3.3 Volts and 5 Volts
Bandwidth: 2 MHz minimum	
Environmental Requirement	Operating Temperature: -22 to +158 °F
	Humidity: From 5 to 95 percent non-condensing
Mechanical Requirement	Maximum Height: 2 inches, Maximum Diameter: 7 inches
	Radio Cable and Connector: 15 feet RG-58 with TNC Plug Connector
	GPS Cable and Connector: 15 feet RG-174/U cable with SMA Plug Straight Connector, and SMA Socket to BNC Plug Adapter.
	Threaded lug and weatherproof watertight bolt mount including mounting hardware, locknut, foam pad and sealing gasket.

- Wireless modem serial cable: The cable must be 4 twisted pair No. 24 AWG stranded tinned copper with polyethylene insulation, color coded, low capacitance computer communications (CM) cable for use in EIA RS-232 applications. The cable must comply with UL-1581 test requirements. The core must be covered with an overall aluminum-polyester foil tape for 100 percent shield coverage, and with an outer chrome PVC jacket. The cable must have stranded tinned copper drain wire, have an operating temperature range of -22 to +176 degrees F and its nominal impedance must be 100 ohm. The serial cable must be 12 feet in length, must have a C2 plug connector with 6 pins to connect to Model 170E and 2070L controllers, must have a DB-9P plug connector to connect to a modem device, must not establish contact between modem and controller chassis, and must use the wiring shown in the table below:

C2 Plug Connector		Wiring	Modem (DCE) RS-232 Signal	DB-9P	Color Code
DTE RS-232 Signal	Pin			Pin	Color
RD	L	Connected	RD	2	White/Blue Stripe
TD	K	Connected	TD	3	Blue/White Stripe
RTS	J	Connected	RTS	7	White/Orange Stripe
CTS	M	Connected	CTS	8	Orange/White Stripe
DC GND	N	Connected	Signal GND	5	White/Green Stripe
DCD	H	Connected	DCD	1	Green/White Stripe
		Jumpered to DSR	DTR	4	White/Brown Stripe
		Jumpered to DTR	DSR	6	Brown/White Stripe

5. Wireless modem mounting hardware: The mounting hardware must include 4 self-tapping screws and washers that match the keyhole screw mounts or mounting bracket of the wireless modem device. The mounting hardware must secure in place the wireless modem device to a mounting plate above terminal block TB0 of the controller cabinet, or to a mounting plate at the location shown on the plans, or to a mounting plate as directed by the Engineer. Mounting screws must not touch the controller cabinet walls.
6. Wireless modem software tool: The software tool must include user's manual, multiple site license, and software tools on compact discs at no additional cost. The wireless software tool must access wireless modem devices in the field from the Los Angeles Regional TMC or the ATMS Support Office. The wireless modem software tool must support local and remote configuration, firmware upgrades, diagnostics, monitoring of signal level at receiver, and reset of the wireless modem device. The user's manual and system manual must describe the function of all configuration parameters accessed by the wireless modem software, describe default values, and provide valid range or values for all configuration settings.
7. Cords and cables: You must use cable ties, wire mounting devices, non-metallic cable strain relief, and fixed diameter clamps in the controller cabinet and equipment rack. You must use wire management brackets every 2 feet at the cabinets to route cable. You must use cables and wire management system components to avoid physical interference between cables and adjacent equipment, to allow equipment to be removed from cabinets without physical interference, and to keep terminal blocks clearly visible. Ethernet cables and serial cables must be industrial type, must have connectors required to connect to equipment, and must have an operating temperature range of -22 to +176 degrees F.

TESTING

Pick up the quality assurance test results from the ATMS Support Office.

Replace equipment that fails quality assurance testing and telephone service connection within 7 days after the Engineer notifies you. Resubmit technical specifications and replace non-compliant equipment with equipment from another manufacturer within 10 days after the Engineer notifies you.

You must test the equipment after installation in the presence of the Engineer. You must verify at each MVDS location that local controllers receive presence indication for each of the emulated loop detectors for each lane. You must verify that an existing ATMS workstation, in use by Department personnel at the Los Angeles Regional TMC or ATMS Support Office, receives presence indication for each of the emulated loop detectors for each lane from each MVDS location.

Testing must comply with the testing requirements specified in "System Testing" of these special provisions. You must notify Engineer and ATMS Support Office when you complete system testing, and you must provide location type, route name, county, route, and post mile for each location tested.

System Testing

System testing must include test plan, pre-installation testing, acceptance testing, and final acceptance as specified in these special provisions.

Test Plan

Develop and submit installation and test plan. The test plan must detail the method of installation and testing for each equipment in the system, and the associated schedule of activities. The test plan must be based on these special provisions, project plans, the manufacturer's recommended test procedures, and industry standard practices.

Pre-installation Testing

Perform a physical inspection of all equipment for quality of workmanship free of manufacturing defects and provide documentation to prove delivery of equipment.

Acceptance Testing

The acceptance testing must comply with the approved test plan. The acceptance testing must include conducting acceptance tests and subsequent retests, and documentation of the test results.

If any aspect of the functional tests is determined by the Engineer to have failed, cease all acceptance testing and determine the cause of the failure and make repairs to the satisfaction of the Engineer. Acceptance testing must, at the discretion of the Engineer, be repeated from the start of functional tests. You are responsible for delay caused by replacement of non-compliant equipment.

Final Acceptance

Final acceptance will not occur until you comply with the following conditions:

1. All testing has been completed and the Engineer has approved all of the test results.
2. All connections that were changed to perform tests were restored and tested.

PAYMENT

Full compensation for wireless data service system is included in the contract lump sum price paid for microwave vehicle detection system and no additional compensation will be allowed therefor.

10-3.13 SERVICE

Continuous welding of exterior seams in service equipment enclosures is not required.

Each service shall be provided with up to 2 main circuit breakers which shall disconnect ungrounded service entrance conductors. Where the "Main" circuit breaker consists of 2 circuit breakers as shown on the plans or required in the special provisions, each of the circuit breakers shall have a minimum interrupting capacity of 10,000 A, rms.

ELECTRIC SERVICE (IRRIGATION)

Electric service (irrigation) shall be from the service points to the irrigation controllers (IC) and to the spaces provided in the irrigation controller enclosure cabinets (CEC) for irrigation controllers as shown on the plans.

Irrigation Controller (IC) : Electric service (irrigation) shall be a metered 120/240 V(ac), single-phase service in a Type III service equipment enclosure.

Service disconnects in service equipment enclosures shall be 1-pole, 20-A circuit breaker.

Nameplate inscriptions shall be as follows:

ITEMS	INSCRIPTION
Metering Equipment Enclosure	IC _____
Service Disconnect	IC _____

The inscription on other nameplates shall be the identifying letter designation used on the plans and in these special provisions, or shall be as directed by the Engineer.

Electric service (irrigation) will be paid for on a lump sum basis.

The contract lump sum price paid for electric service (irrigation) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing electric service (irrigation) for irrigation controllers, complete in place, including conductors, conduit and pull boxes to the

pull box adjacent to irrigation controller enclosure cabinets and irrigation controllers, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

10-3.14 NUMBERING ELECTRICAL EQUIPMENT

Self-adhesive retroreflective numbers and edge sealer shall be Contractor-furnished.

The numbers and edge sealer shall be placed on the equipment where designated by the Engineer.

Where new numbers are to be placed on existing or relocated equipment, the existing numbers shall be removed.

Reflective numbers shall be applied to a clean surface. Only the edges of the numbers shall be treated with edge sealer.

Five-digit, self-adhesive equipment numbers shall be placed for all electroliers, soffit lighting, sign lighting, and service pedestals. On service pedestals, the numbers shall be placed on the front door. On electroliers, the numbers shall be placed 10 feet from the base of the electrolier as shown on the plans and as directed by the Engineer.

Numbers for illuminated signs mounted on overcrossings or for soffit luminaires shall be placed on the nearest adjacent bent or abutment at approximately the same station as the sign or soffit luminaire. Where no bent or abutment exists near the sign or soffit luminaire, the number shall be placed on the underside of the structure adjacent to the sign or soffit luminaire. Arrangement of numbers shall be the same as those used for electroliers.

Numbers for overhead sign bridges shall be placed on both posts.

Numbers for wood poles shall be 3-inch embossed aluminum fastened to the pole with 1-1/4-inch aluminum nails. Numbers for wood poles shall be furnished by the Contractor.

Full compensation for retroreflective numbers and edge sealers are included in the contract lump sum price paid for the items of work involved and no additional compensation will be allowed therefor.

10-3.15 STATE-FURNISHED CONTROLLER ASSEMBLIES

The Model 170 and 2070 controller assemblies, excluding anchor bolts, will be State-furnished as provided under "Materials" of these special provisions.

The Contractor shall construct each controller cabinet foundation as shown on the plans for Model 332 and 334 cabinets (including furnishing and installing anchor bolts), shall install the controller cabinet on the foundation, and shall make field wiring connections to the terminal blocks in the controller cabinet.

A listing of field conductor terminations, in each State-furnished controller cabinet, will be furnished free of charge to the Contractor at the site of the work.

State forces will maintain controller assemblies. The Contractor's responsibility for controller assemblies shall be limited to conforming to the provisions in Section 6-1.02, "State-Furnished Materials," of the Standard Specifications.

10-3.16 LIGHT EMITTING DIODE SIGNAL MODULE

GENERAL

Summary

This work includes installing LED signal module. Comply with Section 86, "Electrical Systems," of the Standard Specifications.

Use LED signal module as the light source for the following traffic signal faces:

1. 12-inch section
2. 12-inch arrow section

Submittals

Before shipping LED signal modules to job site, submit the following to the Transportation Laboratory:

1. Delivery form including district number, EA, and contact information
2. List containing all LED signal module serial numbers anticipated for use
3. LED signal modules

Quality Control and Assurance

Module must be one listed on the Pre-Qualified Products List for LED traffic signals at:

http://www.dot.ca.gov/hq/esc/approved_products_list

The State will test LED signal module shipments as specified in ANSI/ASQ Z1.4.. Testing will be completed within 30 days of delivery to the Transportation Laboratory. LED signal modules tested or submitted for testing must be representative of typical production units. LED and circular LED signal modules will be tested as specified in California Test 604. Arrow, U-turn, and bicycle LED signal modules will be tested as specified in California Test 3001. All parameters of the specification may be tested on the modules. LEDs must be spread evenly across the module. LED arrow indication must provide the minimum initial luminous intensity listed. Measurements will be performed at the rated operating voltage of 120 V(ac).

Delays resulting from submittal of non-compliant materials do not relieve you from executing the contract within the allotted time. Non-compliant materials will be rejected. You must resubmit new LED for retesting and pick up the failed units within 7 days of notification. You must provide new LED signal modules and allow a minimum of 30 days for the retest. You must pay for all shipping and handling costs related to testing and retesting. Delays resulting from resubmittal and retesting are your responsibility and no extra time will be allowed.

After testing, you must pick up the tested LED signal modules from the Transportation Laboratory and deliver to the job site.

Warranty

The manufacturer must provide a written warranty against defects in materials and workmanship for LED signal modules for a minimum period of 48 months after installation of LED signal modules. Replacement LED signal modules must be provided within 15 days after receipt of failed LED modules at your expense. The State pays for shipping the failed modules to you. All warranty documentation must be submitted to the Engineer before installation. Replacement LED signal modules must be delivered to State Maintenance Electrical Shop at 602 S. Flower Street, Burbank CA 91502, (818) 842-2885.

MATERIALS

Minimum power consumption for LED signal module must be 5 W.

LED signal module must have an operational lifecycle rating of 48 months. During the operational lifecycle, LED signal module must meet all parameters of this specification.

LED signal module must be designed for installation in the door frame of standard traffic signal housing.

LED signal module must:

1. Be 4 pounds maximum weight
2. Be manufactured for 12-inch circular
3. Be from the same manufacturer
4. Be the same model for each size
5. Be sealed units with:
 - 5.1. 2 color-coded conductors for power connection, except for lane control LED signal modules use 3 color-coded conductors.
 - 5.2. Printed circuit board and power supply contained inside and complying with Chapter 1, Section 6 of TEES published by the Department.
 - 5.3. Lens that is:
 - 5.3.1. Integral to the units
 - 5.3.2. Convex or flat with a smooth outer surface
 - 5.3.3. Made of UV stabilized plastic or glass, and withstands UV exposure from direct sunlight for 48 months without exhibiting evidence of deterioration
 - 5.4. 1-piece EPDM gasket
6. Include 3-foot long conductors with quick disconnect terminals attached
7. Be sealed in door frames
8. Fit into existing traffic signal section housing and comply with ITE publication, Equipment and Material Standards, Chapter 2, "Vehicle Traffic Control Signal Heads"

Individual LEDs must be wired so catastrophic loss or failure of 1 LED will not result in loss of more than 5 percent of the signal module light output. Failure of an individual LED in a string must not result in loss of entire string or other indication.

No special tools for installation are allowed.

12-inch Arrow

Comply with Section 9.01 of ITE publication, Equipment and Material Standards, Chapter 2, "Vehicle Traffic Control Signal Heads" for arrow indications.

LED signal module must:

1. Be weather tight and connect directly to electrical wiring.
2. Be capable of optical unit replacement.
3. Be a single, self-contained device, ready for installation into traffic signal housing.
4. Have manufacturer's name, trademark, model number, serial number, lot number, month and year of manufacture, and required operating characteristics, including rated voltage, power consumption, and volt-ampere, permanently marked on the back of the module.
5. Have a symbol of module type and color. Symbol must be an inch in diameter. Color must be written out in 0.50 inch high letters next to the symbol.
6. Be AllInGaP technology for red and yellow indications and gallium nitride technology for green indications.
7. Be ultra bright type rated for 100,000 hours of continuous operation from -40 °C to +74 °C.
8. Have a maximum power consumption as follows:

Power Consumption Requirements

LED Signal Module Type	Power Consumption (Watts)					
	Red		Yellow		Green	
	25 °C	74 °C	25 °C	74 °C	25 °C	74 °C
12-inch circular	11	17	22	25	15	15
12-inch arrow	9	12	10	12	11	11

Lens may be tinted, or may use transparent film or materials with similar characteristics to enhance "ON/OFF" contrasts. Tinting or other materials to enhance "ON/OFF" contrast must not affect chromaticity and must be uniform across the face of the lens.

If polymeric lens is used, surface coating or chemical surface treatment must be applied for front surface abrasion resistance.

Power supply must be integral to the module.

Internal components must be adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Lens and LED signal module material must comply with the ASTM specifications for that material.

Enclosures containing either the power supply or electronic components of LED signal module, except lenses, must be made of UL94VO flame-retardant material.

If a specific mounting orientation is required, the LED signal module must have prominent and permanent vertical markings for accurate indexing and orientation within the signal housing. Markings must include an up arrow, or the word "UP" or "TOP."

LED signal module must meet or exceed the following values when operating at 25 °C:

Minimum Initial Intensities for Circular Indications (cd)

Angle (v,h)	12-inch		
	Red	Yellow	Green
2.5, ±2.5	399	798	798
2.5, ±7.5	295	589	589
2.5, ±12.5	166	333	333
2.5, ±17.5	90	181	181
7.5, ±2.5	266	532	532
7.5, ±7.5	238	475	475
7.5, ±12.5	171	342	342
7.5, ±17.5	105	209	209
7.5, ±22.5	45	90	90
7.5, ±27.5	19	38	38
12.5, ±2.5	59	119	119
12.5, ±7.5	57	114	114
12.5, ±12.5	52	105	105
12.5, ±17.5	40	81	81
12.5, ±22.5	26	52	52
12.5, ±27.5	19	38	38
17.5, ±2.5	26	52	52
17.5, ±7.5	26	52	52
17.5, ±12.5	26	52	52
17.5, ±17.5	26	52	52
17.5, ±22.5	24	48	48
17.5, ±27.5	19	38	38

Minimum Luminance for Arrows, U-turn, Bicycle, Lane Control, and PV Indications (FL)

	Red	Yellow	Green
Arrow Indication	1,605	3,210	3,210
U-turn Indication	1,605	3,210	3,210
Bicycle Indication	1,605	1,605	1,605
Lane Control Indication (X)	1,605	--	--
Lane Control Indication (Arrow)	--	--	1,605
PV Indication (cd at 2.5°±2.5°)	91	91	91

LED signal module must meet or exceed the following illumination values for 48 months when operating over a temperature range of -40 °C to + 74 °C. Yellow LED signal module must meet or exceed the following illumination values for 48 months, when operating at 25 °C:

Minimum Maintained Intensities for Circular Indications (cd)

Angle (v,h)	12-inch		
	Red	Yellow	Green
2.5, ±2.5	339	678	678
2.5, ±7.5	251	501	501
2.5, ±12.5	141	283	283
2.5, ±17.5	77	154	154
7.5, ±2.5	226	452	452
7.5, ±7.5	202	404	404
7.5, ±12.5	145	291	291
7.5, ±17.5	89	178	178
7.5, ±22.5	38	77	77
7.5, ±27.5	16	32	32
12.5, ±2.5	50	101	101
12.5, ±7.5	48	97	97
12.5, ±12.5	44	89	89
12.5, ±17.5	34	69	69
12.5, ±22.5	22	44	44
12.5, ±27.5	16	32	32
17.5, ±2.5	22	44	44
17.5, ±7.5	22	44	44
17.5, ±12.5	22	44	44
17.5, ±17.5	22	44	44
17.5, ±22.5	20	41	41
17.5, ±27.5	16	32	32

Minimum Maintained Luminance for Arrow, U-turn, Bicycle, Lane Control, and PV Indications (FL)

	Red	Yellow	Green
Arrow Indication	1,610	3,210	3,210
U-turn Indication	1,610	3,210	3,210
Bicycle Indication	1,610	1,610	1,610
Lane Control Indication (X)	1,610	--	--
Lane Control Indication (Arrow)	--	--	1,610
PV Indication (at 2.5°±2.5°)	91	91	91

LED signal module must comply with the following chromaticity requirements for 48 months when operating over a temperature range of -40 °C to +74 °C.

Chromaticity Standards (CIE Chart)

Red	Y: not greater than 0.308, or less than 0.998 - x
Yellow	Y: not less than 0.411, nor less than 0.995 - x, nor greater than 0.452
Green	Y: not less than 0.506 - 0.519x, nor less than 0.150 + 1.068x, nor more than 0.730 - x

LED signal module must operate:

1. At a frequency of 60 Hz ± 3 Hz, over a voltage range from 95 V(ac) to 135 V(ac), without perceptible flicker to the unaided eye. Fluctuations of line voltage must have no visible effect on luminous intensity of the indications. Rated voltage for measurements must be 120 V(ac).
2. Compatible with currently used controller assemblies, including solid state load switches, flashers, and conflict monitors. Comply with TEES Chapters 3 and 6. If a 20 mA alternating current or less is applied to the unit, the voltage read across the 2 leads must be 15 V(ac) or less.

Wiring and terminal block must comply with Section 13.02 of ITE publication, Equipment and Material Standards, Chapter 2, "Vehicle Traffic Control Signal Heads." Electrical connection for each Type 1 LED signal module must be 2 secured, color-coded, 3-foot long, 600 V(ac), 20 AWG minimum stranded jacketed copper wires. Wires must comply with NEC, rated for service at +105 °C.

LED signal module on-board circuitry must:

1. Include voltage surge protection to withstand high-repetition noise transients. The voltage surge protection must comply with NEMA Standard TS2, Section 2.1.6.
2. Comply with FCC, Title 47, SubPart B, Section 15 regulations for Class A emission limits for electronic noise.

LED signal module must provide a power factor of 0.90 or greater.

Total harmonic distortion from current and voltage induced into an alternating current power line by LED signal module must not exceed 20 percent at an operating temperature of 25 °C.

When power is applied to LED signal module, light emission must occur within 90 ms.

10-3.17 INTERNALLY ILLUMINATED SIGN LIGHT EMITTING DIODE

GENERAL

Summary

This work includes installing LED "METER ON" in Type A modified pedestrian signal. Comply with Section 86 of the Standard Specifications.

Submittals

Before shipping LED signal modules to job site, submit the following to the Transportation Laboratory:

1. Delivery form including district number, EA, and contact information
2. List containing all LED signal module serial numbers anticipated for use
3. LED signal modules

Quality Assurance Testing

Module must be one listed on the Pre-Qualified Products List for LED traffic signals at:

http://www.dot.ca.gov/hq/esc/approved_products_list

The Department will test LED signal module shipments per Normal Sampling Plan (ANSI/ASQC Z1.4-1993), Tables for Inspection by Attributes. Testing will be completed within 30 days of delivery to the Transportation Laboratory. LED signal modules tested or submitted for testing must be representative of typical production units. LED and circular LED signal modules will be tested as specified in California Test 604. Arrow, U-turn, and bicycle LED signal modules will be tested as specified in California Test 3001. All parameters of the specification may be tested on the modules. LEDs must be spread evenly across the module. LED arrow indication must provide the minimum initial luminous intensity listed. Measurements will be performed at the rated operating voltage of 120 V(ac).

Delays resulting from submittal of non-compliant materials do not relieve you from executing the contract within the allotted time. Non-compliant materials will be rejected. You must resubmit new LED for retesting and pick up the failed units within one week of notification. You must provide new LED signal modules and allow a minimum of 30 days for the retest. You must pay for all shipping and handling costs related to testing and retesting. Delays resulting from resubmittal and retesting are your responsibility and no extra time will be allowed.

After testing, you must pick up the tested LED signal modules from the Transportation Laboratory and deliver to the job site.

Warranty

You must provide the manufacturer's written warranty against defects in materials and workmanship for LED signal modules for a minimum period of 48 months after installation of LED signal modules. Replacement LED signal modules must be provided within 15 days after receipt of failed LED modules at no cost to the Department, except the cost of shipping the failed modules. All warranty documentation must be submitted to the Engineer before installation. Replacement LED signal modules must be delivered to Department Maintenance Electrical Shop at 524 S Flower Street, Burbank, CA, 91504.

MATERIALS

LED Meter on module must:

1. Be weather tight and connect directly to electrical wiring.
2. Be capable of optical unit replacement.
3. Have manufacturer's name, trademark, model number, serial number, lot number, month and year of manufacture, and required operating characteristics, including rated voltage, power consumption, and volt-ampere, permanently marked on the back of the module.
4. Be AllnGaP technology
5. Be ultra bright type rated for 100,000 hours of continuous operation from -40°C to +74°C
6. Each module must provide an average luminous intensity of at least 1,547 foot-lambert throughout the useful life over the operating temperature range.
7. The uniformity ratio of an illuminated symbol must not exceed 4 to 1 between the highest luminance area and the lowest luminance area in the module.
8. The color output of the module must conform to the requirements of Section 5.3 in the ITE Publication: Equipment and Material Standards, Chapter 3 (Pedestrian Traffic Control Signal Indications).
9. Meter on must be lunar white with chromatically measured coordinates of LED module operating over a temperature range of -40°C to +74°C as follows:

x: not less than 0.270, nor greater than 0.330

y: not less than $1.055(x) - 0.0128$, nor greater than $1.055(x) + 0.0072$

Lunar white color must be in conformance with the provisions in Section 86-4.06. Pedestrian Signal Faces," of the Standard Specifications.

10. Use LED as the light source.
11. Use required color and be ultra bright type rated for 100,000 hours of continuous operation from -40°C to +74°C.
12. Fit into Type A pedestrian signal modified so that the reflector must be a single chamber.
13. Be a single, self-contained device, not requiring on-site assembly for installation into standard Type A housing.
14. Module Identification
 - a. Each module must have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked on the back of the module.
 - b. The following operating characteristics must be permanently marked on the back of the module: rated voltage and rated power in Watts and Volt-Ampere.
15. Maximum power consumption requirements for the LED modules are as follows (in Watts):

	25°C	74°C
"Meter On"	15.0	17.0

LED Meter on module must have an operational lifecycle rating of 48 months. During the operational lifecycle, LED signal module must meet all parameters of this specification.

Individual LEDs must be wired so catastrophic loss or failure of one LED will result in loss of not more than 5 percent of the PSF module light output. Failure of an individual LED in a string must not result in the loss of entire string or other indication.

No special tools for installation are allowed.

Wiring and terminal block must comply with Section 13.02 of ITE publication, Equipment and Material Standards, Chapter 2, "Vehicle Traffic Control Signal Heads." The LED PSF module must be supplied with spade lugs and 3 secured, color-coded, 3-foot long, 600 V, 20 AWG minimum stranded jacketed copper wires. Wires must comply with NEC, rated for service at +105°C.

LED Meter on module must operate:

1. At a frequency of $60 \text{ Hz} \pm 3 \text{ Hz}$, over a voltage range from 95 V(ac) to 135 V(ac), without perceptible flicker to the unaided eye. Fluctuations of line voltage must have no visible effect on luminous intensity of the indications. Rated voltage for measurements must be 120 V(ac).

2. Compatible with currently used State controller assemblies, including solid state load switches, flashers, and conflict monitors. Comply with TEES Chapters 3 and 6. If a 20 mA alternating current or less is applied to the unit, the voltage read across the 2 leads must be 15 V(ac) or less.

LED Meter on module on-board circuitry must:

1. Include voltage surge protection to withstand high-repetition noise transients. The voltage surge protection must comply with NEMA Standard TS2, Section 2.1.6.
2. Comply with FCC, Title 47, SubPart B, Section 15 regulations for Class A emission limits for electronic noise.

LED signal module must provide a power factor of 0.90 or greater.

Total harmonic distortion from current and voltage induced into an alternating current power line by LED signal module must not exceed 20 percent at an operating temperature of 25°C.

When power is applied to LED signal module, light emission must occur within 90 ms.

Power supply must be integral to the module.

Internal components must be adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Lens and LED signal module material must comply with the ASTM specifications for that material.

Enclosures containing either the power supply or electronic components of LED signal module, except lenses, must be made of UL94VO flame-retardant material.

If a specific mounting orientation is required, the LED signal module must have prominent and permanent vertical markings for accurate indexing and orientation within the signal housing. Markings must include an up arrow, or the word "UP" or "TOP."

Lenses must be 3/16 inch, minimum thickness, clear acrylic or polycarbonate plastic or 1/8 inch nominal thickness glass fiber reinforced plastic, with molded, one piece, neoprene gasket. Message lettering for "METER" must be "Series C," 4-1/2 inches high, with uniform 1/2 inch stroke, and for "ON" must be "Series C," 6 inches high, with uniform one inch stroke. Letters must be clear, transparent or translucent, with black opaque background silk screened on to the second surface of the lens.

10-3.18 BATTERY BACKUP SYSTEM

GENERAL

Summary

This work includes installing battery backup system (BBS). Comply with Section 86, "Signals, Lighting and Electrical Systems," of the Standard Specifications and TEES.

The State will furnish BBS components as listed in "Materials" of these special provisions.

You must furnish the external cabinet and batteries.

Submittals

Before shipping external cabinets to the jobsite, submit material list including contract number, cabinet serial numbers, and contact information to the Transportation Laboratory.

Submit a Certificate of Compliance for each external cabinet and batteries to the Engineer under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Quality Control and Assurance

The State may test the cabinets.

Functional Testing

After complete installation, BBS functional test must be performed. Test for 30 minutes of continuous, satisfactory operation with utility power turned off. Perform test in the presence of the Engineer.

Warranty

Batteries must be warranted by the manufacturer to operate within a temperature range of -25 °C to +60 °C for 2 years.

Batteries must have a written warranty against defects in materials and workmanship from the manufacturer prorated for a period of 60 months after installation. You must provide the Engineer with all warranty documentation before installation. Replacement batteries must be available within 5 business days after receipt of

failed batteries at no cost to the State except the cost of shipping the failed batteries. Replacement batteries must be delivered to Caltrans Maintenance Electrical Shop at 602 S. Flower Street, Burbank, CA 91502, (818) 842-2885.

MATERIALS

Batteries must:

1. Be deep cycle, sealed prismatic, lead-calcium-based, absorbed-glass mat and valve-regulated lead acid (AGM/VRLA) type
2. Have voltage rating of 12 V
3. Be group size 24
4. Be commercially available and stocked locally
5. Have a carrying handle
6. Be marked with date code, maximum recharge data, and recharge cycles
7. Have 2 top-mounted, threaded, stud posts that include all washers and nuts required for attaching 3/8-inch ring lugs of a State-furnished BBS battery harness
8. Include rubber insulating protective covers for protecting the lugs, posts, and wiring - red for positive terminal and black for negative terminal
9. Be new and fully-charged when furnished
10. Be free from damage or deformities

External cabinet must be one listed on the Pre-Qualified Products List at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

External cabinet must be capable of housing:

1. 8 batteries
2. Inverter/charger unit
3. Power transfer relay
4. Manually-operated bypass switch
5. Required control panels
6. Wiring and harnesses

Dimensions and details for the external cabinet, for attaching the external cabinet to the Model 332 cabinet, and for wiring the State-furnished equipment will be available in an information handout as described in "Project Information" of these special provisions.

The following details must comply with Section 86-3.04, "Controller Cabinets," of the Standard Specifications and TEES:

1. Door construction, including material, thickness, coating, and welds
2. Frame
3. Door seals
4. Continuous stainless steel piano hinge or 4 leaves with 2 bolts on each side of each leaf, used to connect the door to external cabinet
5. Padlock clasp or latch and lock mechanism

The external cabinet must be ventilated by using louvered vents, filter, and a thermostatically controlled fan. Fan must be AC-operated from the same line output as the Model 332 cabinet. A 2-position terminal block must be provided on the fan panel, along with 10 feet of connected hookup wire.

The external cabinet surface must be anodized aluminum. Anti-graffiti paint must not be used.

The external cabinet must include all bolts, washers, nuts, and cabinet-to-cabinet coupler fittings necessary for mounting it to the Model 332 cabinet.

Fasteners for the external cabinet must include:

1. 8 cabinet mounting bolts that are 18-8 stainless steel hex head, fully-threaded, and 3/8" – 16 x 1"
2. 2 washers per bolt designed for 3/8-inch bolt and are 18-8 stainless steel 1-inch OD round flat type
3. K-lock nut per bolt: K-lock washer that is 18-8 stainless steel and hex-nut

External cabinet to Model 332 cabinet couplings must include a conduit for power connections between the 2 cabinets. Couplings must include:

1. 2-inch nylon-insulated steel chase nipple, T & B 1947 or equivalent
2. 2-inch sealing, steel locknut, T & B 146SL or equivalent
3. 2-inch nylon-insulated steel bushing, T & B 1227 or equivalent

CONSTRUCTION

Mount external cabinet to either the left or right side of Model 332 cabinet. The typical side-mounting location of external cabinet is flush with the bottom of the Model 332 cabinet and approximately equidistant from the front and rear door edges.

MEASUREMENT AND PAYMENT

The contract unit price paid for battery backup system includes full compensation for furnishing all labor, materials (except State-furnished materials), tools, equipment, and incidentals and for doing all the work involved in assembling and installing battery backup system, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for assembling and installing battery backup system is included in the contract lump sum price paid for signal and lighting and modify signal and lighting, and no separate payment will be made therefor.

10-3.19 LIGHT EMITTING DIODE PEDESTRIAN SIGNAL FACE MODULES

GENERAL

Summary

This work includes installing LED pedestrian signal face (PSF) module into standard Type A pedestrian signal housing. Comply with Section 86, "Electrical Systems," of the Standard Specifications.

Submittals

Before shipping LED PSF modules to job site, submit the following to the Transportation Laboratory:

1. Delivery form including district number, EA, and contact information
2. List containing all LED PSF module serial numbers anticipated for use
3. LED PSF modules
4. Manufacturer's name, trademark, model number, lot number, month and year of manufacture

Quality Control and Assurance

Module must be one listed on the Pre-Qualified Products List for LED traffic signals at:

http://www.dot.ca.gov/hq/esc/approved_products_list

The State will test LED PSF module shipments as specified in ANSI/ASQ Z1.4.. Testing will be completed within 30 days of delivery to the Transportation Laboratory. LED PSF modules tested or submitted for testing must be representative of typical production units. LED PSF modules will be tested as specified in California Test 606. All parameters of the specification may be tested on the modules.

Delays resulting from submittal of non-compliant materials do not relieve you from executing the contract within the allotted time. Non-compliant materials will be rejected. You must resubmit new LED for retesting and pick up the failed units within 7 days of notification. You must provide new LED PSF modules and allow a minimum of 30 days for the retest. You must pay for all shipping and handling costs related to testing and retesting. Delays resulting from resubmittal and retesting are your responsibility and no extra time will be allowed.

After successful testing, you must pick up the tested LED PSF modules from the Transportation Laboratory and deliver to the job site.

Warranty

The manufacturer must provide a written warranty against defects in materials and workmanship for LED PSF modules for a minimum period of 48 months after installation of LED PSF modules. Replacement LED PSF modules must be provided within 15 days after receipt of failed LED PSF modules at your expense. The State pays for shipping the failed modules to you. All warranty documentation must be submitted to the Engineer before

installation. Replacement LED PSF modules must be delivered to State Maintenance Electrical Shop at 602 S. Flower Street, Burbank, CA 91502, (818) 842-2885.

MATERIALS

LED PSF module must:

1. Be from the same manufacturer.
2. Be installed in standard Type A pedestrian signal housing, "UPRAISED HAND" and "WALKING PERSON." Do not include reflectors.
3. Use LED as the light source.
4. Be designed to mount behind or replace face plates of standard Type A housing as specified in ITE publication, Equipment and Material Standards, Chapter 3, "Pedestrian Traffic Control Signal Indications" and the "California MUTCD."
5. Have a minimum power consumption of 10 W.
6. Use required color and be ultra bright type rated for 100,000 hours of continuous operation from -40 °C to +74 °C.
7. Be able to replace signal lamp optical units and pedestrian signal faces with both LED and incandescent light sources.
8. Fit into pedestrian signal section housings without modifications to the housing. The housing must comply with ITE publication, Equipment and Materials Standards, Chapter 3, "Pedestrian Traffic Control Signal Heads."
9. Be a single, self-contained device, not requiring on-site assembly for installation into standard Type A housing.
10. Have the following information permanently marked on the back of module:
 - 10.1. Manufacturer's name
 - 10.2. Trademark
 - 10.3. Model number
 - 10.4. Serial number
 - 10.5. Lot number
 - 10.6. Month and year of manufacture
 - 10.7. Required operating characteristics, as follows:
 - 10.7.1. Rated voltage
 - 10.7.2. Power consumption
 - 10.7.3. Volt-ampere (VA)
 - 10.7.4. Power factor
11. Have prominent and permanent vertical markings for accurate indexing and orientation within the signal housing if a specific mounting orientation is required. Markings must include an up arrow, or the word "UP" or "TOP." Marking must be a minimum of 1-inch diameter.

Circuit board and power supply must be contained inside the LED PSF modules. Circuit board must comply with Chapter 1, Section 6 of TEES published by the Department.

Individual LEDs must be wired so catastrophic loss or failure of 1 LED will not result in loss of more than 5 percent of the PSF module light output. Failure of an individual LED in a string must not result in the loss of entire string or other indication.

LEDs must be evenly distributed in each indication. Do not use outline forms.

No special tools for installation are allowed.

Installation of the LED PSF module into pedestrian signal face must require only removal of lenses, reflectors, lamps, and existing LED modules.

Power supply for LED PSF module must be integral to the module. Power supply for each symbol must be isolated to avoid turn-on conflict.

Assembly and manufacturing processes for LED PSF module must assure that all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Material used for LED PSF module must comply with ASTM D 3935.

Enclosures containing either the power supply or electronic components of LED PSF module, except lenses, must be made of UL94VO flame-retardant material.

Color of "UPRAISED HAND" symbol must be portland orange.

Color of "WALKING PERSON" symbol must be lunar white.

Each symbol must not be less than 10 inches high and 6.5 inches wide. Uniformity ratio of illuminated symbols must not exceed 4 to 1 between highest and lowest luminance areas. Symbols must comply with ITE publication, Equipment and Material Standards, Chapter 3, "Pedestrian Traffic Control Signal Indications," and the "California MUTCD."

LED PSF module must maintain an average luminance value over 48 months of continuous use in signal operation for a temperature range of -40 °C to +74 °C. In addition, LED PSF modules must meet or exceed the following luminance values upon initial testing at 25 °C.

Luminance Values

PSF module	Luminance
UPRAISED HAND	1,094 FL
WALKING PERSON	1,547 FL

Color output of LED PSF module must comply with chromaticity requirements in Section 5.3 of ITE publication, Equipment and Material Standards, Chapter 3, "Pedestrian Traffic Control Signal Indications."

Measured chromaticity coordinates of LED PSF module must comply with the following chromaticity requirements for 48 months when operating over a temperature range of -40 °C to +74 °C.

Chromaticity Standards (CIE Chart)

UPRAISED HAND (portland orange)	Not greater than 0.390, nor less than 0.331, nor less than 0.997-X
WALKING PERSON (lunar white)	X: not less than 0.280, nor greater than 0.320 Y: not less than 1.055*X - 0.0128, nor greater than 1.055*X + 0.0072

LED PSF module maximum power consumption must not exceed the following values:

Power Consumption Requirements

PSF module	Power Consumption @ 24°C	Power Consumption @ 74°C
UPRAISED HAND	10.0 W	12.0 W
WALKING PERSON	9.0 W	12.0 W

Wiring and terminal block must comply with Section 13.02 of ITE publication, Equipment and Material Standards, Chapter 2, "Vehicle Traffic Control Signal Heads." The LED PSF module must be supplied with spade lugs and 3 secured, color-coded, 3-foot long, 600 V(ac), 20 AWG minimum stranded jacketed copper wires. Wires must comply with NEC, rated for service at +105 °C.

LED PSF module must operate:

1. At a frequency of 60 Hz ± 3 Hz over a voltage range from 95 V(ac) to 135 V(ac) without perceptible flicker to the unaided eye. Fluctuations of line voltage must have no visible effect on luminous intensity of the indications. Rated voltage for measurements must be 120 V(ac).
2. Compatible with currently used State controller assemblies including solid state load switches, flashers, and conflict monitors. Comply with TEES Chapters 3 and 6. If a 20 ma alternating current or less is applied to the unit, the voltage read across the 2 leads must be 15 V(ac) or less.

LED PSF module on-board circuitry must:

1. Include voltage surge protection to withstand high-repetition noise transients. The voltage surge protection must comply with NEMA Standard TS2, Section 2.1.6.
2. Comply with FCC, Title 47, SubPart B, Section 15 regulations for Class A emission limits for electronic noise.

LED PSF module must provide a power factor of 0.90 or greater.

Total harmonic distortion from current and voltage induced into an alternating current power line by LED PSF module must not exceed 20 percent at an operating temperature of 25 °C.

The LED PSF module circuitry must prevent perceptible light emission to the unaided eye when a voltage, 50 V(ac) or less is applied to the unit.

When power is applied to LED PSF module, light emission must occur within 90 ms.

The "UPRAISED HAND" and "WALKING PERSON" symbol indications must be electrically isolated from each other. Sharing a power supply or interconnect circuitry between the 2 indications is not allowed.

10-3.20 DETECTORS

Loop detector sensor units will be State-furnished in conformance with the provisions in "Materials" of these special provisions.

Loop detector lead-in cable shall be Type C.

Slots shall be filled with hot-melt rubberized asphalt sealant.

For Type E detector loops, sides of the slot shall be vertical and the minimum radius of the slot entering and leaving the circular part of the loop shall be 1-1/2 inches. Slot width shall be a maximum of 5/8 inch. Loop wire for circular loops shall be Type 2. Slots of circular loops shall be filled with hot melt rubberized asphalt sealant.

The depth of loop sealant above the top of the uppermost loop wire in the sawed slots shall be 2 inches, minimum.

PREFORMED INDUCTIVE LOOPS

Prefomed inductive loops shall be the type shown on the plans.

The loop shall be 6-foot square unless otherwise shown. The loop shall consist of 4 turns of No. 16, or larger, wire with Type THWN or TFFN insulation.

The loop wires shall be encased in 3/8 inch, minimum, Schedule 40 or Schedule 80 PVC or polypropylene conduit. The conduit shall be sealed to prevent the entrance of water and the movement of wires within the conduit.

The loop wires from the preformed loop to the adjacent pull box shall be twisted together into a pair (at least 2 turns per foot) and encased in Schedule 40 or Schedule 80 PVC or polypropylene conduit between the preformed loop and the adjacent pull box or detector handhole. The lead-in conduit shall be sealed to prevent the entrance of water at the pull box or handhole end.

In new reinforced concrete structure decks, the preformed loops shall be secured to the top of the uppermost layer of reinforcing steel using nylon wire ties. The loop shall be held parallel to the structure deck by using PVC or polypropylene spacers where necessary. Conduit for lead-in conductors shall be placed between the uppermost 2 layers of reinforcing steel.

Prefomed inductive loops shall not be installed in existing structure decks.

10-3.21 MICROWAVE VEHICLE DETECTION SYSTEM - SIDE FIRE

This work consists of furnishing and installing a microwave vehicle detection system (MVDS). The work also consists of removing MVDS, including wireless data service system without wireless modem antenna, after the Engineer notifies you and before the completion of the contract. You must furnish all equipment necessary for installation and operation of the MVDS.

MATERIALS LIST AND DRAWINGS

Submit a list of proposed materials to install the MVDS, including the drawings and other data, to the Engineer under Section 86-1.04, "Equipment List and Drawings," of the Standard Specifications. Additionally, you must provide the following before the completion of the contract:

- 1. Certificate of Compliance** – Submit a Certificate of Compliance for MVDS to the Engineer under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.
- 2. Site Analysis Report** - Prior to MVDS installation you must review each detection site and submit a written analysis recommending the optimum sensor placement to comply with the performance requirements of these special provisions. You must consult the MVDS manufacturer for review of the report.
- 3. Lane Configuration** - The documentation must include a diagram that illustrates how the microwave beam is covering the traffic lanes as well as the corresponding MVDS connector pins or wire terminals that correspond to the respective lanes. The lanes must be identified by direction (NB, SB, EB, WB), and in order, with lane one being the lane nearest to the center of the roadway.
- 4. Mounting and Wiring Information** - You must submit to the Engineer for approval one set of detailed diagrams showing wiring connections for each MVDS. The approved diagrams must be covered separately on each side with clear self-adhesive plastic and placed in a heavy-duty plastic envelope. The

envelope must be attached securely to the inside of the cabinet door or at a location designated by the Engineer.

5. **Communication Protocol** - The MVDS communication protocol must be open and must be freely available for use in the public domain. You must submit documentation that defines the complete MVDS communication protocol (e.g. message structure organization, data packet length, as well as all information necessary to make use of such messages).
6. **Remote Programming** - You must submit all information and furnish all software necessary for operating the system from a remote Windows XP or newer based Personal Computer (PC). This information and software must include at minimum the capability to calibrate, tune, align, and program the MVDS and must be provided on a Windows XP or newer compatible compact disc (CD). The information must be formatted so that the files can be matched with the equipment being calibrated or aligned. This documentation must contain files that allow for replacement equipment to be loaded with the same configuration.
7. **MVDS Accuracy Analysis** - You must be responsible for conducting MVDS Performance Testing and must submit to the Engineer three copies of a MVDS accuracy analysis report that complies with the requirements of these special provisions within 15 days of MVDS performance testing. The MVDS accuracy analysis report must include the original video recordings as well as digital versatile disc (DVD) or CD copies of the video images covering the analysis periods, and tabulated results comparing the detection performance requirements of the MVDS vehicle measured quantities to the recorded video image measured quantities.
8. **Acceptance Testing Documentation** - You must submit a test plan, containing time and period of the testing, to be approved by the Engineer. The test plan must be organized so that the Engineer will be able to perform acceptance testing using the documentation without assistance from you. You must collect and submit the data to be certified by the Engineer. If required by the Engineer, the data must be collected in the presence of the Engineer.
9. **Acceptance Testing Schedule** - You must submit a testing schedule to the Engineer for approval 15 days prior to acceptance testing of the MVDS. If the testing period extends beyond the normal working shift or if you fail to submit the necessary material for the testing within one hour of the scheduled testing start time, the Engineer may cancel testing for the day.
10. **Training** - You must submit a copy of the training material to the Engineer for approval 30 days prior to the training. The content of the training must include instruction on how to align, program, adjust, calibrate and maintain the MVDS.

FUNCTIONAL REQUIREMENTS

MVDSs must simultaneously provide vehicle detection data in the form of vehicle presence, volumes, counts, speed, classification, and occupancy for a minimum of 10 lanes of traffic and comply with the performance requirements of these special provisions. MVDSs must provide a separate detection zone per lane and detect vehicles as close as 7 feet and as far as 250 feet from the MVDS sensor. The minimum detection zone range increment or resolution must be 2 feet or less. Detection zones must not detect vehicles on adjacent lanes, must not drift out of the lane assigned, must emulate two single loop detectors for measuring speed, and must have configurable width set to a width between 7 feet and 9 feet before installation. MVDSs must monitor traffic lanes in the presence of barrier railings, guardrails and other obstacles.

Typical MVDS installation is at a minimum of 7 feet from the nearest lane and at a minimum height of 15 feet above the roadway detection zones. MVDSs must meet the following detection performance requirements:

1. Average 5 minute volumes for all lanes combined with better than 95 percent accuracy compared to vehicles observed in video images for the same period, for any 15 minute period selected by the Engineer.
2. Average 30 second volumes in every lane with better than 90 percent accuracy compared to vehicles observed in video images for the same period, for any 5 minute period selected by the Engineer.
3. Average 30 second speed in any lane with better than 95 percent accuracy, for any 5 minute period selected by the Engineer.
4. Average 5 minute occupancy for any lane with better than 85 percent accuracy, for any 15 minute period selected by the Engineer.
5. Count accuracy, when compared to vehicles observed in video images for the same period, must be not less than 90 percent for any lane and not less than 95 percent for all lanes combined.
6. Average 15 minute classification according to user defined criteria with better than 90 percent accuracy compared to vehicles observed in video images for the same period. Vehicle Classification (or Length Classification) must be provided for categories (small car, average car, mid size car, long car, extra-long

- car) that are user definable as either by length parameters (minimum length to maximum length for the category) or by a multiple of length of the average car.
7. You must submit the criteria for speed acceptance test for approval by the Engineer. You must also submit speed acceptance test date, time and periods for verification by the Engineer.

MVDS must consist of a sensor unit and include all required mounting hardware, power supplies, standard surge suppression, cables, connectors and wiring. The MVDS sensor must include, as a minimum, a directional microwave transmitter, antenna, microwave receiver, a processor, memory and an optically isolated serial EIA-RS232/EIA-485 communications interface.

The MVDS must have an Ethernet communication port that supports the National Transportation Communication for ITS Protocol (NTCIP). The MVDS communication protocol must be non-proprietary and openly specified and available for use in the public domain. The MVDS must be addressable and must download count, speed, and occupancy data when polled by the traffic management center computer. Speed must be configurable in English units. The MVDS must support unit set-up from a serial console port on the MVDS unit. The console port protocol must support sensor unit setup from a local Windows XP or newer compatible laptop and from a remote location with a desktop computer.

You must connect MVDS sensor contact outputs to Model 170E/2070 Controller input file to emulate inductive loops and you must install microwave sensor interface cards (MSIF).

The MVDS sensors must be connected to a MSIF installed in the input file of a state furnished Model 170E or Model 2070 controller cabinet. Each detection zone must provide two optically isolated relay output contact pairs that follow the presence and speed of vehicles in every traffic lane, and must send signals to the controller with the accuracy described in these special provisions. The MSIF must have indications for power, communication, as well as the real time operation of each detection contact output.

You must install a MVDS termination assembly (MTA). The MTA must be a single circuit board or a set of modular DIN rail mounted assemblies. The MTA must provide screw lug cable terminations for all MVDS units with clearance for routing the cables and labels to identify the connected MVDS detectors. The MVDS unit must be connected to the MTA in the order shown on the plans and as directed by the Engineer. Each lane detection zone must have an LED that indicates vehicle presence with a minimum viewing angle of 50 degrees and visible from 5 feet in daylight. Power must be routed from the MTA to each MVDS unit. Each MVDS power connection shall have fast-blow AGC type fuse or a resettable circuit breaker such that the loss of power to any single MVDS due to over-current must not limit the operation of the other connected MVDS. The fuses or breakers shall be easily accessible, and replaceable or resettable without requiring tools or removing cables, connectors, or other terminations. The MTA must have DB9 socket and RJ-45 jack connectors for every connected MVDS unit for EIA-232 and Ethernet communications with a local laptop computer as well as with a remote computer for performing setup and diagnostics. The MTA must provide standard optical isolation or standard surge protection to each serial RS-485 communications interface to the MVDS sensor unit and to each contact pair connected to the MVDS sensor unit. The Connectors must be labeled and provide internal routing of data between the DB9 connectors and the MVDS terminal strips. You must supply the cable and connectors for connecting the communication modem as shown on the plans and as specified in these special provisions.

MVDSs must be user programmable in the field, via the MVDS unit console port, with a Windows XP or newer compatible laptop computer. You must furnish software, firmware and equipment to set-up, calibrate and operate the MVDS unit. MVDS software must auto-configure detection lanes, including detection lane placement, and auto-setup sensor sensitivity by observing vehicle traffic. MVDSs must be designed so that a trained Department employee can configure and calibrate the MVDS in less than 15 minutes per lane after the MVDS is installed.

TECHNICAL REQUIREMENTS

MVDSs must be FCC certified under Part 15 for low-power, unlicensed, continuous radio transmitter operation. The MVDS must comply with FCC regulations under all specified operating conditions and over the expected life of the MVDS.

MVDS sensor unit must not weigh more than 5 pounds not including optional communication devices. The MVDS must operate over a temperature range from -40° F to $+165^{\circ}$ F, with up to 95 percent relative humidity. The MVDS sensor enclosure must be weatherproof with a NEMA 4X rating, and the sensor mounted and directed perpendicular to the flow of traffic lanes at the locations shown on the plans.

All electronic assemblies must comply with the requirements detailed in Chapters 1 and 5 of the Transportation Electrical Equipment Specifications (TEES).

The MSIF must be inserted into the controller input file slots using the edge connector to obtain limited 24 V(dc) power, to provide inputs for the MVDS unit outputs and to provide contact closure outputs for the controller inputs. You must not rewire the Model 170E or Model 2070 controller cabinet. The MSIF must comply with the requirements detailed in Chapter 1 as well as Chapter 5, Section 5 of TEES.

MVDS sensors must be wired with a connectorized cable harness. Cables must run continuously (without splices) between the controller cabinet and either the MVDS sensor unit or the MVDS Surge Protection Assembly (MSPA), and must terminate in labeled terminal blocks identified with the purpose served. The connector must be a standard Mil Type and rated plug. The cable must have the number of conductors specified by the MVDS manufacturer to support the number of detection zones depicted on the plans plus spares for two future zones with an overall shield and copper drain wire. Conductors must be stranded copper equal to or exceeding the minimum strands and wire dimensions specified by the MVDS manufacturer for the wiring distance involved and covered with a minimum 12 mils polyvinyl chloride (PVC) insulation, rated for 300 V at 221° F. The outer jacket must be chrome PVC with minimum thickness of 53 mils and the outside diameter of the cable must not exceed 3/4 inch. A minimum of 6.5-foot slack of MVDS cable must be coiled at the bottom of the controller cabinet. Slack in other cabinets must be as shown on the plans and as directed by the Engineer.

MVDS sensor unit power supplies or transformers must be vertically mounted on a standard DIN rack rail using standard mounting hardware. You must wire the MVDS power conductors to DIN rail mounted terminal blocks in the controller cabinet as directed by the Engineer. The serial data communication output conductors must be terminated at MTA, and continue to a DB9F socket connector for setup and diagnostic access. The contact pair output conductors must be terminated at MTA and continue to terminal block, TB-2. The ends of unused and spare conductors must be coiled and taped to prevent accidental contact to other circuits. Conductors inside the cabinet must be labeled for the functions described in the approved detailed diagrams.

The power supply or transformer must meet or exceed the following minimum requirements:

	Power Supply	Transformer
Power Cord	Standard 120V(ac), 3 prong cord, at least 40 inches in length (may be added by Contractor)	Standard 120V(ac), 3 prong cord, at least 40 inches in length (may be added by Contractor)
Type	Switching mode type	Class 2
Rated Power	Twice (2x) full system load	Twice (2x) full system load
Operating Temperature	From -35 °C to +74 °C	From -35 °C to +74 °C
Operating Humidity Range	From 5 percent to 95	From 5 percent to 95
Input Voltage	From 90 V to 135 VAC	From 90V to 135 VAC
Input Frequency	60 Hz +/- 1 Hz	60 Hz +/- 1 Hz
Inrush Current	Cold start, 25 A max. at 115 V	N/A
Output Voltage	As required by the MVDS	As required by the MVDS
Overload Protection	From 105 percent to 150 percent in output pulsing mode	Power limited at >150 percent
Over Voltage Protection	From 115 percent to 135 percent of rated output voltage	N/A
Setup, Rise, Hold Up	800ms, 50ms, 15ms at 115VAC	N/A
Withstand Voltage	I/P-0/P:3kV, I/P-FG:1.5kV, for 60 sec.	I/P-0/P:3kV, I/P-FG:1.5kV, for 60 sec
Working Temperature	Not to exceed 70 °C@30% load	Not to exceed 70 °C@30% load
Safety Standards	UL 1012, TUV EN60950	UL 1585
EMC Standards	EN55022 Class B, EN61000-4-2, 3, 4, 5 and EN61000-3-2, 3	N/A

Field terminated circuits must include transient protection that complies with IEEE Standard 587-1980 Category C. Surge protection must be provided either at the MVDS sensor unit or at the MSPA, and at the MTA. A MSPA is required if MVDS sensor unit does not comply with either the transient protection requirements or the optical isolation requirements for each serial RS-232/RS-485 communications interface and each output contact pair.

MSPA for each MVDS must be preconfigured and tested by the manufacturer of the MVDS sensor unit, and include a back plate with cable management holes, three DIN rails, standard DC power surge protection for DC power external connections, standard RS-232 surge protection for communications interface, standard RS-485 surge protection for communications interface, standard AC surge protection for output contact pairs, terminals, locking mechanism for standard Department lock, NEMA 3R 1/8 inch aluminum UL Listed housing with stainless steel hinge and carriage bolts, power and communication bus, and holes with outdoor bushings for cables runs to the MVDS sensor unit and the controller cabinet. MSPA must not weigh more than 40 pounds.

You must furnish and install a temporary wireless data service system for remote communications at each MVDS location as specified in these special provisions.

The MVDS must automatically restore normal operation following a power failure within 3 minutes and not require manual intervention. The MVDS must maintain the configuration and calibration information in non-volatile memory and retain the information while powered off for at least 90 days.

The MVDS must be configurable for 30 second to 24-hour polling cycles and store vehicle count, speed, classification, and occupancy data at configurable intervals including 10 second, 30 second, 1 minute, 15 minute and 1 hour intervals.

The MVDS must be tested and in standard production for a minimum of 3 months. The Contractor shall not install any MVDS that is older than 6 months from the scheduled start date of the MVDS installation as indicated by date codes or serial numbers of electronic circuit assemblies.

The MVDS system and all supporting equipment must be designed to operate continuously in an outdoor traffic monitoring and control environment. You must submit a manufacturer's warranty stating that the manufacturing quality and electronic components must support a Mean Time Between Failures of 10 years in this environment.

CONSTRUCTION

You must assure that the MVDS will not cause harmful interference to radio communication in the area of the installation as required by FCC Part 15 requirements. The MVDS units must be installed such that each unit operates independently and such that MVDS units do not interfere with other MVDS units or other equipment in the vicinity.

You are responsible for site visits and analysis of each proposed pole location to assure that the detector placement will comply with the manufacturer's published installation instructions, and the performance required in these special provisions including detection performance requirements. You must confirm detector placement with the manufacturer and you must submit the Site Analysis Report to the Engineer for review and approval before performing work at the MVDS location. When the Site Analysis Report requires a change in the proposed pole location, you must arrange a meeting with the manufacturer and the Engineer to select a new pole location.

You must not proceed with any MVDS installation without the Engineer's written approval of the pole location.

You must be responsible for the compatibility of components and for making necessary calibration adjustments to comply with the performance required in these special provisions. You must furnish equipment required to setup, calibrate, verify performance and maintain the MVDS. Each MSIF assigned to a detection zone or traffic lane must be configured to sense the emulated loop detectors assigned on the plans or directed by the Engineer.

You must furnish programming software needed to support the MVDS. The software must be installed in the appropriate equipment including a laptop for local programming and a desktop computer for remote programming, and must be used for the acceptance testing.

TESTING

Accuracy of the MVDS system must be verified by comparing the MVDS vehicle counts, occupancy and speed to recorded video image vehicle counts, occupancy and speed for the same period. The video camera must be located and oriented so that traffic is visible in all lanes. Video images must be time stamped with a resolution of tenths of a second. Analysis periods of recorded video images must be recorded to a DVD or CD media for viewing on a PC. The video field of view must totally encompass the area in which vehicles are detected. You must provide a means for synchronizing the test start and test ending times or furnish software that displays time stamped MVDS data along with the video images of the moving vehicles. You must submit to the Engineer the MVDS accuracy analysis reports as specified in these special provisions and make a copy of these materials for their own use.

The accuracy test must take place at each of the detection site locations shown on the plans and occur during a complex traffic period as specified by the Engineer. The following video recording and analysis options that depend on the available traffic conditions are acceptable; however, the heaviest expected traffic conditions should be used, if possible. The minimum recording period must be 30 minutes when the recording includes congested traffic (vehicles traveling at less than 20 mph for five or more minutes in any lane). The minimum recording period must be 45 minutes when the traffic flow exceeds 1500 vehicles per hour in any lane during the test period. The minimum recording period must be 60 minutes when the flow is less than 1500 vehicles per hour in every lane. The analysis must be based on a minimum of 100 detected vehicles in every lane and cover the same time period for all lanes. The Engineer will select the time periods used for performance testing from the recorded video. The total vehicle count for every lane must be used and include the first and last partial vehicles for each lane. Errors allowed in the start and finish of the MVDS and manual counts are included in the detection performance requirements specified in these special provisions.

MVDS unit vehicle counts must be compared to vehicle counts during the complex traffic period specified by the Engineer. Vehicles licensed for use on State roads must be counted by the MVDS. The data accuracy must be determined by the formula $100\{1 - [\text{absolute value} (TC-MC)/TC]\}$ where TC= Traffic Count derived from the media

recording, $MC = MVDS$ reported count over the same period of time, and where the resulting fraction is expressed as an absolute value.

The accuracy of each MVDS unit must be determined and documented so that each unit may be approved or rejected separately by the Engineer. Your failure to submit the materials at the conclusion of testing invalidates the test. The recorded media serves as acceptance evidence and must not be used for calibration. You must complete the calibration prior to testing and verification.

The Engineer will review the MVDS accuracy analysis report findings and accept or reject the MVDS performance test results. Determination of vehicle anomalies or unusual occurrences will be decided by the Engineer. Data or counts that are not accepted by the Engineer must be considered errors and count against the MVDS unit's calibration. If the Engineer does not accept the test results within 15 days or finds that the MVDS does not meet detection performance requirements, then a failed attempt occurs and you must re-calibrate and re-test the unit and re-submit new test data within 10 days. Following either three failed attempts or 35 days without approval after initial test results, you must replace the MVDS unit with a new unit.

In addition to the accuracy analysis performed by you, you must furnish equipment, software, documentation, support equipment, and any other materials, personnel labor and devices that may be required for acceptance testing by the Engineer. You must notify the Engineer 15 days before the MVDS unit is ready for acceptance testing. Testing must be scheduled to be accomplished before the end of the normal work shift.

TRAINING

You must provide a minimum of 7 hours of training by a certified manufacturer's representative for up to 7 students selected by the Engineer. The content of the training must include instruction on how to align, program, adjust, calibrate and maintain the MVDS. You must furnish materials and equipment for the training. You must give the Engineer 15 days notice prior to the training. The time and location of the training must be agreed upon by the Engineer and you. If no agreement can be reached, the Engineer will determine the time and location.

PAYMENT

The contract lump sum price paid for microwave vehicle detection system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing microwave vehicle detection system, complete in place, including initial site analysis, set-up and configuration of the system, calibration of the device performance, verification of detector accuracy, training of State personnel, testing, and re-testing of failed units, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

For progress pay purposes, an MVDS will not be included for payment until the Engineer accepts the accuracy result for that system.

10-3.22 LUMINAIRES

Ballasts shall be the lag regulator, or high reactance type.

10-3.23 SOFFIT AND WALL LUMINAIRES

No. 7 pull boxes adjacent to each soffit luminaire shown on the plans are not required.

10-3.24 INTERNALLY ILLUMINATED SIGNS

The "METER ON" sign shall be a Type A pedestrian signal modified so that the reflector shall be a single chamber with 2 incandescent lamps.

The message shall be white "METER ON" as shown on the plans. White color shall be in conformance with the provisions in Section 86-4.06, "Pedestrian Signal Faces," of the Standard Specifications.

Lenses shall be 3/16 inch, minimum thickness, clear acrylic or polycarbonate plastic or 1/8 inch nominal thickness glass fiber reinforced plastic, with molded, one piece, neoprene gasket. Message lettering for "METER" shall be "Series C," 4-1/2 inches high, with uniform 1/2 inch stroke, and for "ON" shall be "Series C," 6 inches high, with uniform one inch stroke. Letters shall be clear, transparent or translucent, with black opaque background silk screened on to the second surface of the lens.

10-3.25 INTERNALLY ILLUMINATED STREET NAME SIGNS

Internally illuminated street name signs shall be Type A.

10-3.26 PHOTOELECTRIC CONTROLS

Contactors shall be the mechanical armature type.

ABBREVIATIONS AND GLOSSARY

The following abbreviations and glossary apply to these special provisions.

ABBREVIATIONS

ADM	Add Drop Multiplexer
AIS	Alarm Insertion Signal
APS	Automatic Protection Switching
AVC	Automatic Vehicle Classification system
B8ZS	Bit eight Zero Suppression (data transmission protocol)
BERTS	Bit Error Rate Test Set
BITS	Building Integrated Timing Supply
BNC	Bayonet Navy Connector
bps	Bits per second
CCD	Charge-Coupled Device
CCK	Camera Control Keypad
CCR	Camera Control Receiver
CCT	Camera Control Transmitter
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CMP	Configuration Management Plan
CMS	Changeable Message Sign
COMM	Communication
CPU	Central Processing Unit
CTRL	Controller
CTS	Clear to Send
DACCS	Digital Access Cross Connect System
D4	4 th version of the D-signal format for time division multiplexers
dB	Decibel
dBm	Decibel referred to milliwatts
dBm	Decibel above reference noise
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DCS	Digital Cross-connect System
DEMARC	Demarcation
DEMUX	Demultiplexer
DS-1	Digital Signal Level 1. Digital transmission rate of 1.544 megabits per second.
DS-3	Digital Signal Level 3. Digital transmission rate of 44.736 megabits per second.
DTE	Data Terminal Equipment
DWP	Department of Water and Power (Los Angeles)
ESF	Extended Superframe Format
FRP	Fiberglass Reinforced Plastic
FXS	Foreign eXchange Subscriber
GUI	Graphical user interface
HVAC	Heating, Ventilation and Air Conditioning
IRE	IRE is a SMPTE standard video reference level
ITU	International Telecommunications Union
JKFD	Jackfield
LA	Los Angeles
M13	Multiplexer, 28 DS-1 circuits to 1 DS-3 circuit
MUX	Multiplexer
NHD	North Hollywood
NMS	Network Management System
NRZ	Non-Return to Zero
NTSC	National Television Standards Committee

OC	Optical Channel
OD	Outside Diameter
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
OTDR	Optical Time Domain Reflectometer
OW	Order Wire (multiple voice circuit)
P	Pair
P22	Pair 22 American wire gauge
p-p	Peak to peak
PC	Personal computer
PCMS	Pasadena City Municipal Services or Portable Changeable Message Sign
PDA	Power Distribution Assembly
PIN	Positive-Intrinsic-Negative
PR	Pair
PRBS	Pseudo-Random Bit Sequence
QRSS	Quasi-Random Signal Source
RUS	United States Rural Utilities Service
RF	Radio Frequency
RG	Regulatory Guide
RMS	Ramp Metering System
RTS	Request To Send
Rx	Receive
SF	Superframe Format (D4)
SM	Singlemode
SMFO	Singlemode Fiber Optic
SONET	Synchronous Optical Network
SSOVP	Solid-State Over Voltage Protector
SSPC	Steel Structures Painting Council
ST	Type of connector
TIA	Telecommunications Industry Association
TL-1	Transaction Language 1
TLP	Transmission Level Point
TOSNET	Traffic Operational System Network
TMC	Traffic Management Center
TSG	Traffic Signal Generator
TSI	Time Slot Interchange
Tx	Transmit
UNC	Unified National Coarse
UNIX	Specific operating system
UV	Ultraviolet
VID	Video Identification and date/time Display
VSK	Video Switch Keypad
VSM	Video Switch Matrix
VT-1.5	Virtual Tributary – Level 1.5 (1.728 Mb/s)
VT	Virtual Tributary
WFM	Waveform Monitor
WTO	Wire Transit Only
X.11, X.25	Specific protocol standards generated by the International Telecommunications Union (formerly CCITT)

GLOSSARY

Breakout: Cable "breakout" is produced by removing jackets just beyond the last tie-wrap point, exposing 3 feet to 6 feet of cable buffers, Aramid strength yarn and central fiberglass strength members and cutting Aramid yarn, central strength members and buffer tubes to expose individual glass fibers for splicing or connection to the appropriate device.

Cable Storage Cabinet: A cabinet for holding excess cable slack, allowing flexibility in equipment location and allowing cable pulling for re-splicing.

Channel: An information path between a discrete input and a discrete output. One single input to a multiplexer or output from a demultiplexer.

Closed Circuit Television Assembly: Camera, lens, environmental enclosure, and necessary connectors and cables.

Connector: A mechanical device providing the means for attaching to and decoupling from a transmitter, receiver or another fiber (such as on a patch panel).

Connectorized: A fiber with a connector affixed to it.

Connector Module Housing (CMH): A patch panel used in the FDF to terminate singlemode fibers with most common connector types. It may include a jumper storage shelf and a hinged door.

Couplers: Devices normally located within FDF's mounted in panels, that mate 2 fiber optic connectors to facilitate the transition of optical light signals from one connector into another. They may also be used unmounted, to join 3 simplex fiber runs. Couplers may also be referred to as adapters, feed-throughs and barrels.

Fiber Distribution Frame (FDF): A rack mounted system usually installed in the TMC that consists of a standard equipment rack, fiber routing guides, horizontal jumper troughs, fiber distribution units (FDU), connector module housings (CMH) and splice module housings (SMH).

FDF's serves as the "home" for passive fiber optic components from cable breakout, for connection by jumpers, to the electronics.

Fiber Distribution Unit (FDU): An enclosure containing a Connector Module Housing (CMH) and a Splice Module Housing enclosure.

Field Cabinet: A roadside cabinet housing controllers or communications equipment.

Intermediate Distribution Frame Room (IDF room): The room or area inside a hub or hut containing the FDF and other distribution hardware.

Jumper: A short fiber optic cable with connectors installed on both ends, typically used for connection within an FDF.

Light Source: A portable piece of fiber optic test equipment used to perform end-to-end attenuation testing in conjunction with a power meter containing a stabilized light source operating at the designed wavelength of the system under test.

Link: A passive section of the system, the ends of which are to be connected to active components. A link may include splices and couplers. For example, a video link may be from a F/O transmitter to a video Multiplexer (MUX).

Main Distribution Frame Room (MDF room): The room inside the TMC which contains the FDF and other distribution hardware.

Mux/Demux: Multiplexer/Demultiplexer.

Optical Time Domain Reflectometer (OTDR): Fiber optic test equipment used to measure total amount of power loss between 2 points and the corresponding distance. It provides a visual and printed display of the relative location of system components such as fiber sections, splices and connectors and as losses attributable to each component or defect in fiber.

Patchcord: A short jumper.

Pigtail: A short length of fiber optic cable with a connector installed on one end.

Power Meter: A portable fiber optic test equipment used to perform end-to-end attenuation testing in conjunction with a light source, containing a detector that is sensitive to light at the designed wavelength of the system under test. Its display indicates the amount of power injected by the light source that arrives at the receiving end of the link.

Segment: A section of F/O cable not connected to an active device which may or may not have splices per the design.

Splice Closure: An environmentally sealed container used to organize and protect splice trays, normally installed in a splice vault that allows splitting or routing of fiber cables from multiple locations.

Splice Module Housing (SMH): A housing for storage of splice trays, pigtails and short cable lengths.

Splice Tray: A container used to organize and protect spliced fibers.

Splice Vault: An underground vault used to house splice closures.

10-3.27 MODIFY COMMUNICATION SYSTEM

Modify communication system must consist of, but not limited to:

1. Removing, relocating and disposing pull boxes, and conduits, of various sizes and types,
2. Installing:
 - 2.1. Closed circuit television camera assembly, including camera control circuits and accessories, CCTV wiring, including composite video cables, connectors and coaxial cables,

- 2.2. Video encoder, temperature sensor, layer 2 ethernet switch, and connecting wires and cables,
 - 2.3. Conduits, conductors and cables of various sizes, types and installation methods,
 - 2.4. Splice vaults, pull boxes of various sizes, types and installation methods,
 - 2.5. Circuits breaker, in existing service equipment enclosure,
 - 2.6. Fiber optic splice closures inside existing or new splice vault or pull boxes of various sizes and types, and
 - 2.7. Other required incidental equipment,
- 3 Installing, and connecting existing or new conductors of various sizes, types and installation methods, including, but not limited to, conductors, composite video cables, coaxial cables, and singlemode fiber optic cables (12 SMFO, 36SMFO and 2-72SMFO) cables, and incidentals to make the installed or connected equipment fully operational, complete in place, as shown on the plans, and as directed by the Engineer.

New equipment must be current standard production units and must have been in production for a minimum of 6 months.

You must arrange, at your expense, to have a technician qualified to work on traffic signal and communication system routing materials and equipment present at the time these materials and equipment are installed, modified, connected, or reconnected.

COMMUNICATION CONDUIT

Communication conduit must conform to the details on the plans and comply with Section 86-2.05, "Conduit," of the Standard Specifications and these special provisions.

Conduit must enter splice vaults and communication pull boxes through knockouts. Conduits entering ends of communication pull boxes must be vertically and horizontally aligned with conduits at the opposite end of communication pull boxes. Conduit ends must not extend beyond interior wall of splice vaults and communication pull boxes. Space around conduits through end walls of splice vaults and communication pull boxes must be filled with minor concrete cement mortar conforming to the provisions in Section 51-1.135, "Mortar," of the Standard Specifications. Conduit bodies or communication pull boxes must not be used in lieu of specified bends to change the direction of communication conduit runs, except where specified.

Bends must not be placed in sections of conduit in excess of those indicated on the plans without the approval of the Engineer. The total degrees of bending in a section of conduit between splice vaults and communication pull boxes must not exceed a total of 180 degrees, except where specified.

Changes in indicated conduit bends may be made to suit field conditions if the change reduces the degree of bend or increases the radius of bend. The angle of the bend must not be decreased without the approval of the Engineer.

Minimum bending radius for 2 inches, 3 inches and 4 inches communication conduits must be 24 inches, 36 inches and 48 inches, respectively. Bends greater than 22 degrees must be factory bends and bends greater than 45 degrees must be galvanized rigid steel with necessary adapters.

Deflections of communication conduit must not exceed one inch/foot when avoiding obstructions. Conduit from typical trench sections must not deflect by more than one inch/foot from the alignment preceding or following communication pull boxes and splice vaults.

Where edge drains are in the path of conduit routing, you must first locate edge drains, then install conduit maintaining a minimum depth of 24 inches. If an edge drain is damaged by your work, repairs must be at your expense.

Conduit adjacent to overcrossings or bridge foundations must be trenched and installed in shoulders as close as possible to the edge of traveled way.

New communication conduits must not terminate in power pull boxes.

COMMUNICATION CONDUIT (BRIDGE)

Fiberglass communication conduit used on bridges and must conform to the details shown on the plans and to these special provisions.

Excavation and slurry cement must conform to Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications. Slurry cement backfill must reach initial set prior to placing reinforced concrete for approach slabs.

Where conduits are installed in soil, a 52 inches minimum bending radius for conduit installation from soil to pavement transition must be provided.

FIBERGLASS CONDUIT

Fiberglass conduit and components must comply with the specifications in ANSI/NEMA Standards Publication TC-14A or TC-14B, must be free of defects, including delaminating and foreign inclusions, nominally uniform in color, density and physical properties. Fiberglass conduits must be straight and ends must be cut square and true.

Fiberglass conduits and fiberglass conduit system components must be purchased from the same manufacturer to insure component compatibility.

Conduit Sizes

Fiberglass conduits must be supplied in 20-foot minimum lengths.

System Components

Fiberglass conduit components must include compatible fittings, adapters, expansion joints, and factory bends at nominal radii of 52 inches for 4-inch conduits.

Material

Fiberglass conduit system components must be produced from heat cured, corrosion resistant epoxy resin and continuous fiberglass roving. Materials must be manufactured for use at temperatures from -40 to 230 degrees F. Fiberglass conduit components must be manufactured using a homogeneously dispersed UV inhibitor. When exposed to direct diurnal sunlight, UV inhibitors must prevent the degradation of physical material properties, except for surface cosmetic appearance. Materials must contain no halogens above trace levels and must be fire resistant.

Joining Method

Joints must be watertight and withstand a minimum 1000 lbf of pullout tension.

Stiffness

Under a load of 27 lbf/ft of conduit, deflection of the inside diameter must not exceed 5 percent.

Impact Resistance

Minimum impact resistance values for fiberglass conduits must be as follows when measured as described in ASTM Designation: D2444-70, using a 20 pounds.tup "B" with a 2 inches radius nose:

4 inches conduit	7 pounds/ft
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Hangers, and Metal Supports (Bridge)

Wrapping tape for pipes in contact with soils must be a pressure sensitive polyvinyl chloride or polyethylene tape with a minimum thickness of 50 mil.

Anchor bolts, pipe clamps, nuts and bolts, and other fittings must be suitable for the type and size of the supply lines or casing and must conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Metal supports (bridge) must consist of galvanized steel pipe hangers/clamps, anchor bolts/rods, steel brackets and other fittings, and, where shown on the Standard plans, a stainless steel pipe protection shield.

Epoxy adhesive must conform to the provisions in Section 95-1, "General," of the Standard Specifications.

TRACER WIRE

Tracer wire must be provided and placed in communication conduits containing fiber optic cable as shown on the plans.

Tracer wire must be No. 12 minimum solid copper conductor with Type TW, THW, RHW, or USE insulation. A minimum of 3 ft of slack must be extended into each communication pull box, splice vault and fiber optic vault from each direction.

The tracer wire must form a mechanically and electrically continuous line throughout the length of the trench. Where trenched communication conduit joins metal conduit that has been jacked or drilled, the tracer wire must be bonded to the metal conduit with a brass grounding clamp.

Tracer wire may be spliced at intervals of not less than 500 feet and in pull boxes. Splices must conform to Section 86-2.09, "Wiring," of the Standard Specifications.

COLORED CEMENT BACKFILL

Slurry cement backfill for installation of communication conduits that will contain fiber optic cables must be a medium to dark, red or orange color. Concrete must be pigmented by addition of commercial quality cement pigments to concrete mixes. Red or orange concrete pigment must be LM Scofield Company; Orange Chromix Colorant; Davis Colors; or equal. The concrete must conform with the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications.

Excavation and slurry cement backfill must conform to Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications. Slurry cement backfill must reach initial set prior to placing reinforced concrete for approach slabs.

The size of the aggregate must not be larger than 0.375 inch.

PLASTIC SHEET (20 mil)

Plastic sheets, 20 mil thick, manufactured from high density polyethylene (HDPE) virgin compounds or polyvinyl chloride (PVC) virgin compounds, must be furnished and installed in trenches within roadway pavement, 0.10-foot over new communication conduits, as shown on the plans and as directed by the Engineer.

10-3.28 WARNING TAPE

Warning tape must be furnished, installed and placed in the trench over new conduits to receive reinstalled or new communication fiber optic conduit, as shown on the plans.

The warning tape must be:

Description	Parameter
Warning tape thickness	not be less than 4 mil thick
Warning tape width	6 inches
Warning tape material	pigmented polyolefin film
Warning tape tensile strength	minimum of 2800 psi for 6 inches wide strip
Warning tape elongation	minimum of 500 percent elongation before breakage
Printed Text height	1 inch
Message background color	bright orange color background
Message statement	CAUTION: BURIED FIBER OPTIC CABLE – CALTRANS (323)259-1922,
Message spacing intervals	approximately 30 inches

The printed warning must not be removed by the normal handling and burial of the tape and must be rated to last the service life of the tape.

The construction of the warning tape must be such that it will not delaminate when it is wet. It must be resistant to insects, acid, alkaline and other corrosive elements in the soil.

ONE INCH INNERDUCT

Innerducts must be installed to protect fiber optic cables. Separate innerducts must be installed for each fiber optic cable along communication mainlines, unless otherwise shown on the plans,

Innerducts must be one inch, smooth or ribbed high density polyethylene (HDPE) duct with the following characteristics:

1. Inner diameter greater than or equal to one inch, nominal.
2. Environmental stress crack resistance in excess of 2000 hours at -148 degrees F, no failures.
3. Cold impact resistance to -105 degrees F not brittle until -148 degrees F.
4. Minimum tensile strength of 600 pounds for finished product.
5. Minimum crush strength of 650 pounds.
6. Coefficient of friction less than 0.4 unlubricated on nonmetallic conduit and with common polyethylene cable jackets.

Yellow must be used for the 72SMFO, fiber optic cables used for video/data and contrasting colors approved by the Engineer for the 36SMFO and 72SMFO for spare. Exteriors of innerducts must be marked with sequential measurement markings each meter.

Innerduct must be installed using manufacturer's recommended practices using cable pulling lubricants recommended by the innerduct manufacturer and pull ropes conforming to the requirements in Section 86-2.05C,

"Installation," of the Standard Specifications. If innerduct is installed with adjacent cables in the same conduit, innerducts and cables must be installed together in one operation. Innerducts must be installed in continuous runs between communication pull boxes and splice vaults without splices or joints.

Ends must be smooth to prevent scraping of cables. Dynamometers must be used to record installation tensions and tension limiting devices must be used to prevent exceeding maximum pulling tensions during installation. Breakaway devices must be used to limit pulling tensions. One device must be placed in series with every element rated for less than maximum pulling tensions of that element. Innerducts must not be stressed beyond the minimum-bending radius allowed by the innerduct or fiber optic cable manufacturer.

Tension must be set to the manufacturer's maximum limit. Maximum pulling tension must be recorded for each innerduct run.

Immediately prior to installing cables, innerducts must be blown out with compressed air until foreign material is removed. After cables have been installed, ends of innerducts must be sealed with an approved type of sealing compound.

COMMUNICATION PULL BOXES

Communication pull boxes must comply with Section 86-2.07, "Traffic Pull Boxes," of the Standard Specifications and these special provisions.

Communication pull box steel covers must have "CALTRANS COMMUNICATION" markings.

Pull boxes must have tamper resistant pinhead bolts to secure the cover/metal lid to the box. Tamper resistant pinhead bolts must be approved by the Engineer before ordering and installing.

Concrete placed around and under communication pull boxes must contain a minimum of 20 pounds of cement per cubic foot.

Steel covers must be installed and kept bolted down.

Communication pull boxes shown on the plans in shoulders are shown for general location. The exact location must be outside of paved shoulders and will be determined by the Engineer.

Additional communication pull boxes must not be installed without the Engineer's written approval.

SPLICE VAULT

Splice vaults must be 60 inches (L) x 30 inches (W) x 30 inches (D) nominal inside dimensions and must conform to Section 86-2.06, "Pull Boxes," of the Standard Specifications and these special provisions. Covers must be in one or 2 sections with inset lifting pull shots in each portion. Cover markings must be labeled "CALTRANS COMMUNICATION" on each cover section. Enclosures, covers and extensions must be concrete gray. Vault and covers may be constructed of reinforced portland cement concrete or of non-PCC material.

Splice vaults must have tamper resistant pinhead bolts to secure the cover/metal lid to the box. Tamper resistant pinhead bolts must be approved by the Engineer before ordering and installing.

Non-PCC vault and covers must be sufficiently rigid that when a 100 pounds concentrated force is applied perpendicular to the midpoint of one of the long sides at the top, while the opposite long side is supported by a rigid surface, the cover may be removed without the use of tools. When a vertical force of 1500 pounds is applied, through a 0.5-inch by 3-inch by 6-inch steel plate, to a non-PCC cover in place on a splice vault, the cover must not fail and must not deflect more than 0.25 inch.

Splice vaults must be installed as detailed and where shown on the plans. Splice vaults and covers must have an AASHTO HS 20-44 rating where shown on the plans, except in areas protected from vehicular traffic, may be rated for AASHTO H5 loads (25 percent of HS 20-44).

Splice vaults must be installed one inch above grade in unpaved areas.

Splice vaults shown on the plans in shoulders are shown for general location. Exact locations will be determined by the Engineer.

Metallic or non-metallic cable racks must be installed on the interior of both sides of splice vaults. Racks must be capable of supporting a load of 100 pounds, minimum, per rack arm. Racks must be supplied in lengths appropriate to boxes in which they will be placed. Rack arms must not be less than 6 inches in length. Metallic cable racks must be fabricated from ASTM Designation: A36 steel plate and must be hot-dip galvanized after fabrication. Steel plate, hardware, and galvanizing must conform to the requirements in Section 75, "Miscellaneous Metal," of the Standard Specifications. Metallic cable racks must be bonded and grounded.

FIBER OPTIC CABLE

Fiber optic cable must conform to the details shown on the plans and these special provisions.

Definitions:

The following definitions must apply to fiber optics:

1. Active Component Link Loss Budget: Difference between average transmitter launch power (in dBm) and receiver maximum sensitivity (in dBm).
2. Distribution Cable: Fiber cable that provides connections between hubs. Drop cables are typically spliced into distribution cables.
3. Drop Cable: Fiber cable that provides connections between distribution cables to field elements. Typically these run from splice vaults to splice trays within field cabinets. Drop cables are usually short in length (less than 65 feet) and are of the same construction as outside plant cable. "Breakout cable" is used interchangeably with drop cable.
4. End-to-End Loss: The maximum permissible end-to-end system attenuation is the total loss in a given link. This loss could be actual measured loss or calculated using typical (or specified) values. This number will determine the amount of optical power (in dB) needed to meet the System Performance Margin.
5. Fan Out Termination - Permits branching of fibers contained in optical cables into individual cables and can be done at field locations, allowing cables to be connectorized or terminated per system requirements. A kit provides pullout protection for individual bare fibers to support termination. It provides 3 layers of protection consisting of a Teflon inner tube, a dielectric strength member, and an outer protective PVC jacket. Fan out terminations must not be used for more than 6 fibers. Use of a patch panel would be appropriate.
6. F/O: Fiber optic.
7. FOOP: Fiber optic outside plant cable.
8. FOTP: Fiber optic test procedures as defined by TIA/EIA standards.
9. Loose Tube Cable: Type of cable construction in which fibers are placed in buffer tubes to isolate them from outside forces (stress). A flooding compound or material is applied to the interstitial cable core to prevent water migration and penetration. This type of cable is primarily for outdoor applications.
10. Mid-span Access Method: Procedure in which fibers from a single buffer tube are accessed and spliced to an adjoining cable without cutting unused fibers in buffer tubes, or disturbing remaining buffer tubes in cables.
11. Patch Panel: Precision drilled metal or punched frame containing couplers used to mate 2 fiber optic connectors.
12. SMFO: Singlemode Fiber Optic Cable.
13. Splice: Permanent joining of 2 fiber ends using a fusion splicer.
14. System Performance Margin: Calculation of the overall "End to End" permissible attenuation from the fiber optic transmitter (source) to the fiber optic receiver (detector). The system performance margin should be at least 6 dB. This includes the difference between the active component link loss budget, the passive cable attenuation (total fiber loss), and the total connector/splice loss.
15. Tight Buffered, Non-Breakout Cable (Tight Buffer Cable): Type of cable construction where glass fiber is tightly buffered (directly coated) with a protective thermoplastic coating to 35 mil (compared to 10 mil for loose tube fibers).

Fiber optic outside plant cable

Fiber optic outside plant cable (FOOP) must be dielectric, nongel filled or water-blocking material, duct type, with loose buffer tubes. Cables with singlemode fibers must contain 12, 36 and 72 singlemode (SM) dual-window (1310 nm and 1550 nm) fibers. Optical fibers must be contained within loose buffer tubes stranded around a dielectric central member. Aramid yarn or fiberglass must be used as a primary strength member, and a polyethylene outside jacket must provide protection.

Fiber optic (F/O) cable must be from the same manufacturer who is regularly engaged in the production of fiber optic cables.

Cables must be compliant with 7 CFR 1755.900 (RUS Bulletin 1753F-601), "RUS Specification for Filled Fiber Optic Cables."

CABLE TYPE	DESCRIPTION
E	12SMFO
G	36SMFO
K	72SMFO

Fiber Characteristics

Optical fiber must be glass and consist of a doped silica core surrounded by concentric silica cladding. Fibers in buffer tubes must be usable fibers, and must be free of surface imperfections and occlusions. Required fiber grade must reflect the maximum individual fiber attenuation.

Coating must be dual layered, UV cured acrylate, mechanically or chemically strippable without damaging fibers.

Cable must comply with optical and mechanical requirements over an operating temperature range from -40 to +165 degrees F and must be tested in accordance with EIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components." Change in attenuation at extreme operational temperatures (from -40 to +165 degrees F) for singlemode fiber must not be greater than 0.32 dB/mi, with 80 percent of measured values no greater than 0.16 dB/mi. Singlemode fiber measurement must be made at 1550 nm.

Fibers within finished cables must meet the following requirements:

Fiber Characteristics Table	
Parameters	Singlemode
Type	Step Index
Core diameter	0.33 mil (nominal)
Cladding diameter	5 mil \pm 0.04 mil
Core to Cladding Offset	\leq 0.03 mil
Coating Diameter	10 mil \pm 0.31 mil
Cladding Non-circularity defined as: [1-(min. cladding dia \div max. cladding dia.)] x 100	\leq 1.0%
Proof/Tensile Test	50 ksi, min.
Attenuation: (65 to +165 °F) @ 1310 nm @ 1550 nm	\leq 0.6 dB/mi \leq 0.5 dB/mi
Attenuation at the Water Peak	\leq 3.4 dB/mi @ 1383 \pm 3 nm
Chromatic Dispersion: Zero Dispersion Wavelength Zero Dispersion Slope	1301.5 to 1321.5 nm \leq 0.15 ps/(nm ² *mi)
Maximum Dispersion:	\leq 5.3 ps/(nm*mi) from 1285 to 1330 nm <29 ps/(nm*mi) for 1550 nm
Cut-Off Wavelength	<1260 nm
Numerical Aperture (measured in Accordance with EIA-455-47)	N/A
Mode Field Diameter (Petermann II)	0.37 \pm 0.02 mil at 1310 nm 0.41 \pm 0.04 μ m at 1550 nm

Color Coding

In buffer tubes containing multiple fibers, length of fiber must be distinguishable from others in the same tube by means of color-coding according to the following:

1. Blue (BL)	7. Red (RD)
2. Orange (OR)	8. Black (BK)
3. Green (GR)	9. Yellow (YL)
4. Brown (BR)	10. Violet (VL)
5. Slate (SL)	11. Rose (RS)
6. White (WT)	12. Aqua (AQ)

Buffer tubes containing fibers must be color-coded with distinct and recognizable colors according to the table listed above for fibers.

Colors must be in accordance with the Munsell color shades (ASTM D 1535-1) and must meet EIA/TIA-598 "Color Coding of Fiber Optic Cables."

Color formulations must be compatible with fiber coatings and buffer tube filling compounds, and be heat stable. Colors must not fade or smear or be susceptible to migration and must not affect transmission characteristics of optical fibers and must not cause fibers to stick together.

Cable Construction

Fiber optic cable must consist of, but not limited to, the following components:

- A. Buffer tubes
- B. Central member
- C. Filler rods
- D. Stranding
- E. Core and cable flooding
- F. Tensile strength member
- G. Ripcord
- H. Outer jacket

Buffer Tubes

Clearance must be provided in loose buffer tubes between fibers and insides of tubes to allow for expansion without constraining fibers. Fibers must be loose or suspended within tubes and must not adhere to insides of buffer tubes. Buffer tubes must contain a maximum of 12 fibers.

Loose buffer tubes must be extruded from material having a coefficient of friction sufficiently low to allow free movement of fibers. Material must be tough and abrasion resistant to provide protection of fibers and permit safe intentional "scoring" and breakout without damaging or degrading internal fibers.

Buffer tube filling compound must be a homogeneous hydrocarbon-based gel with anti-oxidant additives used to prevent water intrusion and migration. Filling compound must be non-toxic and dermatologically safe to exposed skin, chemically and mechanically compatible with cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. Filling compound must be free from dirt and foreign matter and must be readily removable with conventional nontoxic solvents.

Buffer tubes must be stranded around a central member by a method, such as the reverse oscillation stranding process, which will prevent stress on fibers when the cable jacket is placed under strain.

Central Member

The central member must be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fibers and buffer tubes. A symmetrical linear overcoat of polyethylene may be applied to central members to achieve optimum diameter to ensure proper spacing between buffer tubes during stranding.

Filler Rods

Fillers must be included in cables to maintain symmetry of cable cross-sections. Filler rods must be solid medium or high-density polyethylene. The diameter of filler rods must be the same as the outer diameter of buffer tubes.

Stranding

Completed buffer tubes must be stranded around the central member using stranding methods, lay lengths and positioning so cables meet mechanical, environmental and performance specifications. A polyester binding must be applied over stranded buffer tubes to hold them in place. Binders must be applied with sufficient tension to secure buffer tubes to central members without crushing buffer tubes. Binders must be non-hygroscopic, non-wicking (or rendered so by the flooding compound) and dielectric with low shrinkage.

Core and Cable Flooding

Cable core interstices must contain a water blocking material to prevent water ingress and migration. Water blocking material must be a polyolefin based compound, which fills the cable core interstices, or an absorbent polymer, which fills voids and swells to block ingress of water. Flooding compound or material must be

homogeneous, non-hygroscopic, electrically non-conductive, non-nutritive to fungus, nontoxic, dermatologically safe, and compatible with other cable components.

Tensile Strength Member

Tensile strength must be provided by high tensile strength aramid yarns or fiberglass helically stranded evenly around cable cores and must not adhere to other cable components.

Ripcord

Cables must contain at least one ripcord under the jacket for easy sheath removal.

Outer Jacket

Jackets must be free of holes, splits, and blisters and must be medium or high-density polyethylene (PE), or medium density cross-linked polyethylene with minimum nominal jacket thickness of 39 mil \pm 3 mil. Jacketing material must be applied directly over tensile strength members and water blocking materials and must not adhere to Aramid strength materials. Polyethylene must be carbon black and must not promote fungus growth.

Jackets or sheaths must be marked with the manufacturer's name, the words "Optical Cable," the number of fibers, "SM," year of manufacture, and sequential measurement markings every meter. Actual cable lengths must be within -0/+1 percent of length markings. Markings must be a contrasting color to cable jackets. Heights of markings must be 98 mil \pm 8 mil.

General Cable Performance Specifications

F/O cable must withstand water penetration when tested with 3 feet static head or equivalent continuous pressure applied at one end of a 3 feet length of filled cable for one hour. No water must leak through open cable ends. Testing must be in accordance with EIA-455-82 (FOTP-82), "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

A representative sample of cable must be tested in accordance with EIA/TIA-455-81 (FOTP-81), "Compound Flow (Drip) Test for Filled Fiber Optic Cable." No preconditioning period must be conducted. Cables must exhibit no flow (drip or leak) at 158 °F as defined in the test method.

Crush resistance of finished F/O cables must be 125 pounds per inch applied uniformly over the length of cables without showing evidence of cracking or splitting when tested in accordance with EIA-455-41 (FOTP-41), "Compressive Loading Resistance of Fiber Optic Cables." The average increase in attenuation for fibers must be 0.10 dB at 1550 nm (singlemode) for a cable subjected to this load. Cables must not exhibit measurable increase in attenuation after removal of load. Testing must be in accordance with EIA-455-41 (FOTP-41), except that loads must be applied at the rate of 0.1 inch to 0.8 inch per minute and maintained for 10 minutes.

Cables must withstand 25 cycles of mechanical flexing at a rate of 30 \pm 1 cycles/minute. The average increase in attenuation for fibers must be less than or equal to 0.20 dB at 1550 nm (singlemode) at the completion of testing. Outer cable jacket cracking or splitting observed under 10x magnification constitute failure. Testing must be conducted in accordance with EIA-455-104 (FOTP-104), "Fiber Optic Cable Cyclic Flexing Test," with sheave diameters a maximum of 20 times the outside diameter of cables. Cables must be tested in accordance with Test Conditions I and II of FOTP-104.

Cables must withstand 20 impact cycles, with a total impact energy of 4.4 pounds•ft. Impact testing must be conducted in accordance with TIA/EIA-455-25B (FOTP-25) "Impact Testing of Fiber Optic Cables and Cable Assemblies." The average increase in attenuation for fibers must be <0.20 dB at 1550 nm for singlemode fiber. Cables must not exhibit evidence of cracking or splitting.

Finished cable must withstand a tensile load of 600 pounds without exhibiting an average increase in attenuation of greater than 0.20 dB (singlemode) and 0.40 dB (multimode). Testing must be conducted in accordance with EIA-455-33 (FOTP-33), "Fiber Optic Cable Tensile Loading and Bending Test." Load must be applied for 30 minutes in Test Condition II of the EIA-455-33 (FOTP-33) procedure.

Packaging and Shipping Requirements

Documentation of compliance to specifications must be provided to the Engineer prior to ordering materials.

Attention is directed to "Fiber Optic Testing," of these special provisions.

Completed cables must be packaged for shipment on reels. Cables must be wrapped in weather and temperature resistant covering. Ends of cables must be sealed to prevent ingress of moisture.

Ends of cables must be securely fastened to reels to prevent cables from coming loose during transit. Thirteen feet of cable on ends of cables must be accessible for testing.

Cable reels must have durable, weatherproof labels or tags showing the manufacturer's name, cable type, the actual length of cable on reels, your name, the contract number, and the reel number. A shipping record must be

included in a weatherproof envelope showing the above information, including the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number and other pertinent information.

Minimum hub diameter of reels must be at least 30 times the diameter of the cable. F/O cable must be in one continuous length per reel with no factory splices in fibers. Reels must be marked to indicate the direction reels should be rolled to prevent loosening of cables.

Installation procedures and technical support information must be furnished at the time of delivery.

LABELING

General

Label fiber optic cables permanently. Tags must be material designed for long term permanent labeling of fiber optic cables. Metal tags must be stainless steel with embossed lettering. Non-metal label materials must be approved by the Engineer and marked with permanent ink. Labels must be affixed to cables per the manufacturer's recommendations and must not be affixed in a manner, which will cause damage to fibers. Handwritten labels will not be allowed.

Label Identification

Labeling of Cables

Labeling of backbones, distribution and drop fiber optic cables must conform to the following unique identification code elements:

UNIQUE IDENTIFICATION CODE ELEMENTS For Backbone, Distribution or Drop Cables		
DESCRIPTION	CODE	NUMBER OF CHARACTERS
District	District number	2
Cable Type	Fiber: S: Singlemode	1
Cable fiber (or copper pairs) Count	Number of fibers or conductor pairs (Examples: 144 fibers; or 100 TWP)	3
Route Number	Hwy. Rte (Example: 005)	3
Begin Function	T: TMC; H: HUB;-M: CCTV Camera; Z: Ramp Meter; U: Traffic Monitoring. S: Splice Vault	1
Begin Function Number	Unique ID number corresponds to Begin Function (Example: H02 [Hub 02])	2
End Function	T: TMC; H: HUB;-M: CCTV Camera; Z: Ramp Meter; U: Traffic Monitoring; S: Splice Vault	1
End Function Number	Unique ID number corresponds to Begin Function (Example: H03 [Hub 03])	2
Unique Identifier	XX: If 2 or more cables of the same count are in the same run	2
TOTAL		17

Cables must display one unique identification, regardless of where the cable is viewed. The begin function and end function correspond to end points of cables. The order of the begin and end functions follow the hierarchy listed below, where the lowest number corresponding to the begin/end function is listed first.

List of Hierarchy										
1	2	3	4	5	6	7	8	9	10	11
TMC	HUB	Video Node (VN)	Data Node (DN)	Cable Node	CCTV Camera	CMS	Traffic Signal	Ramp Meter	Traffic Monitoring/ Count Station	Splice Vault

A cable labeled 07S060010H02H0302 would contain the following information:

District	Mode	# of fibers	Route	Begin	End	Unique ID
07	S	060	010	H02	H03	02

Example: 07S060010H02H0302

This cable is located in District 7, identified as a singlemode fiber optic cable containing 60 fibers, installed along Route 10, beginning in Hub 2, and ending in Hub 3, with unique ID of number 2. The implication for the unique ID is that there may be another 60 fiber optic cable between those hubs. This is an example for a backbone cable.

Labeling Jumpers and Pigtails

Labeling jumpers and pigtails must conform to the following unique identification code elements:

UNIQUE IDENTIFICATION CODE ELEMENTS for JUMPERS (active component to FDU) and PIGTAILS (to connector # on patch panel)		
DESCRIPTION	CODE	NUMBER OF CHARACTERS
Hub Identifier	Hub, TMC , Numbers or Alphanumeric or both	2
From (Source) Device	FD: FDU (Fiber Distribution Unit)	2
From (Source) Device Identifier	Numbers or Alphanumeric or both	2
Transmitter or Receiver	T or R	1
To (Destination) Device	FD: FDU (Fiber Distribution Unit)	2
To (Destination) Device Identifier	Numbers or Alphanumeric or both	2
Connector Identifier	Connector ID	2
TOTAL		13

A pigtail labeled 01MU01TFD0203 would contain the following information:

Hub	Multiplexer	Transmitting to	To Patch Panel Position (Connector)
01	MU01	TFD02	03

Example: 01MU01TFD0203.

This pigtail is located in Hub 1, from multiplexer 01, transmitting to FDU 02 to patch panel position (connector) 03.

Label Placement

Label placement must be as following:

1. Cables - Cables must be labeled with the unique identification code element method at terminations, even if no connections or splices are made, and at splice vault entrances and exits.
2. Cable to Cable Splices - Cable jackets entering splice closures must be labeled in accordance with the identification method.
3. Cable to Fiber Distribution Units - Cable jackets must be labeled at entries to FDUs in accordance with the unique identification code element method. Fibers must be labeled with Fiber IDs and pigtails must be

labeled at connectors with Fiber IDs. FDU's must be labeled with Cable IDs on faces of FDU's. If multiple cables are connected to FDU's, each block of connectors relating to individual cables must be identified by a single label with Cable IDs. Individual connections must be marked on the face of FDU's in the designated area with Fiber IDs.

4. Fiber - Fiber labels must be placed next to connectors of individual fibers.
5. Jumpers - Equipment to FDU jumpers must be labeled as to equipment type connected and must be labeled at both ends. FDU to FDU jumpers must be labeled at each end in accordance with the unique identification code element method.
6. Pigtailed - Pigtailed must be labeled at the connector in accordance with the unique identification code element method described elsewhere in these special provisions.
7. Copper Cable Labels - Twisted-pair communications cables must be labeled in accordance with the unique identification code element method.

CABLE INSTALLATION

Cable installation must be in conformance with the procedures specified by the cable manufacturer. Submit the manufacturer's recommended procedures for pulling fiber optic cable at least 20 working days prior to installing cable. Mechanical aids may be used if a tension measuring device and break-away swivel are placed in tension to the end of cables. Tension in cables must not exceed 500 ft-lb or the manufacturer's recommended pulling tension, whichever is less.

Bend radius must be a minimum of 20 times the outside diameter during installation. Cable grips for installing fiber optic cables must have a ball bearing swivel to prevent cables from twisting during installation.

F/O cable must be installed using a cable pulling lubricant recommended by the F/O cable manufacturer and a pull rope conforming to Section 86-2.05, "Conduit," of Standard Specifications. Personnel must be stationed at splice vaults and pull boxes through which cables are pulled to lubricate and prevent kinking or other damage.

F/O cable must be installed without splices except where allowed on the plans and must be limited to one cable splice every 4 miles if splice locations are not shown on the plans. Midspan access splices or FDU terminations must involve fibers being spliced as shown on the plans. Cable splices must be located in splice closures installed in splice vaults. A minimum of 65 feet of slack must be provided for F/O cables at splice vaults. Slack must be divided equally on each side of F/O splice closures.

SPLICING

Field splices must be done in splice vaults, or cabinets, in splice trays housed in splice closures.

Fiber splices must be fusion type unless otherwise specified. Mean splice loss must not exceed 0.07 dB per splice and must be obtained by measuring loss through splices in both directions and averaging the resultant values.

Splices must be protected with a metal reinforced thermal shrink sleeve.

The mid-span access method must be used to access individual fibers in cables for splicing to other cables. Cable manufacturers recommended procedures and approved tools must be used for mid-span access. Only fibers to be spliced may be cut. Buffer tubes and individual fibers not being used in mid-span access must not be modified or damaged.

Individual fibers must be looped one full turn within splice trays to avoid micro bending. A 1.75 inch minimum bend radius must be maintained during installation and after final assembly in optical fiber splice trays. Bare fibers must be individually restrained in splice trays. Optical fibers in buffer tubes and placement of bare optical fibers in splice trays must not produce tensile force on optical fibers.

The Contractor will be allowed to splice a total of 30 percent of fibers to repair damage done during mid-span access splicing without penalty. The Engineer will assess a fine of \$300.00 for each additional and unplanned splice. A single fiber may not have more than 3 unplanned splices. If a fiber requires more than 3 unplanned splices, the entire length of F/O cable must be replaced at your expense.

SPLICE CLOSURES

F/O field splices must be enclosed in splice closures, complete with splice organizer trays, brackets, clips, cable ties, seals and sealant, as needed. Splice closures must be suitable for direct burial or pull box applications. Manufacturer's installation instructions must be supplied to the Engineer prior to installation of splice closures. Location of splice closures must be where a splice is required as shown on the plans, where designated by the Engineer, or described in these special provisions.

The fiber optic splice closure must consist of an outer closure, an inner closure and splice trays, and must conform to the following special provisions.

The fiber optic splice closure must be suitable for a temperature range of 32°F to 122°F.

The size of the closure must allow all the fibers of the largest fiber optic cable to be spliced to a second cable of the same size, plus 12 additional pigtails. The closure must be not more than 36 inches in length and not more than 8 inches in diameter. Two outer closures must fit into the fiber optic splice vault and must leave sufficient space for routing of the fiber optic communication cables, without exceeding the minimum bending radius of any cable. The closures must be designed for butt splicing.

Splice closures must conform to the following specifications:

- A. Non-filled thermoplastic case
- B. Rodent proof, waterproof, re-enterable and moisture proof
- C. Cable entry ports must accommodate 0.4-inch to one-inch diameter cables
- D. Multiple grounding straps
- E. Accommodate a minimum of 6 splice trays
- F. Suitable for "butt" or "through" cable entry configurations
- G. Place no stress on finished splices within splice trays
- H. Expandable from 2 cables per end to 8 cables per end by using adapter plates

All materials in the closures must be nonreactive and must not support galvanic cell action. The outer closure must be compatible with the other closure components, the inner closure, splice trays, and cables.

The end plate must consist of two sections and must have capacity for 2 fiber optic trunk communication cables and 2 fiber optic pigtails communication.

The outer closure must protect the splices from mechanical damage, must provide strain relief for the cable, and must be resistant to salt corrosion.

The outer closure must be waterproof, re-enterable and must be sealed with a gasket. The outer closure must be flash-tested at 14.9 psi.

The inner closure must be of metallic construction. The inner closure must be compatible with the outer closure and the splice trays and must allow access to and removal of individual splice trays. The splice trays must be compatible with the inner closure and must be constructed of rigid plastic or metal.

Adequate splice trays must be provided to splice all fibers of the largest fiber optic cable, plus 12 pigtails.

Each splice must be individually mounted and mechanically protected in the splice tray.

Splice closures must be bolted to side walls of splice vaults.

Verify the quality of splices prior to sealing splice closures. Splice closures must not be sealed until link testing is performed and is approved by the Engineer.

SPLICE TRAYS

Splice trays must accommodate a minimum of 12 fusion splices and must allow a minimum bend radius of 1.75 inch. Individual fibers must be looped one full turn within splice trays to allow for future splicing. Stress must not be applied on fibers when located in final position. Buffer tubes must be secured near entrances of splice trays. Splice tray covers may be transparent.

Splice trays must conform to the following:

1. Accommodate up to 24 fusion splices
2. Place no stress on completed splices within the tray
3. Stackable with a snap-on hinge cover
4. Buffer tubes securable with channel straps
5. Accommodate a fusion splice with the addition of an alternative splice holder
6. Be labeled after splicing is completed.

Only one splice tray may be secured by a bolt through the center of the tray in fiber termination units. Multiple trays must be securely held in place per the manufacturer's recommendation.

PASSIVE CABLE ASSEMBLIES AND COMPONENTS

F/O cable assemblies and components must be compatible components, manufactured by a company regularly engaged in the production of material for the fiber optic industry. Components or assemblies must be best quality, non-corroding, with a minimum design life of the cable.

FIBER OPTIC CABLE TERMINATIONS

General

Cables must continue within conduit to the designated cable termination point. Components must be the size and type required for the specified fiber. Fiber optic cable terminations may take place in several locations such as traffic monitoring station, traffic signal ramp metering system, and CCTV camera locations.

Cable Termination

Factory terminated pigtailed must be spliced and placed in splice trays.

Distribution Interconnect Package

Distribution involves connecting fibers to locations shown on the plans. The distribution interconnect package consists of FDFs, C-MICs and FDUs with connector panels, couplers, splice trays, fiber optic pigtailed and cable assemblies with connectors. The distribution interconnect package must be assembled and tested. Attention is directed to "Fiber Optic Testing" of these special provisions. Distribution components must be products of same manufacturers, regularly engaged in the production of these components with quality assurance programs.

Fiber Optic Cable Assemblies and Pigtailed

Cables for cable assemblies must be made of fiber meeting the performance requirements of these special provisions for the F/O cable being connected.

Pigtailed must be of simplex (one fiber) construction, in 35-mil tight buffer form, surrounded by Aramid yarn for strength, with a PVC jacket with manufacturer's identification information, and a nominal outer jacket diameter of 118 mil. Singlemode simplex cable jackets must be yellow. Pigtailed must be factory terminated and tested and at least one meter in length.

Jumpers may be of simplex or duplex design. Duplex jumpers must be duplex round cable construction and must not have zipcord (Siamese) construction. Jumpers must be at least 6 feet in length.

Outer jackets of duplex jumpers must be yellow. The 2 inner simplex jackets must be contrasting colors to provide easy visual identification for polarity.

Connectors must be ceramic ferrule ST type for SMFO. Indoor ST connector body housings must be nickel-plated zinc or glass reinforced polymer construction. Outdoor ST connector body housings must be glass reinforced polymer.

F/O connectors must be the 0.1-inch connector ferrule type with Zirconia Ceramic material with a PC (Physical Contact) pre-radiused tip.

ST connector operating temperature range must be from -40 degrees F to +165 degrees F. Insertion loss must not exceed 0.4 dB for singlemode and return reflection loss on singlemode connectors must be at least -35 dB. Connection durability must be less than a 0.2 dB change per 500 mating cycles per EIA-455-21A (FOTP-21). Terminations must provide a minimum 50 ft-lb pull out strength. Factory test results must be documented and submitted to the Engineer prior to installing connectors. Singlemode connectors must have a yellow color on the body and boot.

Field terminations must be limited to splicing of adjoining cable ends and cables to ST pigtailed.

Connectors must be factory-installed and tested.

Unmated connectors must have protective caps installed.

Fiber Distribution Unit

The Contractor must install components to terminate incoming fiber optic communication cables.

FDU Type	Accommodates Termination of
E	12SMFO
G	36SMFO
K	72SMFO

Fiber distribution units (FDU) must include the following:

1. Patch panels to terminate the appropriate number of singlemode fibers with ST type connectors feed through couplers.
2. Splice trays.

3. Storage for splice trays.
4. A slide out metal drawer for storage of spare jumpers.

Strain relief must be provided for incoming fiber optic cables. Cable accesses must have rubber grommets or similar material to prevent cables from contacting bare metal. Fibers must be terminated and individually identified in FDUs and on patch panels.

Patch panels must be hinged or have coupler plates to provide easy access and maintenance. Brackets must be provided to spool incoming fibers a minimum of 2 turns. Turns must not be less than 12 inches before separating out individual fibers to splice trays.

FDUs must be 19-inch rack mountable.

FDUs must not exceed 10 inches in height and 15 inches in depth.

Termination and distribution cable trays must accommodate 12, 36, and 72 singlemode fiber optic cables, and must have sufficient tray areas for excess optical fiber storage with provisions to assure that optical fibers do not exceed a 2-inch bend radius. Termination and distribution cable tray assemblies must include a designation strip for identification of 12, 36 and 72 singlemode optical fibers, Splice drawers must include 2 splice trays with an individual splice tray capable of accommodating 12, 36, and 72 fusion type splices. Splice drawers must allow storage of excess lengths of optical fibers of fiber optic cables. Fiber distribution units must be provided with cable clamps to secure fiber optic cables to the chassis.

Fibers must be labeled in the splice tray with permanent vinyl markers. Fiber bonds must be labeled to identify the physical designation of each individual fiber strand

Installation

Optical fibers must be of appropriate lengths to allow future splicing with splice drawers and must be appropriately identified. Splices must be fusion type and must be arranged within splice trays of fiber distribution units in accordance with the organizational design of splice trays. Appropriate protective coatings must be applied to fusion splices.

FIBER OPTIC TESTING

General

Documentation for testing conducted at the manufacturer's premises must be submitted to the Engineer when the equipment is delivered to the site.

For field testing, provide personnel, equipment, instrumentation, and materials necessary to perform testing. The Engineer must be notified 2 working days prior to field tests. Notification must include the exact location or portion of system to be tested.

Documentation of field testing results must be provided to the Engineer within 2 working days after testing.

A minimum of 15 working days prior to arrival of cable at the site, you must provide detailed test procedures for field testing for the Engineer's review and approval. Procedures must include tests involved and how tests are to be conducted. Test procedures must include the model, manufacturer, configuration, calibration, and alignment procedures for proposed test equipment.

Factory Testing

Documentation of compliance with fiber specifications as listed in the Fiber Characteristics Table must be supplied by the original equipment manufacturer. Before shipment, but while on shipping reels, 100 percent of fibers must be tested for attenuation. Copies of the results must be maintained on file by the manufacturer with a file identification number for a minimum of 7 years, attached to cable reels in waterproof pouches, and submitted to you and to the Engineer.

Arrival On Site

Cables and reels must be physically inspected on delivery and 100 percent of fibers must be attenuation tested to confirm that cable meets requirements. Failure of a fiber in the cable must be cause for rejection of the entire reel. Test results must be recorded, dated, compared and filed with copies accompanying shipping reels in weatherproof envelopes. Attenuation deviations from shipping records of greater than 5 percent must be brought to the attention of the Engineer. Cables must not be installed until completion of testing and written approval of the Engineer. Copies of traces and test results must be submitted to the Engineer. If test results are unsatisfactory, the reel of F/O cable must be considered unacceptable and records corresponding to that reel of cable must be marked accordingly. Unsatisfactory reels of cable must be replaced with new reels of cable at your expense. New reels of cable must be tested to demonstrate acceptability. Copies of test results must be submitted to the Engineer.

After Cable Installation

Index matching gel will not be allowed in connectors during testing. After fiber optic cable has been pulled, but before breakout and termination, 100 percent of fibers must be tested with an OTDR for attenuation. Test results must be recorded, dated, compared, and filed with previous copies of these tests. Copies of traces and test results must be submitted to the Engineer. If OTDR test results are unsatisfactory, the F/O cable segment of cable will be rejected. Unsatisfactory segments of cable must be replaced with new segments, without additional splices, at your expense. New cable segments must be tested to demonstrate acceptability. Copies of test results must be submitted to the Engineer.

System Cable Verification At Completion

Power Meter and Light Source

At the conclusion of OTDR testing, 100 percent of fiber links must be tested end-to-end with a power meter and light source, in accordance with EIA Optical Test Procedure 171 and in the same wavelengths specified for OTDR tests. Tests must be conducted in one direction. As shown in Appendix A, the Insertion Loss (IC) must be calculated. Test results must be recorded, compared, and filed with the other recordings of the same links. Test results must be submitted to the Engineer. These values must be recorded in the Cable Verification Worksheet in Appendix A.

OTDR Testing

After passive cabling systems have been installed and are ready for activation, 100 percent of fibers must be tested with OTDR for attenuation at wavelengths of 1310 nm and 1550 nm. OTDR testing must be performed in both directions (bi-directional) on fibers. Test results must be generated from software of test equipment, recorded, dated, compared and filed with previous copies. A hard copy printout and an electronic copy on a CD of traces and test results must be submitted to the Engineer. The average of the 2 losses must be calculated and recorded in the Cable Verification Worksheet in Appendix A. The OTDR must be capable of recording and displaying anomalies of at least 0.02 dB. Connector losses must be displayed on OTDR traces.

Cable Verification Worksheet

The Cable Verification Worksheet shown in Appendix A must be completed for links in fiber optic systems using data gathered during cable verification. Completed worksheets must be included as part of system documentation.

Test Failures

If link loss, measured from the power meter and light source, exceeds the calculated link loss or the actual location of fiber ends does not agree with the expected location of fiber ends, fiber optic links will not be accepted. Unsatisfactory segments of cable or splices must be replaced with new segments of cables or splices at your expense. OTDR testing, power meter and light source testing, and Cable Verification Worksheet must be completed for repaired links to determine acceptability. Copies of test results must be submitted to the Engineer. Removal and replacement of segments of cable must be considered as removal and replacement of a single contiguous length of cable connecting 2 splices and 2 connectors. Removal of a section containing a failure will not be allowed.

Passive Component Package Testing and Documentation

Pigtails or jumpers must be tested for insertion attenuation loss using optical power meters and light sources. Singlemode terminations must be tested for return reflection loss. Values must meet loss requirements specified and must be recorded on tags attached to pigtails or jumpers.

After an assembly is complete, you must visually verify that tagging of loss values is complete. The manufacturer must conduct an "end-to-end" optical power meter/light source test from pigtail ends to end of terminating points assuring continuity and overall attenuation loss values are acceptable.

Final test results must be recorded with previous individual component values on forms assigned to individual FDU or C-MIC. Completed forms must be dated and signed by the Manufacturer's Quality Control supervisor. One copy of the form must be attached in a plastic envelope to the assembled FDU or C-MIC unit. Copies must be provided separately to the Contractor and the Engineer, and must be maintained on file by the manufacturer or supplier for a minimum of 7 years.

Assembled and completed FDU or C-MIC units must be protectively packaged for shipment to you for installation.

Fiber Optic System Performance Margin Design Criteria

Installed system performance margin must be at least 6 dB for links. If the design system performance margin is less than 6 dB, the Engineer must be notified of your plan to meet this requirement.

Active Component Testing

Transmitters and receivers must be tested with power meters and light sources to record transmitter average output power (dBm) and receiver sensitivity (dBm). Values must be recorded in the Fiber System Performance Margin Calculations Worksheet in Appendix B, section C, number 6.

APPENDIX A

Cable Verification Worksheet

*End-to-End Attenuation (Power Meter and Light Source) Testing
and OTDR Testing*

Contract No. _____ Contractor: _____

Operator: _____ Date: _____

Link Number: _____ Fiber Number: _____

Test Wavelength (Circle one): 1310 nm 1550 nm

Expected Location of fiber ends: End 1: _____ End 2: _____

Power Meter and Light Source Test Results:

Power In:	_____ dBm	1A
Output Power:	_____ dBm	1B
Insertion Loss [1A - 1B]:	_____ dB	1C

OTDR Test Results:

Forward Loss:	_____ dB	2A
Reverse Loss:	_____ dB	2B
Average Loss [(2A + 2B)/2]:	_____ dB	2C

To Be Completed by Caltrans:

Resident Engineer's Signature: _____

Cable Link Accepted: _____

APPENDIX B
Fiber System Performance Margin Calculations Worksheet

A. Calculate the Passive Cable Attenuation

1. Calculate Fiber Loss at Operating Wavelength: _____ nm	Cable Distance (times) Individual Fiber Loss (equal) @ 1310 nm (0.6 dB/mi) @ 1550 nm (0.5 dB/mi)	_____ mi x _____ dB/mi =
Total Fiber Loss:		_____ dB

B. Calculate the Total Connector/Splice Loss

2. Calculate Connectors/couplers Loss: (exclude Tx and Rx connectors)	Individual Connector Loss (times) Number of Connector Pairs (equal) Total Connector Loss:	0.4 dB x _____ = _____ dB
3. Calculate Splice Loss:	Individual Splice Loss (times) Number of Splices (equal) Total Splice Loss:	0.1 dB x _____ = _____ dB
4. Calculate Other Components Loss:	Total Components:	_____ dB
5. Calculate Total Losses:	Total Connector Loss (plus) Total Splice Loss (plus) Total Components (equal)	+ dB + dB + dB =
Total Connector/Splice Loss:		_____ dB

C. Calculate Active Component Link Loss Budget

System Wavelength:	_____ nm
Fiber Type:	singlemode
Average Transmitter Output (Launch Power):	_____ dBm
Receiver MAX Sensitivity (10^9 BER) (minus)	_____ dBm
Receiver MIN Sensitivity (equal)	- _____ dBm =
Receiver Dynamic Range:	
	_____ dB
6. Calculate Active Component Link Loss Budget:	Average Transmitter Output (Launch Power) (minus) _____ dBm Receiver MAX Sensitivity (equal) - _____ dBm =
Active Component Link Loss Budget:	
	_____ dB

D. Verify Performance

7. Calculate System Performance Margin to Verify Adequate Power:	Active Component Link Loss Budget [C] _____ dB (minus) Passive Cable Attenuation [A] (minus) - _____ dB Total Connector/Splice Lost [B] (equal) - _____ dB =
System Performance Margin:	
	_____ dB

CLOSED CIRCUIT TELEVISION CAMERA SYSTEM

Closed circuit television (CCTV) camera on Interstate 5 at various locations, consist of, but not limited to:

- A. A CCTV camera assembly on new pole, overhead/truss mount, or tower,
- B. Camera control circuits and accessories,
- C. CCTV wiring, including composite cables, connectors and coaxial cables,
- D. and other required incidental equipment, complete in place, as shown on plans and as directed by the Engineer, to provide a fully functional location as shown on the plans.

The CCTV camera assembly must be supplied as a fully-assembled, integrated, tested and configured single unit from the manufacturer at the camera manufacturer facility and must be delivered to the project site accompanied with a written certification of assembly and configuration from the camera manufacturer. This certification must serve as the manufacturer documentation that the assembly and configuration of the camera/lens/housing equipment were performed. A sample certification document must be furnished as part of the materials submittal data to the Engineer

Test equipment prior to installation to verify that it functions in accordance with the manufacturer's specifications.

After installation, CCTV camera equipment must be tested in conformance with the requirements of "System Testing and Documentation" of these special provisions.

CLOSED CIRCUIT TELEVISION EQUIPMENT

Equipment racks must be industrial grade and must conform to EIA-310.

Rack mounted equipment and card cage assemblies must have metal filler plates to cover unused channel slots or card slots.

Equipment must be current standard production units and must have been in production for a minimum of 6 months.

The Contractor must arrange, at the Contractor's expense, to have a technician qualified to work on CCTV equipment and employed by the manufacturer or the manufacturer's representative, present when equipment is turned on.

CLOSED CIRCUIT TELEVISION CAMERA ASSEMBLY

Closed circuit television (CCTV) camera assembly must consist of installing the following:

- A. A CCTV camera assembly on new pole,
- B. Camera control circuits and accessories,
- C. CCTV wiring, including composite video cables, connectors and coaxial cables,
- D. and other required incidental equipment, complete in place, as shown on plans and as directed by the Engineer, to provide a fully functional location as shown on the plans.

The CCTV camera assembly must be supplied as a fully-assembled, integrated, tested and configured single unit from the manufacturer at the camera manufacturer facility and must be delivered to the project site accompanied with a written certification of assembly and configuration from the camera manufacturer. This certification must serve as the manufacturer documentation that the assembly and configuration of the camera/lens/housing equipment were performed. A sample certification document must be furnished as part of the materials submittal data to the Engineer.

The CCTV camera assembly must meet the following communications specifications:

- A. Serial data communications ports conforming to EIA/Telecommunication Industry Association (TIA)-232 and EIA/TIA-422
- B. Configurable to support National Transportation Communication for ITS Protocol (NTCIP) 1205 - NTCIP Objects for CCTV Camera Control
- C. Via the CCTV protocol, the user must be able to obtain camera position information including tilt angles, pan positions and zoom levels. The information must be supplied as from zero degree to 359 degrees azimuth and from -95 degree to +95 degree elevation.
- D. TCP/IP 100 Base T Fast Ethernet data communication port

CCTV Camera Assembly Installation

Before installation and after installation, the Contractor must test to verify that all new CCTV camera assembly equipment functions in accordance with the manufacturer's specifications. After installation, new CCTV camera equipment must be tested at each individual location described under "System Testing and Documentation," in these special provisions.

Install and fully adjust the CCTV camera assembly with the associated components, power supply, housing, and all necessary cabling and incidental equipment to make the CCTV camera assembly completely operational. The CCTV camera assembly components must be fully interchangeable.

Supply all of the required mounting brackets, adapters, bolts, nuts, screws and other components to fully install and firmly attach the CCTV camera assembly on camera pole. Exercise care to tighten the CCTV camera assembly mount within the torque limits specified by the camera manufacturer.

Dress and secure the electrical cables inside the housing and cabinet so that they do not interfere with the closing of the cabinet, the fan or any other moving part.

Verify that the camera in the housing enclosure such that the lens is centered in the optical window.

Adjust the back-focus adjustment on the camera such that the lens focus is properly set and maintained over the zoom range. This adjustment must be made such that when the zoom is adjusted from long range (telephoto) to wide angle that no refocusing is necessary.

The CCTV camera assembly must operate reliably under a full range of environmental and lighting conditions and must provide clear and usable images. The CCTV camera assembly must be protected from brown outs and voltage spikes up to 1000 V.

Composite Video Cable

Composite video cable must consist of a single composite cable containing coax, power, and two sets of control conductors (DB-9 and RJ-45). The single-jacket cable must be able to transport video, power, and data control up to 750 feet, and as recommended by the CCTV camera manufacturer.

The composite video cable must be compatible with the camera assembly and the various camera control equipment housed inside the Model 334-TV controller cabinet and must be configured to make the CCTV sub-system completely operational.

The composite video cable must run continuously between terminations without splices.

Specifications of all cables, cable assemblies, and connectors with strain relief backshells intended for use must be submitted to the Engineer as part of the shop drawings for review and approval. Test all composite video cables for continuity prior to and after installation.

Each conductor in the composite video cable must be insulated with a polypropylene jacket, color coded for positive identification, must be rated for outdoor usage, and as approved by the Engineer.

Closed Circuit Television Camera

The CCTV camera must consist of a Digital Signal Processing (DSP) color video camera unit, camera zoom lens, enclosed camera control cables and connectors, environmental camera housing, and pan and tilt unit.

Physical Specifications

Maximum overall weight of the CCTV camera assembly must be less than 20 pounds

Shock/Vibration Specifications

The built-in pan and tilt unit must meet the following vibration specifications:

Shock	Conforms to NEMA TS2, paragraph. 2.1.10, 2.2.4
Vibration	Conforms to NEMA TS2, paragraph. 2.1.9, 2.2.3

The built-in pan and tilt unit must not incur any physical damage after a shock, must return to normal operation immediately, and must operate within the specified vibration.

DSP Color Video Camera Unit

The DSP color video camera must operate reliably under a full range of environmental and lighting conditions, must provide clear and usable images and must be fully interchangeable.

The DSP color video camera must be of solid state design, and must meet the following configuration requirements:

A. Performance.--The following are the performance specifications for the camera:

Optical device	Color CD interline transfer, National Television System Committee (NTSC)
Optical device size	0.25 inch
Pixels	35X Lens & Electronic Image Stabilization (EIS): 768 (horizon.) x 494 (vertical) min.
Horizontal resolution	35X Lens & EIS: 520 television lines minimum
Sensitivity (scene) using 35X Lens & EIS	0.1 fc at 1/60 sec. (color day) 0.01 fc at 1/4 sec. (color day) 0.001 fc at 1/4 sec. (mono night)
Scanning	Progressive scan at 35X Lens & EIS
Back focus adjustment	Required
Frame frequency	30, 15, 8, 4, 2 and 1 frames per second (selectable)
Width to height aspect ratio	4:3

The system must be capable of providing clear, low-bloom and low-lag video pictures under all conditions from bright sunlight to nighttime scene illumination. White balance must meet the following:

1. Auto: Color quality must be maintained by a continuous through the lens automatic white balance system for color temperatures from 2850 K to greater than 5100 K with less than 10 IRE units unbalance
2. Set: Allows user to set white as preferred. For instance, the camera could be focused on an Off White scene and Set to white balance. The camera will then automatically track color temperature changes, biasing the auto white balance on the Off White instead of the factory-defined white
3. Lock: Locks the white balance at the current levels
4. Indoor: Sets the White to be consistent with 3200 K
5. Outdoor: Sets the White to be consistent with 5100 K
6. Fluorescent: Sets the White to be consistent with fluorescent lighting

B. Electrical Specifications.--The following are the electrical specifications for the camera:

Operating voltage	115 V(ac). At 50/60 Hz. ($\pm 10\%$)
Heater Power Input Requirements	115 V(ac) at 50/60 Hz. ($\pm 10\%$)
Power Consumption	54 W max; 154 W max with pan-and-tilt heater
Power Interruption	Conforms to National Electrical Manufacturers Association (NEMA) TS2 paragraph 2.1.4
Power Transients/Interruptions	Conforms to NEMA TS2 paragraph 2.1.6
EMI	FCC rules, Part 15, subpart J, for Class B devices
Video output signal	Standard NTSC color TV
Motorized-Iris connector	Required
Gamma	0.45
Sensitivity (3200 K): Full Video, AGE off, iris at f/1.6, shutter at 1/60: 80% Video, AGE on; Iris at f/1.6, shutter at 1/60 : 30% Video, AGE on, Iris at f/1.6, shutter at 1/60: 30% Video, AGE on, 1/4-second integration:	11 fc scene illumination (0.85 fc faceplate illum.) 1 fc scene illumination (0.08 fc faceplate illum.) 0.2 fc scene illumination (0.016 fc faceplate illum.) 0.0125 fc scene illumination (0.001 fc faceplate illum.) Note 1: Scene Illumination is based on 100% reflectance.
Video output connector	Standard Bayonet Navy Connector (BNC) bulkhead on rear of camera
Imager	Interline transfer micro-lens CD with mosaic-type color compensating filter.
Resolution	460 horizontal; 350 vertical- NTSC
Digital Zoom Range	Auto/Manual (12X)
Lens Zoom	35X Lens & EIS: 0.14" to 4.7" f1.4 (w) f4.2 (t)
Horizontal Angle of View	35X Lens & EIS: 55.8 degrees (w) 1.7 degrees (t)
Iris/Focus/Shutter Operation	Auto/Manual
Minimum Focus Distance	0.4" at max. wide angle; 40" at max tele angle
Auto Focus	Selectable Auto/Manual. Minimum Scene Illumination for Reliable Auto Focus, 30% video
Electronic stabilization	Two-motion-frequency (5Hz or 16 Hz) selectable stabilization method.
Zoom & Focus Presets	64 preset positions (Note: recalling a preset position puts camera into manual focus mode)
Long Term Integration Range	Provides manual selection of integration duration for enhanced sensitivity. Integration times are 1/2 second, 1/4 second, 1/8 second, 1/15 second, 1/30 second. Frame Store video output provides continuous video output, updated at the integration rate.
Signal to noise ratio	>50 dB
Synchronization	Internal Crystal/Phase sync or adjust line lock
Video output level	1.0 V p-p (75 ohms composite), unbalanced, NTSC
Gain control	Automatic
Automatic white balance	Required
Title Generation	2 lines of 24 characters each for camera, dedicated for user input, user defined image/logo
Alarm Messages	Automatically generated by the camera, pop up on the screen to alert user
Camera Control ID	Selectable from 001 to 999 min.
Camera Position after power interruption	Camera must return to previous position and state of operation upon power interruption and restoration

Provide the camera with a suitable power supply that operates with an AC input voltage.

The camera must have automatic gain control (AGC) from 0 dB to 16 dB in order to be able to handle the range of lighting extremes from very low light night scenes to full sunlight conditions. If the AGC control is switchable, the Contractor must set the AGC to the "on" position.

The camera must be equipped with an electronic shutter with adjustable speeds. Manual Shutter: Selectable shutter speeds of 1/60, 1/100; 1/120, 1/180, 1/250; 1/500; 1/1,000; 1/2,000; 1/4,000; 1/10,000; 1/30,000 second. Auto Shutter: Automatically controls shutter speed between 1/60 and 1/30,000 second to maintain correct video level output. Auto Iris: Iris automatically adjusts to compensate for changes in scene illumination to maintain constant video level output within sensitivity specifications. Manual Iris: In the manual iris mode the iris opens and closes in steps.

The Contractor must set the shutter speed of the camera at 1/60th of a second.

C. Physical Specifications.--The following are the physical specifications for the camera:

Maximum dimensions	12" (H) x 14" (W) x 7" (D) (body)
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D. Environmental Specifications.--The following are the environmental specifications for the camera:

Operating temperature	From -27 °F to 165 °F
Storage temperature	From -40 °F to 185 °F
Operating humidity	Up to 100% relative humidity
Storage humidity	Conforms to NEMA TS2 paragraph 2.1.5.1
Protection rating	NEMA 4X
Housing Protection	Sealed and pressurized with 5 pound/sq. inch dry nitrogen with Schraeder purge fitting and 20 pound/sq. inch relief valve

CCTV CAMERA LENS

The CCTV camera lens must work properly in conjunction with the camera as well as all of the other video system components. It must operate reliably and produce clear images when properly adjusted and meet the following specifications.

The CCTV camera lens must be an integral component of the CCTV camera. The lens must be factory assembled, back-focused, and adjusted during manufacturing of the camera. Separate camera and lens combinations must not be accepted. The camera lens must provide auto iris with manual iris over-ride capabilities.

The following are the specifications for the lens:

Iris type	Motorized iris
Iris position without power	Closed
Operating temperature	From 29.2 °F to +165 °F (min. range).
Storage temperature	From -40 °F to 185 °F
Operating humidity	From 20% to 80% non-condensing
Storage humidity	From 20% to 90% non-condensing

When the camera is pointed at a very bright object or when the camera and lens is first turned on, the image produced by the lens and camera combination should not optically "oscillate" (i.e., produce an image that alternates from too light to too dark) or otherwise be unstable. The lens and camera combination should react to temporary overload situations (such as described above) in a smooth and rapid fashion and with minimum overshoot.

The following are the optical specifications for the lens:

- A. When the power is removed from the lens, the lens iris must automatically close
- B. The lens must incorporate an integral variable-density filter
- C. The lens must include mechanical and electrical means to protect the motors from over running in the extreme position

The lens must be supplied with zoom and focus in preset position.

CCTV CAMERA ASSEMBLY HOUSING

The CCTV camera Assembly housing must protect the CCTV camera and camera lens from rain, dust, wind and other elements. The housing must be corrosion resistant, tamperproof sealed and pressurized. The camera housing must include a loss of pressure sensor that will trigger an alarm message, which will be inserted in the video output signal.

The housing exterior must be finished by pre-treatment with a conversion coating and baked enamel paint and must be designed to withstand the effects of hose-directed water, rain, sand, dust, and other adverse environmental conditions. All connections must be watertight. A gas-tight connector must be used at the rear plate of the housing. Wiring to the connector must be sealed with silicon or potting compound.

The internal humidity of the housing must be less than 10 percent, when sealed and pressurized. Desiccant packs must be securely placed inside the housing to absorb any residual moisture and maintain internal humidity at 10 percent or less. The viewing window must allow unrestricted camera views can be obtained at all camera and lens positions and the lens in the center of the housing window. Provide any adapter plates required to mount positioning system to pole.

DIGITAL VIDEO REQUIREMENTS

The following are the digital video requirements:

Video Encoding	Moving Picture Experts Groups (MPEG 4) SP/H.264
Resolution	640 X 480 (VGA); 640 X 240 (ACIF); 320 X 240 (CIF)
Frame Rates	30, 15, 8, 4, 2 and 1 frames per second (selectable)
Video Latency	<200ms
Bit Rates	Constant: 3 Mbps maximum Variable: 8 Mbps maximum

BUILT-IN PAN AND TILT UNIT

The pan and tilt unit will be built-in with camera assembly unit with any electrical or communication interfaces required to perform the functions specified. The built-in pan and tilt unit must operate reliably with little or no maintenance, be environment and weather-resistant under a full range of environmental conditions, and provide repeatable day-to-day operation.

Performance Specifications:

The built-in pan and tilt unit must meet the following performance specifications:

Braking: Pan and Tilt	Mechanical or Electrical to limit coasting
Overload Protection	Motors: Impedance protected
Construction	Corrosion resistant steel or aluminum
Angular Travel	Pan: 360 degrees continuous Tilt: At least -90 degrees to +90 degrees
Motor Reversal	Immediate

The camera must return to the position before power is disrupted.

The built-in pan and tilt with camera assembly unit must be able to withstand a wind load of 100 mph.

Electrical Specifications

The built-in pan and tilt unit must meet the following specifications:

Power requirements	From 108 V(ac) to 132 V(ac), 50/60 HZ \pm 3 PERCENT
Duty cycle	Pan: continuous Tilt: intermittent
Pan and Tilt position preset	Minimum of 16 preset positions. Enables preset position to a predetermined Azimuth, elevation and lens position

Physical specifications

The built-in pan and tilt unit must meet the following physical specifications:

Maximum dimensions	12" (H) x 14" (W) x 7" (D) (body)
Pan Speed (manual)	From 0.1 to >80 degrees/sec (operator control)
Pan Speed (preset)	120 degrees/second
Tilt Speed (manual)	From 0.1° to > 4 degrees°/sec (variable - operator control)
Tilt Speed (preset)	120 degrees/second
Mounting (Base)	7" + 0.12"
Camera Mount	Compatible with camera housing
Preset Accuracy	0.1 degree
Privacy Zones	8 programmable zones can be set for video blanking

Environmental Specifications

The built-in pan and tilt unit must meet the following environmental specifications:

Operating temperature	From -40 °F to + 185 °F
Finish	Weather resistant paint or polyurethane

Pan and Tilt Stops

The built-in pan and tilt unit must have pan and tilt stops. The setting must be determined by the Engineer. Pan and tilt stops must have both mechanical and electrical stops.

Built-in Pan and Tilt Unit Installation

The Engineer will notify the Contractor of the pan and tilt stops for the built-in pan and tilt unit for the Contractor to set, prior to installation check. Installation check must be done in the presence of the Engineer. The operation of the built-in pan and tilt unit will be performed at the Model 334-TV controller cabinet. Contractor must furnish a laptop with software, for testing only, to view and control the actual camera. The Engineer must direct adjustments for pan and tilt presets and pan and tilt stops, to be made by the Contractor. Upon completion of the installation, the Engineer must verify operation of the pan and tilt unit.

CCTV Camera Equipment Warranty

All CCTV camera equipment installed must be warranted for a minimum of one year from time of final acceptance test, or 2 years from date of delivery, whichever is longer. The period of warranty coverage must not be less than the manufacturer's warranty period.

Testing

The Contractor must test and demonstrate to the Engineer control capability and video viewing from the RJ-45. The Contractor must demonstrate pan, tilt, zoom, preset, focus, and iris control functions. The Contractor must demonstrate the capability to set and read the camera control ID, to create and modify the video titler, and to retrieve the camera information such as camera position and alarms. The Contractor must demonstrate full-motion analog video from the BNC connection. The Contractor must demonstrate digital video in compliance with meets the

digital video requirements using software viewer. The Contractor must furnish equipment and software package for testing without additional cost to the State, to test the MPEG 4 video, H.264 video, and to perform the camera control using the Ethernet at the cabinet site.

Prior to installation, the Contractor must verify video and camera control from the Los Angeles Regional Traffic Management Center (LARTMC) on existing equipment before installing the new camera assembly.

After installation, the Contractor must perform analog video testing and serial control testing at the LARTMC.

VIDEO ENCODER

General

The Video Encoder for encoding the analog video streams from portable CCTV units and permanent CCTV units, specified elsewhere in these special provisions. Digitizing the analog video streams is required for optimum bandwidth usage for transmission of the video stream, both over wireless cellular links during temporary phase of the construction and also for the permanent installation. The video encoder must support Mpeg-2, Mpeg-4 and H.264 codecs, with the preferred codecs being Mpeg-4 and H.264 because of higher image quality and efficient bandwidth usage. It must also provide 2-wire or 4-wire simplex/duplex bi-directional data sub-channels.

The video encoder must be IP multicast capable and each of the streams must transmit at a user-selected rate that must include rates approximating 128 kilobits per second (kbps) to 6 Megabits per second (Mbps) and several intermediate data rates in elementary stream. The video encoder must be able to support both NTSC (30 frames per second) analog video streams.

It must have at least 2 serial ports (1 EIA/TIA-232 and 1 EIA/TIA-422/485) that may be used for making serial camera control available over IP and socket connection. The camera control over IP, if needed, can be converted back to native serial protocol using compatible IP to serial converters at the transportation management center. The serial data transmission must be software selectable, ranging from 300 bits per second (bps) to 115.2 kbps.

The video encoder must have the ability for remote management via Telnet, https and SNMP. It must have the following features and characteristics summarized in the table below:

Digital Field Video Encoder	
Input Voltage	From 10 to 15 V(dc)
Electrical Requirement	Power Consumption: Maximum of 15W
Ethernet Interface	1 Ethernet 10/100 Mbps port, RJ-45
Video Protocols	MPEG-2, MPEG-4, H.264
Resolution(D1/CIF/QCIF)	NTSC 720x480, 352x480, 352x240, 192x128, 176x120
Frame rate/Bit Rate	Constant and Variable to 30/25 fps 128 kbps to 6Mbps
Multi-Stream	Triple Streaming up to D1, 30/25 fps Up to 12 Mbps aggregate
IP Multicasting	IP Multicast capable
Application Interfaces	TCP/IP, UDP/IP, Hypertext Transfer Protocol Secure (HTTPS), Telecommunications Network (Telnet)
Serial Asynchronous Port	Yes
Serial Port Connectors	2 Ports via DB9
Serial Port Interface Protocol	Port 1 - EIA/TIA-232, Port 2 - EIA/TIA-422/485
Serial Port Data Rate	300 bps to 115 kbps
Remote management	Telnet, http, https via browser
Environmental Requirement	Minimum Range of Operating Temperature: -29 to +165 °F Humidity: From 5 to 95 percent Non-condensing
Physical Requirement (WxDxH)	Maximum Device Size: 3"x2'4"

LAYER 2 ETHERNET SWITCH

General

Layer 2 Ethernet Network Switch must be installed in ramp metering, traffic monitoring station and CCTV camera controller cabinets.

The Layer 2 switch may be connected via Small Form Pluggable (SFP) modules to other Layer 2 switches in the fiber trunk line or to a Layer 3 switch in the communication Hubs.

All non-Ethernet equipment in a field cabinets must be converted to Ethernet using compatible terminal servers in the field cabinet to enable connection to the Layer 2 Switch in the cabinet. Connections are to be done using CAT-5E network patch cables which must be manufacturer certified as TIA/EIA-568-B standard compliant. Connectors at both ends of the CAT-5E patch cables must be 8P8C-type modular connectors using T568B termination. Appropriate length must be used for all cables with sufficient length to allow for cable organization using cable ties but cable lengths not to exceed 368 feet.

Depending on whether the field cabinet has an AC or DC power supply (possibly from a Solar power generator), Layer 2 Ethernet switch must have compatible AC or DC power supply which must meet the following requirements.

Power Supply	
Electrical Requirement	Input Voltage: From 18 to 60 V(dc), 88 to 300 V(dc) and 85 to 265 V(ac) Input Current: From 0.8 to 1.3 A

Layer 2 switches must be provided with compatible fiber optic SFP modules to populate the SFP slots on the switches as required. The choice of SFP module types must be determined based on the distance of the fiber link involved.

Layer 2 Ethernet Network switches shall must at a minimum meet the following specifications:

Layer 2 Ethernet Switch	
Ethernet Downlink Interface	At least 4 (maximum 8) Ethernet 10/100 Mbps ports
Ethernet Uplink Interface	At least 2 dual purpose uplink ports (each dual purpose uplink port has one 10/100/1000 Mbps Ethernet port and one SFP-based Ethernet port, one port active)
Expansion module	8 additional 10/100 Mbps Ethernet ports and/or 8 additional 100 base-FX multi mode fiber ports
Application Interfaces	TCP/IP, UDP/IP, Hypertext Transfer Protocol (HTTP),
Additional Requirements	IP Multicast capable IEEE 802.1Q standard VLAN Compatible to Cisco Works network and switch management and monitoring software
Environmental Requirements	Minimum Range of Operating Temperature: -40 to +167 °F Humidity: From 10 to 95 percent condensing
Mechanical Requirement	Integrated mounting including either 4 keyhole screw mounts in 19 inch rack or mounting bracket using DIN rail

SFP Modules

SFP modules for the Layer 2 Ethernet network switches must be from the same manufacturer of the Ethernet switch. SFP modules must be of appropriate type depending on the distance covered by the fiber optic link and must also be compatible with the appropriate type of fiber used in the fiber optic link in question. All SFP modules must be compatible with LC (IEC 61754-20) type fiber connector. SFP modules used in Layer 2 Ethernet Switches must be one of the following types with following specifications:

SFP Module Type	Throughput	Fiber Type	Wavelength	Typical Transmission Distance
100Base-LX	100 Mbps	Single Mode	1310 nm	6.2 miles
1000Base-LX/LH	1000 Mbps	Single Mode	1310 nm	6.2 miles
1000Base-ZX	1000 Mbps	Single Mode	1550 nm	43.4 miles

All SFP modules must support a minimum connection distance of 6.2 feet (2 meters).

SFP module models used with Layer 2 Ethernet Switches must be specified by the manufacturer as compatible with the switch they are used with. SFP modules must have a minimum temperature range of +32 °F to +158 degrees °F (0 °C to 70 °C). The transmit and receive power range of different types of SFP must be as per the following table:

SFP Module Type	Transmit Power (dBm)	Receive Power Range (dBm)
100BASE-LX	-8 to -15	-8 to -28
1000BASE-LX/LH	-3 to -9.5	-3 to -20
1000BASE-ZX	+5 to 0	-3 to -23

In case of too high transmit power at receiving end, 5 or 10 db inline optical attenuator must be used at both ends to avoid overloading the receiver.

EIA-232 to EIA-422 Converter

The port-powered two-channel EIA-232 to EIA-422 converter must convert EIA-232 Transmit Data (TD) and Receive Data (RD) lines to balanced EIA-422 signals. The unit can be powered either from Data Terminal Ready (DTR or Ready To Send (RTS) of EIA-232 handshake lines. Only one of these lines must be present, and the unit will work regardless whether the lines are high or low. The unit can also be powered externally on the terminal blocks. Both the EIA-422 driver and receiver are always enabled.

To satisfy the requirements of some software packages, EIA-232 handshake lines are looped back (tied together). RTS is connected to Clear To Send (CTS), and DTR is connected to Data Set Ready (DSR) and Data Carrier Detect (DCD).

Connections for the EIA-232 to EIA-422 converter:

The converter is configured to transmit in both directions between an EIA-232 and EIA-422 system. The EIA-232 side is pinned out to connect directly into the COM port on the computer/laptop or any other Data Terminal Equipment (DTE) device (Table 1). The EIA-422 side of the converter is pinned out as described in Table 2. When connecting to an EIA-422 system, the converter must be connected with proper polarity as shown in Table 2. When no data is being sent and the driver is enabled, the EIA-232 line is negative and the EIA-422 line TD(A) is negative with respect to TD(B).

Table 1 – EIA-232 Pin Out	
Signal	DB-9 Female Pin #
TD	3
RD	2
RTS	7
CTS	8
DTR	4
DSR	6
DCD	1
GND	5

Table 2 – EIA-422 Pin Out	
Signal	DB-9 Female Pin #
TD(A)	8
TD(B)	3
RD(A)	2
RD(B)	7
GND	4,6

Specification for the EIA-422 to RS232 converter:

1. Communication: EIA-422
2. Data Rate: Up to 115.2 kbps max.
3. Power: Port-powered from handshake lines on the EIA-232 side
4. Dimensions: 2.4 x 1.3 x 0.7 inches
5. Temperature: From 0 to 159°F

10-3.29 TEMPERATURE SENSOR

Temperature Sensor must be IP enabled and accessible remotely. Temperature Sensor must comply with the following:

IP enabled Remote Temperature Sensor:	
Electrical Requirement	Worldwide external power adapter
Network/Interface	Ethernet Interface: One 10/100base-T RJ-45 Ethernet port
	Built-in digital temperature sensor, accurate to +/- 0.36 F with range from -40F to +254.8F
	Open Source Plugins in VBScript and C languages
	Application Interfaces: TCP/IP, Hypertext Transfer Protocol (HTTP), accessible via any web browser
	Data Logging Software
Environmental Requirement	Operating Temperature: -40 °F to +254.8 °F Humidity: From 1 percent to 99 percent
Mechanical Requirement	Maximum Device Size: 4 inches perimeter

10-3.30 CATEGORY 5E CABLE

Category 5E cable must be the unshielded, outdoor rated, non-gel filled type, and must meet the requirements of TIA/EIA 568B.2, Category 5E Cable, and the following:

1. The cable must contain 8 conductors, No. 24, minimum, solid bare copper conductors. Conductors must be insulated with polyolefin, polyethylene, polyvinyl chloride or fluorinated ethylene propylene material. Conductors must be in twisted pairs. Color coding must distinguish each pair: blue, blue/white; brown, brown/white; green, green/white; orange, orange/white.
2. The cable jacket must be rated for a minimum of 300 V and 60°C and must be polyvinyl chloride, polyethylene, polyolefin or fluorinated ethylene propylene. The jacket must shall be black, gray, or blue. The jacket must be marked as required by NEMA. The jacket must be marked at not more than every meter with the cable identification: manufacturer's name, product identification, number of conductors and conductor size, and voltage and temperature ratings. Cable length markings may be sequentially alternated with the cable identification markings at not more than every other meter.
3. The finished outside diameter of the cable must not exceed 1/2 inch.
4. The cable run between components must be continuous without splices. A minimum of 3 ft of slack must be provided at each pull box, junction box or vault, and a minimum of 10 ft at each cabinet. The ends of category 5E cable must be terminated with appropriate RJ-type connectors as necessary to connect the equipment shown on the plans, or must be terminated with crimped and soldered spade type terminals at terminal blocks where shown on the plans.
5. Category 5E Certified installations are required for installed lengths of less than 300 ft of finished cable.

ACCESS TO EAST LOS ANGELES HUB

Except as otherwise provided in these special provisions or as directed by the Engineer, work that requires access to the East Los Angeles Hub (ELA) building must be subjected to the following restrictions:

1. Work in the ELA Hub building shall be limited to the hours between 6:00 a.m and 4:00 p.m. Mondays through Fridays and between 7:00 a.m. and 3:30 p.m. on Saturdays, Sundays and designated legal holidays.
2. You must obtain approval from the Engineer a minimum of 48 hours before scheduling work in the ELA Hub building. Access to the equipment room in the ELA building must be limited to the hours needed to

complete that portion of work being performed within these rooms. Work performed in the equipment room must take place in the presence of the Engineer and the TMC Support Engineer, telephone (323) 259-1922, and / or the Caltrans Maintenance Supervisor or designee as directed by the Engineer.

3. The work performed in the ELA Hub building must be done in a manner to maintain the integrity of the equipment room as neatly as possible. You must provide a clear walking path to equipment in the ELA Hub building for the building staff's use.
4. You must protect existing equipment within the equipment room from damage from your operations. Access to hardware, electronics and peripheral equipment must be limited to those items necessary for you to perform the work required as stated in these special provisions.
5. You must cooperate with other contractors, vendors, and support personnel for ongoing systems work that may be in progress at the ELA Hub building during the term of this contract.

SYSTEM TESTING AND DOCUMENTATION-PERMANENT ITS

System testing and documentation must cover factory testing, sub-system testing, fiber optic cable testing, video link testing, data link testing, acceptance testing, physical inspection, functional testing, performance testing, final acceptance and system documentation required to validate the operational performance of communications systems as described elsewhere in these special provisions.

TEST PLAN

Design builder must submit 5 copies of an installation and test plan that details methods of installation, material, equipment, and cable testing, and a working day schedule to the Department within 14 working days. The Department will review the test plan and approve or disapprove it within 10 working days. If the Department rejects the test plan, submit a revised test plan within 20 working days for review and approval by the Department. No testing must be performed until the Department has approved the Design builder's test plan. Material and equipment must meet the requirements of these special provisions. Test results, including results of failed tests or re-tests, must be submitted to the Department and a copy placed with the equipment at the site. Design builder must supply site test equipment.

Design builder must notify the Department of intent to proceed with functional and sub-system testing 48 hours prior to commencement of tests. Full environmental conditions must be recorded as part of the functional tests for field equipment. Sub-system testing and inspections must include visual inspection for damage in correct installation, adjustments and alignment, and measurement of parameters and operating conditions.

Factory Testing

Documentation for testing conducted at the manufacturer's premises must be submitted to the Department when the equipment is delivered to the site.

Functional testing must be performed by the representative or the Design builder on material after delivery to the site. Functional tests must be performed in accordance with an approved test plan. Material or equipment which fails to meet requirements must be repaired or replaced and tests must be repeated until satisfactory. Functional test results, including results of failed tests or re-tests, must be submitted and delivered with material and equipment delivered to the site

Sub-system Testing

Sub-system testing must encompass testing of material, equipment and cables after installation, but prior to acceptance tests. Tests must be in accordance with the performance testing for individual items.

Materials, equipment and cables must be tested after installation at the site. Sub-system testing and inspections must include visual inspection for damaged or incorrect installation, adjustments and alignment, and measurement of parameters and operating conditions. Notify the Department of intent to proceed with sub-system testing 48 hours prior to commencement of individual tests.

Installation documentation and test results must be provided for materials, equipment and cables prior to commencement of acceptance tests. Installation documentation must include the following as appropriate:

1. Model, part number and serial number for material and equipment.
2. Test equipment model number, serial number, settings, and date of last calibration.
3. Strap and switch settings.
4. Record of adjustments and levels.
5. Alignment measurements.
6. Identification of interconnections.

Video Link Testing

Video link testing must be conducted after the Design builder submits a test plan and receives approval from the Department. A video link must be established from CCTV cameras to ELA Hub then to the LARTMC operators' workstations for testing and verification. Measurements must be made from the baseband-in to baseband-out connections.

Video links in communications systems must be tested with a video test signal at the video transmitter input. The Design builder must perform level adjustments and alignments required on video links. If a video link fails to meet performance requirements, the Design builder must restore failed links to the required performance.

Video links in communications systems must be tested for qualitative performance with associated cameras turned on and connected to BNC connectors of video transmitters. Measure, record, and tabulate video receiver's dynamic range at the optical connector of the new single fiber optic video receivers at LARTMC and at the new single fiber optic video transmitters in the ELA Hub building under test using a 90 percent APL (average picture level) flat field input to the existing single video transmitter.

The output video signal must be connected to a video display monitor. The observed picture on the video display monitor must be assessed for qualitative performance. Qualitative comments must be recorded for individual cameras.

The Department will approve the video test set. Measure, record and demonstrate that the performance meets or exceeds the specified EIA RS-250 requirements listed below:

1. Differential gains.
2. Differential phases.
3. Chrominance to luminance delays inequality.
4. Amplitude vs. frequency characteristics.
5. Frequency response characteristic.
6. Signal to noise ratio.
7. Signal to low frequency noise.
8. Signal to periodic noise.
9. Output signal levels.

Data link testing

Data link testing for the alignment and testing of data systems must be conducted after the Design builder submit a test plan and receive approval from the Department. The activities must include verification of data circuits in the low speed data links, high speed data ring network and in the integrated data system. Adjust levels required for the data system to operate.

Data link tests must be conducted between LARTMC and the communication system routing equipment in the controller cabinets, including CCTV cameras and Model 2070 controllers.

Records of tests must be delivered to the Department. Circuits must be fully tested to the channel card using a transmission impairment measuring set (TIMS). Bit error rate (BER) tests must be conducted using State furnished Model 400 modems (or equivalent) at 1200 bps from LARTMC to the circuit terminus. BERTS must be used in a 3-hour test for each circuit.

The bit error rate in both directions must be less than 1×10^{-6} at 9600 bps for all circuits.

Data link performance

Data link performance tests must consist of functional tests conducted between the existing Data multiplexer in the LARTMC and from the East Los Angeles Hub to various field element locations, such as closed circuit television (CCTV) cameras, traffic monitoring stations, and ramp metering systems that are connected to the existing and new trunk line fiber optic cables, as shown on the plans and as directed by the Department. The audio channel must be verified in both directions using telephone instruments. The signaling system must be verified in both directions. In addition to circuits using 4 WTO channel cards for modems, bit error rate (BER) tests must be conducted using appropriate State furnished Model 400, 1200 BPS modem or ITU compatible high speed modem, and a bit error rate test set (BERTS) must be used to verify error free transmission for 5 minutes at the bit rate to be employed in the system.

Records of tests must be delivered to the Department. Circuits must be tested to the channel card manufacturer's specifications. End-to-end bit error rate tests (BERTS) must be conducted using the type modem to be employed on the link at the bit rate to be employed. The BERTS must be with the modem at the equipment sites configured in a loop back and with the test setup at the node. The BERTS must be a minimum of 3 hours for each circuit including required bridges.

Circuits affected by the Design builder's work must provide an error rate less than 1×10^{-6} .

Acceptance Testing

Acceptance testing must be conducted in accordance with the approved test plan. Acceptance testing must include acceptance tests and subsequent retests, and documentation of test results.

Final acceptance tests must be conducted after site and sub-system test results have been reviewed and accepted by the Department. These tests include the complete system in normal operations. The test plan must address full testing requirements of these special provisions. The test plan must detail tests to be performed, expected test results, and test schedules. The acceptance test plan must include the following test and acceptance categories:

1. Physical inspection.
2. Functional tests.
3. Performance tests.

Test communications systems, according to the approved acceptance test plan, must provide test equipment, labor and ancillary items required to perform testing. Test equipment must be certified to be calibrated to manufacturer's specifications. The model, part numbers, and date of last calibration of test equipment must be included with test results.

Acceptance testing must not commence until materials required by these special provisions and plans are delivered, installed, connected and aligned and the Department has approved production test and site test documentation and results.

Acceptance test results must be documented and documentation provided to the Department as a condition of acceptance.

Physical Inspection

The Design builder must provide documentation to prove delivery of material, equipment, cable and documentation. If material or documentation is pending or has been replaced under pre-acceptance warranty, physical inspection and documentation must be provided. Physical inspection must consist of inspecting installed equipment to ensure quality workmanship satisfies the specified requirements.

Functional Tests

Functional tests must be performed in accordance with an approved test plan.

Functional tests must include testing of camera images and verification of camera control from camera control receiver. Connectivity of data channels must be demonstrated. Functional test results are documented. If an aspect of functional tests is determined by the Department to have failed, you must cease acceptance testing, determine the cause of the failure, and repair materials to the satisfaction of the Department. Acceptance testing must, at the discretion of the Department, be repeated beginning from the start of functional tests.

Performance Tests

Conduct operational performance tests on the following:

1. The video links from the LARTMC building and the East Los Angeles Hub to new CCTV camera locations that are connected to the existing and new trunk line fiber optic cables.
2. Data circuits operational from the modify CCTV cameras, ramp metering system (RMS), traffic monitoring stations to the East Los Angeles Hub.

Video tests must satisfy the end-to-end performance requirements under normal operating conditions. Video tests must be measured with camera video output transmitting a video signal at the input of video display monitors. The Design builder must test the video sub-system and record the results. Test must be performed according to EIA-250, "Electrical Performance for Television Transmission" with minimum video signal to noise ratio as under:

Video Signal Test	Minimum Requirement
Video Signal to Noise Ratio	47 dB
Video Signal to Low Frequency Noise Ratio	39 dB
Video Signal to Periodic Noise Ratio	52 dB

Data tests must be performed on operational and data circuits using appropriate test equipment for the measurement of the following parameters:

Run end-to-end bit error rate tests from the data nodes and cable node to individual remote drop of individual data Circuit A data test set must be used at cable nodes and remote modems to insert an asynchronous pseudo-random pattern using 8 data bits, 1 start bit, 1 stop bit and even parity. The data test set at remote modems must hold RTS high for the duration of the data test. The data rate of the test sets must be set to rate as employed in the system.

A 15-minute test on individual drop of multipoint circuits must be error free in both directions. One drop of individual circuit as chosen by the Department must be tested for 72 hours. Distortion must be tested between cable nodes and the field modems for data circuits. Signals must not have a gross span-stop distortion greater than 20 percent at a data interface measured as per EIA-404-A.

If a circuit or element fails to satisfy the specified performance requirements, determine the cause and correct the failure to the satisfaction of the Department. Full performance tests must be repeated under operating conditions as determined by the Department.

SYSTEM DOCUMENTATION

Submit draft documentation 8 week prior to the start of installation. The Department will review and approve or reject the draft documentation within 2 weeks of receipt. Draft documentation must show the general approach in preparing final manuals.

Arrange for re-submission within 2 weeks if the documents are rejected.

Final documentation must be submitted no later than 4 weeks after completion of the acceptance tests and must incorporate comments made during approval stages. The Design builder are responsible for delay caused by non-compliance to requirements. Ten copies of final documents must be delivered. The copies must be 8.5 inch x 11 inch paper and bound in 3-ring hard-cover binders with dividers.

System documentation must be arranged in an operation and maintenance (O & M) manual format providing information necessary to operate, maintain and repair equipment and cables to the lowest module or component level.

Operations and maintenance manuals must as a minimum consist of the following sub-sections:

1. Master Items Index, This must be the first section of the O & M manual. The section must describe the purpose of individual manual and brief description to the directory of the manual. It must reference equipment manuals as required for additional and support material. Accurate Block Diagrams must be included.
2. System Description and Technical Data, This section must contain an overall description of the system and associated equipment and cables with illustrative block diagrams. This section must identify equipment and cables in the system stating the exact module and option number that are employed in the system. Technical data specification and settings for every type of equipment or cable must be provided. Modifications to equipment must be clearly described.
3. Theory of Operation, The manual must contain a functional description of elements of the system, explaining how an individual function is achieved separately and how elements work together to form the complete system.
4. Operations, The manual must describe how to operate the system and a particular type of equipment. Equipment layout, layout of controls, displays, and other information required to correctly operate the system and each functional unit must be provided. Procedures must be provided for initial tune-up of the system and adjustment and checkout required to ensure that the system is functioning within the performance requirements. Warning of special and turn-on procedures must be included. The functions and setting of parameters must be explained.
5. Parts List, The manual must include a list of replaceable parts with exact parts description and number and a directory of recommended suppliers with correspondence address, telephone and fax numbers.
6. Test Results, This section must include a copy of the results for the tests that have been conducted for the contract.

Twelve complete sets of operation and maintenance manuals must be provided. Provide system schematic drawings to identify the type of equipment at individual location. Drawings must show how systems are interconnected. A list of cabling and wiring must be provided to identify the interconnection and labeling of equipment in the field.

FINAL ACCEPTANCE

Final acceptance of systems will not occur until the following conditions have been met:

1. Physical, functional and full performance acceptance tests have been completed and the Department approves the results.
2. Documentation has been completed and submitted to the Department.
3. Connections that were changed to perform acceptance tests are restored and tested.

10-3.31 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT

Salvaged electrical materials shall be hauled to 602 S. Flower Street, Burbank, CA 91502 and stockpiled.

The Contractor shall provide the equipment, as necessary, to safely unload and stockpile the material. A minimum notice of 3 business days shall be given prior to delivery. The phone number for the Burbank Electrical Maintenance Yard is (818) 842-2885.

10-3.32 DISPOSING OF ELECTRICAL EQUIPMENT

Polychlorinated biphenyl (PCB) containing materials are suspected to be present in the overhead sign lighting, Empire Avenue UP Bridge No. 53-3003, San Fernando Blvd. SBD UC Bridge No. 53-1215, and San Fernando Blvd. NBD UC Bridge No. 53-1109. These structures are proposed for removal. Prior to starting construction, the Contractor must inspect the existing electrical components to determine if any hazardous materials are present. The Contractor must notify the Engineer in writing three days of the findings.

Fluorescent light ballasts which contain polychlorinated biphenyls (PCBs) shall be disposed of in conformance with the California Department of Toxic Substances Control (DTSC) Regulations set forth in Title 22, Division 4.5, Chapter 42, of the California Code of Regulations.

Ballasts and transformers that contain polychlorinated biphenyl (PCB) are designated as extremely hazardous wastes and fluorescent tubing and mercury lamps are designated as hazardous wastes under Title 22, Division 4.5, Chapter 11, Article 4.1 and Article 5, of the California Code of Regulations.

The State assumes generator responsibility for these wastes. The Engineer will prepare the Hazardous Waste Manifest for Shipment. Ballasts shall be packaged and transported to a hazardous waste disposal facility. The Contractor shall package and transport fluorescent lights to an appropriately permitted facility.

PAYMENT

Full compensation for hauling, stockpiling, and disposing of transformers, fluorescent tubing and mercury lamps and non-leaking fluorescent light ballasts shall be considered as included in the contract price paid for the various items of work and no additional compensation will be allowed therefor.

10-3.33 PAYMENT

The contract lump sum price or prices paid for signal and lighting shall include highway lighting at intersections in connection with signals only.

Other roadway lighting on the project shall be considered as included in the contract lump sum price paid for lighting and sign illumination, lighting (temporary), and lighting (city).

Full compensation for hauling and stockpiling electrical materials shall be considered as included in the contract price paid for the item requiring the material to be salvaged and no additional compensation will be allowed therefor.

If any of the fabrication sites for the materials listed are located more than 300 air line miles from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Whereas it is and will be impractical and difficult to determine the actual increase in these expenses, it is agreed that payment to the Contractor for furnishing these listed materials from each fabrication site located more than 300 air line miles from both Sacramento and Los Angeles will be reduced \$2,000:

1. Service equipment enclosures
2. Telephone demarcation cabinets
3. Closed circuit television cabinets furnished by the Contractor

The contract lump sum price paid for microwave vehicle detection system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing and removing pole on steel plate and blocks, installing conduits pull boxes and cables, installing equipment in controller cabinet and on pole, installing and removing K-rail, calibrating system, complete in place as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract lump sum price paid for sprinkler control conduit (bridge) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing conduits pull boxes in bridge structure, complete in place as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

SECTION 11. (BLANK)

SECTION 12. BUILDING WORK

12-1.01 SCOPE

This consists of furnishing all labor, tools, transportation, equipment, and materials required for the construction of Empire Avenue Storm Water Pump Station, including, but not limited to, earthwork, dewatering, below ground concrete wet well, three (3) 75 HP wet pit submersible pumps, one (1) 5 HP submersible sump pump, piping, fittings, valves, hoist system, HVAC, ventilation and ducting, electrical and instrumentation, and site grading.

Sections 10 through 95 of the Standard Specifications do not apply to the work in Section 12 except when specific reference is made thereto.

12-1.02 ABBREVIATIONS

Abbreviations:

AAMA	American Architectural Manufacturers' Association
ACI	American Concrete Institute
AGA	American Gas Association
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association
APA	Engineered Wood Association
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
BIA	Brick Industry Association
CBC	California Building Code
CEC	California Electrical Code
CMC	California Mechanical Code
CPC	California Plumbing Code
ESO	Electrical Safety Orders
FM	FM Global
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
ICC	International Code Council
ISO	International Organization for Standardization
LEED	Leadership in Energy and Environmental Design
NAAMM	National Association of Architectural Metal Manufacturers
NEC	National Electrical Code
NFPA	National Fire Protection Association or National Forests Products Association
PEI	Porcelain Enamel Institute
RIS	Redwood Inspection Service
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
TCNA	Tile Council of North America
TPI	Truss Plate Institute
WCLIB	West Coast Lumber Inspection Bureau (stamped WCLB)
WCLB	Grade stamp for WCLIB
WI	Woodwork Institute
WWPA	Western Wood Products' Association

12-1.03 COOPERATION

Comply with "Cooperation" in Section 10, "Constructions Details," of these special provisions.

Submit requests for approval to the Engineer before interrupting any services for the purpose of making or breaking a connection. Include in the request the proposed time period necessary to complete the work. Allow the Engineer 5 days to review each request.

Do not use State telephone facilities.

12-1.04 SUBMITTALS

Items to be submitted to the Engineer must be approved under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

Items to be furnished to the Engineer do not require approval.

The Engineer may request submittals for materials or products where submittals have not been specified in these special provisions, or may request that you include additional information in specified submittals, as necessary to determine the quality or acceptability of such materials or products.

Submit the following items within 50 days of contract approval:

1. Working drawings
2. Material lists
3. Product and descriptive data
4. Samples
5. Other submittals

Submit at least 5 sets of each item. Two sets will be returned either approved for use or returned for correction and resubmittal.

Submit the Schedule of Values within 20 days of contract approval. Submit at least 2 sets.

Each item submitted must include a descriptive title, the name of the project, district, county, contract number, and must reference the applicable portion of the contract documents that it pertains to. Plans and detailed drawings must be not larger than 24" x 36."

The material lists must include the name of manufacturer, catalog number, size, capacity, finish, all pertinent ratings, and identification symbols used on the plans and in these special provisions for each unit.

Deliver submittals to Offices of Structure Design, Documents Unit.

Allow 25 days for approval or return for correction of each submittal or resubmittal. Should the Engineer fail to complete the review within the time specified and Engineer determines that your controlling operation is delayed or interfered with by delay in review, an extension of time commensurate with the delay in completion of the your work will be granted under Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Remove unapproved samples and samples not incorporated in the work from State property.

Furnish 3 copies of the following items to the Engineer at the job site:

1. Parts lists and service instructions packaged with or accompanying the equipment
2. Operating and maintenance instructions
3. Manufacturer's warranties
4. Qualification data

12-1.05 SCHEDULE OF VALUES

Divide the Schedule of Values into sections representing the cost of each separate building or structure. Do not include work that is not part of the building or structure in the building or structure cost. Include this work under a specific section as General Work.

List indirect costs and bond premiums as separate line items of work.

Identify the sections representing each building or structure as to the building or structure they represent and break them down to show the corresponding value of each craft, trade or other significant portion of the work. Provide a sub-total for each section.

The Schedule of Values must be approved by the Engineer before any partial payment estimate is prepared.

The sum of the items listed in the Schedule of Values must equal the contract lump sum price for building work. Distribute overhead and profit proportionally across all line items of cost.

12-1.06 INSPECTION

Any work that will be covered or not visible in the completed work must be inspected and approved by the Engineer before progress of work conceals portions to be inspected. Notify the Engineer not less than 72 hours in advance of when such inspections are needed.

Provide adequate temporary lighting to allow the Engineer to inspect the project as each portion is completed.

12-1.07 UTILITY CONNECTION

Make all arrangements and obtain all permits and licenses required for the extension of and connection to each utility service applicable to this project. For extensions not performed or provided by the utility, provide all labor and materials necessary for such extensions and install any intermediate equipment required by the serving utilities.

The costs incurred by you for (1) utility permits, licenses, connection charges, and excess length charges, (2) the extensions of utilities beyond the limits shown on the plans, and (3) furnishing and installing any intermediate equipment required by the serving utilities, will be paid for as extra work under Section 4-1.03D of the Standard Specifications.

12-1.08 SANITARY FACILITIES

Do not clean tools or dispose of cleaning liquids in State sanitary facilities or sewers.

During toilet room renovation or other periods when State sanitary facilities are not operational, provide the following for State forces:

1. Wash facilities
2. Drinking water fixtures
3. At least two temporary toilet units

Provide separate temporary toilet units for your personnel.

Temporary toilet units must be 1) single occupant units of the chemical type, 2) properly vented, and 3) fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

Perform periodic flushing, waste removal, and cleaning of temporary toilet units. Maintain units in a clean and sanitary condition, including a supply of toilet tissue, toilet seat covers, and paper towels. Dispose of waste material off site in a lawful manner.

12-1.09 MEASUREMENT AND PAYMENT

The contract lump sum price paid for building work includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in performing the building work, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for any incidental materials and labor, not shown on the plans or specified that are necessary to complete the building work, are considered as included in the contract lump sum price paid for building work and no additional compensation will be allowed therefor.

12-1.10 PROJECT RECORD DRAWINGS

Prepare and maintain one set of project record drawings, using an unaltered set of original project plans, to clearly show all as-constructed information for the project.

As a minimum, project record drawings must include the following information:

1. Any plan clarifications or change orders
2. Locations of any underground utilities
3. Location, size, type, and manufacturer of all major products or components used in the work.

Prepare project record drawings as follows:

1. Place markings on the project record drawings using red ink or red pencil.
2. Do not eradicate or write over original figures.
3. Neatly line out superseded material.
4. Submit additional drawings if the required information cannot be clearly shown on the original set of project plans. The additional drawings must be not less than 11" x 17" in size. Label each sheet with the contract number.
5. Sign and date each sheet verifying that all as-built information shown on the drawings is correct.

Review the project record drawings monthly with the Engineer during the progress of the work to assure that all changes and other required information are being recorded.

Before completion of the work, request a review of the project record drawings to determine the completeness and adequacy of them. If the project record drawings are unacceptable, you must inspect, measure, and survey the project as necessary to record the required additional information.

Deliver the completed project record drawings to the Engineer before acceptance of the contract.

12-1.11 FIELD ENGINEERING

This section specifies administrative and procedural requirements for field engineering services to be performed by the Contractor.

Lines and Grades:

Attention is directed to Section 5-1.07 "Lines and Grades," of the Standard Specifications.

Such stakes or marks will be set by the Engineer as he determines to be necessary to establish the lines and grades required for the completion of the work shown on the plans and as specified in these special provisions. In general, these will consist of the primary vertical and horizontal control points.

Stakes and marks set by the Engineer shall be carefully preserved by the Contractor. In case such stakes and marks are destroyed or damaged they will be replaced at the Engineer's earliest convenience. The Contractor will be charged for the cost of necessary replacement or restoration of such stakes and marks which in the judgment of the Engineer were carelessly or willfully destroyed or damaged by the

Contractor's operations. This charge will be deducted from any moneys due or to become due the Contractor.

All other stakes or marks required to establish the lines and grades required for the completion of the work shall be the responsibility of the Contractor.

Existing utilities and equipment:

The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, the Contractor shall investigate and verify the existence and location of underground utilities and other construction.

Prior to construction, the Contractor shall verify the location and invert elevation at points of connection of sanitary and septic sewers, storm sewer, and water or fire service piping.

Surveys for layout and performance:

The Contractor shall perform all surveys for layout and performance, reduce field notes, and make all necessary calculations and drawings necessary to carry out the work.

The Contractor shall locate and layout site improvements, and other work requiring field engineering services, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.

Batter boards shall be located and laid out for structures, building foundations, column grids and locations, floor levels and, control lines and levels required for mechanical and electrical work.

Survey accuracy and tolerances:

The tolerances generally applicable in setting survey stakes for foundations, slabs, and underground work shall not exceed the following:

Survey Stakes or Markers	Tolerance
Rough grading or excavation	0.10-foot
Trimming or preparation of subgrade for roadways	0.05-foot
Roadway surfacing, steel or concrete pipe	0.02-foot
Structures or building construction	0.01-foot

Such tolerance shall not supersede stricter tolerances required by the plans or special provisions, and shall not otherwise relieve the Contractor of responsibility for measurements in compliance therein.

SECTION 12-2. SITEWORK

12-2.01 CLEARING AND GRUBBING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of removing all objectionable material from the building site in accordance with the details shown on the plans and these special provisions.

Clearing and grubbing shall be performed in advance of any other grading or construction operations.

The area to be cleared and grubbed shall be within the building work construction area.

SITE CONDITIONS

Traffic: Clearing and grubbing shall be conducted to ensure minimum interference with roads, street, walks or other occupied areas.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

SITE CLEARING

Remove trees, shrubs, grass and other vegetation, concrete and masonry, improvements, or obstructions interfering with the new construction.

Trees to be removed shall be grubbed to a depth of not less than 2 feet below finished grade.

REMOVAL OF WASTE MATERIAL

Hauling: When hauling is done over highways or city streets, and when directed by the Engineer, the loads shall be trimmed and all material removed from shelf areas of the vehicles.

Disposal: Trees, shrubs, grass, weeds and other vegetation, debris, and any obstructions above or below the ground surface that interfere with the building work, shall be removed and disposed of outside the highway right of way in accordance with Section 7-1.13 of the Standard Specifications.

12-2.02 ROUGH GRADING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of rough grading the site in accordance with the details shown on the plans and these special provisions.

Rough grading shall consist of excavation or removal of above grade material regardless of character and subsurface condition; filling of all holes, swales, embankments, and low points to the elevation shown on the plans or specified; and the preparation of basement material for the placing of other material thereon and the establishment of the grading plane.

Earthwork for building construction shall conform to the requirements specified under "Earthwork for Building Work" in this Section 12-2 of these special provisions.

Surplus Grading Material: The grading shown on the plans will develop a surplus of approximately 2,490 cubic yards.

PART 2 - PRODUCTS

Fill Material:

Material from the excavation that is suitable for the required compaction may be used for filling holes, swales and low points. Fill material shall be free of organic material. Rocks and lumps shall be well distributed with sufficient earth or other fine matrix material to produce a dense, compacted fill that is suitable for the construction and load support intended.

The Contractor shall furnish suitable borrow material to offset any material deficiencies developed from grading work.

PART 3 - EXECUTION

EXCAVATION

Care shall be exercised to avoid disturbing material below and beyond the limits of excavation. When excavation is carried beyond the limits shown on the plans or specified, such excavation shall be replaced in kind and compacted at the Contractor's expense.

Limits of the excavation shall allow for adequate working space for installing materials and as required for safety of personnel. Such working space excavation shall be replaced in kind and compacted at the Contractor's expense.

Excess and waste materials from the excavation shall become the property of the Contractor and be disposed of outside the highway right of way in accordance with the requirements in Section 7-1.13 of the Standard Specifications.

FILL

Subgrade Preparation: Preparation of subgrade material for placing other material thereon shall include fine grading, compaction, reworking as necessary, and preparation of cut, or fill upon which base materials, surfacing, or slabs are to be placed. The upper 8 inches of the subgrade shall have the same compaction as the fill to be placed over it.

Placing: When footings are to be constructed in fill, the fill shall be constructed to the grading plane required for the building construction prior to excavating for the footings. Fill shall be placed and compacted in layers. The loose thickness of each layer before compaction shall not exceed 6 inches.

Water shall be added to the fill material as needed for compaction.

COMPACTION

Relative compaction shall be determined in accordance with California Test 216 or 231. 22

Relative Compaction (95 percent):

In fill relative compaction of not less than 95 percent shall be obtained for a minimum depth of 2.5 feet below finished grade for the width of the paved areas plus 3 feet on each side thereof.

The prism of fill directly underneath the building foundation and sloping downward at 1:1 shall be compacted to 95 percent.

Relative Compaction (90 percent): Relative compaction of not less than 90 percent shall be obtained in all fill except as specified above.

FIELD QUALITY CONTROL

Testing and Inspection: The State will conduct compaction tests during the earthwork operations.

12-2.03 EARTHWORK FOR BUILDING WORK

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of performing earthwork for building work in accordance with the details shown on the plans and these special provisions.

Earthwork for building work shall consist of structure excavation and structure backfill. Structure excavation shall include excavation for footings, foundations, walls, slabs, manholes, and trenches. Structure backfill shall include backfilling under slabs; backfilling under and around footings; backfilling for walls, backfilling for pipes and conduits; backfilling holes resulting from removal of existing facilities. In addition to structure excavation and structure backfill, earthwork for building work shall include any other earthwork, not mentioned, but necessary to complete the building work.

Attention is directed to the Materials Information Handout for information regarding foundation recommendations and reports that were prepared for use during the design of this project. Refer to the geotechnical report prepared by Leighton Consulting, Inc. (Project No. 603239-001) dated November 9, 2011. Attention is directed to the requirements of "Field Engineering" in Section 12-1, "General Requirements," of these special provisions.

QUALITY ASSURANCE

Samples: Samples of sand, pea gravel, or crushed stone, weighing not less than 25 pounds, shall be submitted to the Engineer at the jobsite for approval.

SITE CONDITIONS

Existing Underground Piping and Conduit: The location of existing underground piping and conduit is based on the best records available. Before beginning work, the Contractor shall accurately locate the piping and conduit involved in the work. If the location of the existing piping or conduit deviates from the location shown on the plans by more than 5 feet, or, if no elevations are indicated and the piping or conduit is more than 3 feet below grade, the cost of the additional excavation, backfill, piping or conduit, and removal and replacement of concrete, if any, will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

Existing Surfaced or Planted Areas:

Existing surfaced or planted areas that are removed, broken or damaged by the Contractor's operations shall be restored to their original condition except as otherwise shown on the plans or specified herein.

Restoration materials shall be equal to or better than the original materials. Surfacing shall be replaced to match the material thickness, grades, and finish of the adjacent surrounding surfaces.

PART 2 - PRODUCTS

BACKFILL MATERIALS

Structure Backfill: Structure and trench backfill shall be free of organic and other deleterious material and shall be suitable for the required compaction. Gravel without sand matrix shall not be used except as free draining granular material beneath slabs and footings.

Sand: Sand shall be clean, washed sand, free from clay or organic material graded such that 100 percent passes the 1/4-inch sieve, 90 percent to 100 percent passes the No. 4 sieve and not more than 5 percent passes the No. 200 sieve size.

Pea Gravel (Naturally Rounded):

Pea gravel (naturally rounded) shall be clean, washed, dry density of not less than 95 pounds per cubic foot, free from clay or organic material and shall conform to the following grading as determined by California Test 202:

Sieve or Screen Size	Percentage Passing
3/4"	100
1/2"	90-100
3/8"	40-70
No. 4	0-15
No. 8	0-3

Pea gravel shall conform to the following requirements:

Test	California Test No.	Test Requirements
Durability Index	229	35 Min.

Crushed Stone:

Crushed stone shall be clean, washed, dry density of not less than 95 pounds per cubic foot, crushed stone or crushed gravel with an angular particle size not less than 1/8 inch or more than 1/2 inch.

Sieve or Screen Size	Percentage Passing
1/2"	100
3/8"	85-100
No. 4	10-30
No. 8	0-3

Crushed stone shall conform to the following requirements:

Test	California Test No.	Test Requirements
Durability Index	229	35 Min.

PART 3 - EXECUTION

PREPARATION AND RESTORATION

Sawcutting: Prior to excavation or trenching, existing surfacing shall be removed to saw cut lines, or to existing wood dividers or expansion joints, if any. The saw cut shall be to a neat line and have a depth not less than one inch.

Restoration: Surfacing shall be replaced to match the thickness, grades and finish of the adjacent surrounding surfaces.

STRUCTURE EXCAVATION

Unless otherwise noted, all excavation for building work shall be classified as structure excavation.

Footing Excavation:

The bottom of excavation shall not be disturbed. The Contractor shall excavate by hand to the final grade. The bottom of concrete footings shall be poured against undisturbed material. Unless otherwise noted, compaction of the bottom of footing excavation is not required unless the material is disturbed. The footing depths shown on the plans shall be changed to suit field conditions when directed by the Engineer. Solid rock at or near required depths shall not be disturbed. Unsuitable material shall be excavated down to firm bearing as directed by the Engineer. Work and materials required because of excavation in excess of the depths shown on the plans, when such excavation has been ordered by the Engineer, will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

Excavate to the elevations and dimensions within a tolerance of $\pm 1/2$ inch. Limits of the excavation shall allow for adequate working space for installing materials and as required for safety of personnel. Such working space excavation shall be replaced in kind and compacted at the Contractor's expense.

Overdepth excavation for footings shall be backfilled with concrete or such other material recommended by the Contractor and approved by the Engineer. Relative compaction shall be not less than 95 percent.

At locations and to the limits shown on the plans, material below the bottom of the foundation or footing shall be removed and replaced with select backfill in accordance with the placing and compacting requirements for backfill.

Excavation for Pipes and Conduits:

Pipes or conduits in the same trench shall have a minimum clear distance between pipes or conduits of 6 inches. Pipes or conduits shall have not less than $2\frac{1}{2}$ feet of cover from top of pipes or conduits to finished grade unless otherwise shown on the plans or specified.

Trenching shall be of sufficient depth to permit placing a minimum depth of 4 inches of compacted sand under all pipes and conduits.

Excavation adjacent to trees shall be performed by hand methods where necessary to avoid injury to trees and roots. Roots 2 inches in diameter and larger shall be protected with heavy burlap. Roots smaller than 2 inches in diameter adjacent to trees shall be hand trimmed. Cuts through roots $1/2$ inch in diameter and larger shall be sealed with tree trimmers' asphaltic emulsion. If trenches remain open more than 24 hours, the side of the trench adjacent to the tree shall be shaded with burlap and kept damp. Materials shall not be stockpiled within the drip line of trees.

Dewatering: Excavations shall be kept clear of standing water. Water shall be removed by pumping if necessary. Water removed from excavation shall be carried away from the building site and disposed of in a manner that will not harm State or adjacent property.

STRUCTURE BACKFILLING

Unless otherwise noted, all backfill for building work shall be classified as structure backfill. Backfill shall be placed and compacted in horizontal layers, not more than 6 inches thick prior to compaction, and to the lines and grades shown on the plans or to original ground.

Structure Backfill: After structures are in place and forms are removed, wood and other debris shall be removed from excavations before placing structure backfill. No backfill material shall be placed against the outside walls of cast-in-place concrete structures until the concrete reaches its 28-day compressive strength.

Backfilling Pipes and Conduits:

Backfill placed under pipe and conduits shall be compacted sand, (minimum SE 30), 6 inches minimum depth. Backfill material placed to a level 12 inches above tops of pipes and conduits shall be sand or fine earth and particles shall not exceed 1/2 inch in greatest dimension. For wrapped, coated, or plastic pipe or conduits, sand shall be used for backfill. Backfill material within the trench zone placed higher than 12 inches above tops of pipes or conduits shall consist of excavated native or imported backfill, fine-grained non-organic materials free from peat, roots, debris, and rocks larger than 3 inches, and which can be compacted to a relative compaction of 90% in unpaved areas and 95% in paved areas.

Unless otherwise shown on the plans, pipe under roads, with less than 2½ feet of cover over the top of pipe, shall be backfilled with concrete to a level 4 inches above the top of pipe. Concrete for backfill shall be commercial quality concrete containing not less than 564 pounds of cement per cubic yard.

COMPACTION

Relative compaction shall be determined in accordance with California Test 216 or 231.

Unless otherwise noted below, all backfill shall be compacted to a minimum relative compaction of 90 percent.

Unless approved in writing by the Engineer, compaction by jetting or ponding will not be permitted.

Compact Original Ground: Original ground surface under fill with surfacing of concrete and asphalt concrete shall be compacted to a relative compaction of not less than 95 percent for a minimum depth of 6 inches.

Subgrade Preparation:

Preparation of subgrade material for placing aggregate base, surfacing, or slabs thereon shall include fine grading, compaction, reworking as necessary. The upper 6 inches of the subgrade shall have the same compaction as the fill to be placed over it.

The prism of backfill directly underneath the building foundation and sloping downward at 1:1 shall be compacted to 95 percent.

Structure Backfill: Structure backfill shall be compacted to not less than 95 percent relative compaction.

Select Backfill:

Select backfill shall be compacted to not less than 95 percent relative compaction.

A relative compaction of not less than 95 percent shall be obtained for a minimum depth of 6 inches below the bottom of the excavation before placing select backfill.

Trench Backfill: Trench backfill placed beneath slabs or paved areas shall be compacted to a relative compaction of not less than 95 percent.

DISPOSAL

Surplus Material: Surplus material from the excavation shall be removed and disposed of outside the right-of-way in accordance with Section 7-1.13 of the Standard Specifications.

FIELD QUALITY CONTROL

Inspection: When the excavation is substantially completed to grade, the Contractor shall notify the Engineer. No concrete shall be placed until the foundation has been approved by the Engineer.

Testing: The State will conduct compaction tests during the backfilling and compacting operations.

12-2.04 GUARD POSTS

PART 1 - GENERAL

Scope: This work shall consist of constructing guard posts in accordance with the details shown on the plans and these special provisions.

PART 2 - PRODUCTS

Steel Posts: Steel posts for guard posts shall be standard weight, galvanized steel pipe conforming to the details shown on the plans.

Concrete: Concrete for guard posts shall be commercial quality concrete, proportioned to provide a workable mix suitable for the intended use, with not less than 470 pounds of cement per cubic yard.

PART 3 - EXECUTION

Installation:

The length and diameter of the guard posts shall conform to the details shown on the plans.

Guard posts shall be placed in holes excavated to the depth and cross section shown on the plans, and shall be installed plumb.

Guard posts shall be backfilled with concrete as shown on the plans.

Painting: Guard posts shall be prepared and painted in accordance with the requirements specified under "Painting" in Section 12-9, "Finishes," of these special provisions.

SECTION 12-3. CONCRETE AND REINFORCEMENT

12-3.01 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of constructing cast-in-place concrete facilities in accordance with the details shown on the plans and these special provisions.

Structural concrete shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications, and these Special Provisions.

SUBMITTAL

Concrete:

Mix Designs: Prior to beginning the work, the Contractor shall submit to the Engineer, for review, concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete specified herein in. The mix designs shall be checked by an independent testing laboratory acceptable to the Department. All costs related to such checking shall be borne by the Contractor. Since laboratory trial batches require 35 calendar days to complete, the Contractor may consider testing more than one mix design for each class of concrete.

Delivery Ticket: Where ready-mix concrete is used, the Contractor shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.

Provide the following submittals in accordance with ACI 301:

- a. Mill tests for cement.
- b. Admixture certification. Chloride ion content must be included.
- c. Aggregate gradation and certification.
- d. Materials and methods for curing.

Reinforcement:

The Contractor shall furnish shop bending diagrams, placing lists, and drawings of all reinforcement steel prior to fabrication.

Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams which clearly indicate the locations and dimensions of each bar splice.

Where mechanical couplers are required or permitted to be used to splice reinforcement steel, the Contractor shall submit manufacturer's literature containing instructions and recommendations for installation for each type of coupler used. A current ICBO report for the specific product proposed to be used, or certified test reports which verify the load capacity of each type and size of couplers to be used. Shop drawings shall be prepared which show the location of each coupler with details of how they are to be installed and secured in the formwork.

PART 2 - PRODUCTS

CONCRETE

Concrete Materials:

Cement shall be standard portland cement conforming to ASTM C 150 for Type II or Type V, including Table 2 optional requirements. A minimum of 85 percent of cement by weight shall pass a 325 screen. The Contractor shall select cement from the Department's Pre-Qualified Products List. The cement selected shall be the same used throughout the work. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the Engineer if requested regarding compliance with these Specifications.

Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of Burbank Water and Power. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

Aggregates shall conform to the Standard Specifications and these Special Provisions. Aggregates shall be non-reactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified herein. Lightweight sand for fine aggregate will not be permitted.

- a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than 3/4-inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the Paragraph in Part 2 entitled "Trial Batch and Laboratory Tests" for the use of the size groups.
- b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM D 2419, the sand equivalency shall not be less than 75 percent for an average of three samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33. The fineness modulus of sand used shall not be over 3.00.
- c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
- d. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
- e. When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
- f. When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
- g. When tested in accordance with ASTM C 33, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.

Ready-mix concrete shall conform to the requirements of ASTM C 94.

Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, the Contractor shall discontinue use of the admixture. Admixtures shall not contain thiocyanates or more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.

- a. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. The Engineer reserves the right, at any time, to sample and test the air-entraining agent received on the job by the Contractor. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement. Air entraining agent shall be selected from the Department's Pre-Qualified Products List.
- b. Set controlling and water reducing admixtures: Admixtures may be added at the Contractor's option to control the set, effect water reduction, and increase workability. The addition of an admixture shall be at the Contractor's expense. The use of an admixture shall be subject to acceptance by the Engineer. Concrete containing an admixture shall be first placed at a location determined by the Engineer. Admixtures shall be selected from the Department's Pre-Qualified Products List. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.
 1. Concrete shall not contain more than one water reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the Engineer.
 2. Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture may be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees F, a non-corrosive set accelerating admixture may be used.
 3. Normal range water reducer shall conform to ASTM C 494, Type A. The quantity of admixture used and the method of mixing shall be in accordance with the Manufacturer's instructions and recommendations.
 4. High range water reducer shall conform to ASTM C 494, Type F or G. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.

5. If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches \pm 1/2-inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
6. Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.
7. Flyash: Flyash shall conform to ASTM C618, Class F, and not exceed 15-percent of the total cementitious material weight used in the concrete mix design.

Curing Materials:

Materials for curing concrete as specified herein shall conform to the following requirements and ASTM C 309:

- a. All curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Kurez by Euclid Chemical Company; MB-429 as manufactured by Master Builders; or L&M Cure R. Water based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent based compound. Water based curing compounds shall be Aqua-Cure by Euclid Chemical Company; Masterkure-W by Master Builders; or L&M Cure R-2.
- b. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
- c. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
- d. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.
- e. Curing mats shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
- f. Evaporation retardant shall be a material such as Confilm as manufactured by Master Builders; Eucobar as manufactured by Euclid Chemical Company; or E-CON as manufactured by L & M Construction Chemicals, Inc.

Concrete Design Requirements:

General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost. All changes shall be subject to review by the Engineer.

Fine Aggregate Composition: In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight, shall be as indicated in the following table:

Fine Aggregate	
Fineness Modulus	Maximum Percent
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.0	44

For other concrete, the maximum percentage of fine aggregate of total aggregate, by weight, shall not exceed 50.

Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

Type of Work	Min 28-Day Compressive Strength (psi)	Max Size Aggregate (in)	Minimum Cement per cu yd (lbs)	Max W/C Ratio (by weight)
Structural Concrete:				
Roof, floor slabs, and all other concrete items not specified elsewhere.	4,500	1	564	0.42
12" and thicker walls, slabs on grade and footings. (optional)	4,500	1-1/2	564	0.42
Other Concretes:				
Sitework concrete	3,000	1	470	0.45

NOTE: The Contractor is cautioned that the limiting parameters specified above are not a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the Contractor's construction methods and aggregates. The Contractor is responsible for any costs associated with furnishing concrete with the required workability.

Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

Consistency:

The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (in)
All concrete, unless note otherwise	3 inches ± 1 inch
With high range water reducer added	7 inches ± 2 inches

Trial Batch and Laboratory Tests:

Before placing any concrete, a testing laboratory designated by the Engineer shall prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the Contractor. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor’s preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and 6 compression test specimens from each batch. Trial batch testing required shall be performed at the expense of the Contractor.

The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.

A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve.

Shrinkage Limitation:

The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 28-day drying age shall be 0.042 percent. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete to be used in water-containing structures.

The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

If the required shrinkage limitation is not met during construction, the Contractor shall take any or all of the following actions, at no additional cost, for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

Measurement of Cement and Aggregate:

The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the Contractor and acceptable to the Engineer.

Weighing tolerances:

Material	Percent of Total Weight
Cement	1
Aggregates	3
Admixtures	3

Measurement of Water:

The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the Engineer and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete. A positive quick-acting

valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

Ready-Mixed Concrete:

At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the following supplementary requirements.

Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.

Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the Engineer in accordance with the Concrete Submittals.

The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

Drypack Grout:

Drypack shall be 1 part cement and 3 parts sand (by volume).

Cement Slurry Backfill:

- a. Cement slurry may be used in lieu of compacted soil backfill only where indicated on the plans.
- b. Cement slurry shall consist of Type V cement in accordance with ASTM C-150, water and aggregate. Aggregate shall be either excavation material free of organic material or commercial quality concrete sand conforming to ASTM C-33 for fine aggregate. If excavated material is used for the slurry aggregate, it shall meet the following grading requirements:

Sieve Size	PCT. Passing
1"	80-100
3/4"	60-100
3/8"	50-100
No. 4	40-80
No. 100	10-40

- c. The minimum amount of cement shall not be less than 2 sacks (188 LBS.) per cubic yard of slurry. Enough water shall be added to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.
- d. The cement slurry shall be placed within one hour of being mixed.
- e. A minimum of 4 hours shall elapse prior to the placement of backfill on the cement slurry.

Waterstop:

Ribbed Type

Materials:

- a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or pigment.
- b. Standard: COE CRD-C572

In all joints, unless noted otherwise on the Plans:

- a. 6 IN wide x 3/8 IN thick ribbed type.
- b. Similar to Greenstreak Plastics Products Style #783.

Provide hog rings or grommets at maximum 12 IN OC along the length of the waterstop.

Provide factory-made waterstop fabrications at all changes in direction, intersections and transitions, leaving only straight butt splices for the field.

Dampproofing:

Dampproofing agent shall be an asphalt emulsion, such as Hydrocide 600 by ChemRex Sonneborn; Damp-proofing Asphalt Coating by Euclid Chemical Company; or Sealmastic by W. R. Meadows Inc.

REINFORCEMENT

Reinforcing Steel:

Bar reinforcement shall conform to the requirements of ASTM A615, Grade 60, deformed, except #3 bars may be grade 40.

Bar reinforcement to be welded shall meet the requirements of ASTM A706, Grade 60.

Welded wire fabric shall conform to the requirements of ASTM A185 or ASTM A497.

Proprietary rebar mechanical splices shall develop in tension and compression a minimum of 125 percent of the yield strength of the rebars being spliced.

Rebar adhesive anchors manufactured for the specific purpose of embedding and developing 125 percent of the yield strength of rebars in hardened concrete.

Bar Support Accessories:

Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete or grout placement. All bar supports

shall meet the requirements of the CRSI Manual of Standard Practice. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

Protective plastic caps at mechanical splices.

Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

Fabrication:

Fabrication details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Plans. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1-1/2-inch for No. 3 bars, 2-inch for No. 4 bars, and 2-1/2-inch for No. 5 bars or as specified on the Plans. Bends for other bars shall be made around a pin having a diameter not less than 6 times the bar diameter, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters or as specified on the Plans. Bars shall be bent cold.

The Contractor shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing Plans. Said Plans, diagrams, and lists shall be prepared by the Contractor.

Reinforcement shall not be straightened or rebent in a manner which will reduce the strength of the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the Engineer.

Fabrication Tolerances:

Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

- a. Sheared lengths: +1 IN.
- b. Depth of truss bars: + 0, - 1/2 inch
- c. Stirrups, and ties: + 1/2 inch
- d. All other bends: + 1 inch

PART 3 – EXECUTION

CONCRETE

Proportioning and Mixing:

Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.

Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of said ACI 301 Specifications.

Slump: Maximum slumps shall be as specified herein.

Retempering: Retempering of concrete or mortar which has partially hardened shall not be permitted.

Preparation of Surfaces for Concreting:

General: Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the Engineer, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Plans call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the Engineer.

Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the Engineer at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

All inserts or other embedded items shall conform to the requirements herein. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.

No pipes or ducts shall be placed in structural concrete unless specifically detailed. See mechanical and electrical Plans for location of sleeves through walls and floors.

Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the Engineer.

No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the Engineer.

Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.

Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.

Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

Handling, Transporting, and Placing:

General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.

Non-Conforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the Contractor.

Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the Engineer. The Contractor shall notify the Engineer in writing at least 24 hours in advance of placement of any concrete.

Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

Casting New Concrete Against Old: An epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations. This provision shall not apply to joints where waterstop is installed.

Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be selected from the Department's Pre-Qualified Products List. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.

Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick nor less than 50 degrees for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

Pumping of Concrete:

General: If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

Pumping Equipment: The pumping equipment must have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.

The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.

Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.

Aluminum conduits for conveying the concrete shall not be permitted.

Field Control: Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

- a. Sets of field control cylinder specimens shall be taken during the progress of the Work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set of each 150 cubic yards of concrete, nor less than one set for each 5,000 square feet of surface area for slabs or walls.
 1. A "set" of test cylinders consists of six cylinders: two to be tested at seven days and two to be tested and their strengths averaged at 28 days. The final two may be used for a special test after 28 days. Compressive strength tests shall comply with ASTM C39.
 2. Each cylinder shall be coded to identify the date of delivery, the truck number, the location where the concrete has been used and the slump measured upon discharge.
- b. Slump tests shall be made in the field prior to placing the concrete. Such test shall be made in accordance with ASTM C143. Slump test shall be taken for each set of test cylinders defined above. If the slump is greater than that specified, the concrete shall be rejected.
- c. Air content: test for air content shall be made on a fresh concrete sample. Air content test shall be taken for each set of test cylinders defined above. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used.

Joints and Embedded Items:

General: Construction Joints:

- a. Located joints as indicated on Contract Plans or as shown on approved Shop Drawings.
 1. Where construction joint spacing shown on Plans exceeds the joint spacing indicated in Paragraph 2 below, submit proposed construction joint location in conformance with the Specification.
- b. Unplanned construction joints will not be allowed.
 1. If concrete cannot be completely placed between planned construction joints, then it must be removed.
- c. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
- d. Locate joints in walls at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.

1. At Contractor's option, beam pockets may be formed into concrete walls.
 2. Size pockets to allow beam reinforcing to be placed as details on Plans.
- e. Place beams and girders at same time as slabs.
- f. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
- g. Provide roughened construction joints where indicated on the Plans.
1. Clean the previously hardened concrete interface and remove all laitance.
 2. Intentionally roughen the interface to a full amplitude of 1/4 IN.
- h. Provide continuous keyways at construction joints indicated on the Plans.
1. Construction joint keyways shall have the following dimensions, unless shown otherwise on the Plans or directed otherwise by Engineer.
 2. Construction joint keyways in walls:
 - a) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
 - b) Keyway depth to be not less than 1-1/2 IN.
 - c) Place keyway in wall center unless shown otherwise on Plans.
 2. Construction joint keyway in footings, foundations, base slabs, and structural or elevated slabs:
 - a) Keyway height, not less than 1/3 and not more than 1/2 the footing or slab thickness.
 - b) Keyway depth to be not less than 1-1/2 IN.
 - c) Place keyway in footing or slab center unless shown otherwise on Plans.
- i. Allow a minimum of 48 hours before placement of adjoining concrete construction.

Construction Joints – Spacing:

General – Structures not intended to contain liquid:

- a. Wall vertical construction joints:
 1. 60 FT maximum centers.
 2. At wall intersections, 30 FT maximum from corner.
- b. Wall horizontal construction joints: 20-25 FT centers.
- c. Base slab, floor, and roof slab construction joints:
 1. Placement to be approximately square and not to exceed 3500 SF.
 2. Maximum side dimension of a slab pour to be 80 FT.

General – Structures intended to contain liquid:

- a. Wall vertical construction joints:
 1. 30 FT maximum centers unless indicated otherwise on the Plans.
 2. At wall intersections, 15 FT maximum from corner unless otherwise indicated on the Plans.
- b. Base slab, floor, and roof slab construction joints:
 1. Placement to be approximately square and not to exceed 2000 SF.
 2. Maximum side dimension of a slab pour to be 60 FT.

Waterstops:

Ribbed type:

- a. Position waterstop accurately in forms.
- b. Secure waterstops in correct position using hog rings or grommets spaced along the length of waterstop and tie wire to adjacent reinforcing.
- c. Hold horizontal waterstops in place with continuous supports.
- d. Install according to manufacturer's instructions.
 1. Do not displace reinforcement from required location.
- e. Waterstops to be continuous.
- f. Splice ends with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's instructions.
- g. Unless otherwise noted, use for all construction joints in new construction.

Dampproofing:

The exterior surface of all buried roof slab and walls shall be dampproofed as follows:

Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as specified herein.

As soon as the asphalt emulsion, applied as specified herein, has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until the backfill is placed, the Contractor shall apply additional whitewash.

It shall be the responsibility of the Contractor to ensure that all columns, walls, beams, etc. are adequately braced and shored during construction. All bracing/shoring shall be designed by a registered engineer hired by the Contractor. Bracing of concrete walls, columns, and roof beams shall remain in place until roof slabs are completely installed, and concrete reaches 28-day compressive strength.

REINFORCEMENT**Placement:**

All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of Standard Specifications and the supplementary requirements specified herein.

Reinforcement steel shall be accurately positioned as shown, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties embedded in the blocks. For concrete over or in formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers to maintain the required clearances.

Limitations on the use of bar support materials shall be as follows:

- a. Concrete Dobies: permitted at all locations except where architectural finish is required.

- b. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
- c. Plastic Bar Supports: permitted at all locations except on grade.

Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.

Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Standard Specifications.

Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.

Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane shown.

Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

Dowels shall be provided at all pour joints and shall be the same size and spacing as reinforcing directly beyond pour joints.

The specified dimensions of the vertical legs of "L" dowels, whose horizontal legs are cast into a footing or slab cast on top of earth, are based upon the slab thickness as shown on the Plans. If a slab is poured thicker than shown on the Plans, such as for the subgrade occurring at a lower elevation than shown, the vertical legs must be fabricated to a longer length or the horizontal tails must be supported above subgrade high enough to provide the same amount of lap length between the dowel and the wall vertical reinforcing.

Spacing of Bars:

The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.

Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch and the bars of the upper layers placed directly above the bars of the bottom layer.

In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.

The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

Splicing:

General:

- a. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer and shall be specified on the submitted shop drawings.
- b. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

Splices of Reinforcement:

- a. The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318, Section 12.15.1 for a Class B splice.
- b. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.

Unless noted otherwise, mechanical coupler shall have the same size bar on each side of the coupler.

Welding:

Welding of reinforcing steel, metal inserts and connections in reinforced concrete shall conform to ANSI/AWS 61.4-05. Use low hydrogen E-70 series electrodes for welding reinforcing bars.

Embedment of Drilled Reinforcing Steel Dowels:

Hole Preparation: The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations. The depth of the hole to fully develop the bar shall be determined with calculations on a case by case basis. Calculations shall be stamped and signed by a licensed Civil or Structural Engineer hired by the Contractor. Min embedment of reinforcing steel dowels varies based on bar diameter and shall be recommended by the epoxy manufacturer. The hole in the concrete shall be drilled by a method which does not interfere with the proper bonding of epoxy. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars. The hole shall be brushed out and blown clean with clean, dry compressed air to remove all dust and loose particles.

Dowel Installation: Epoxy shall be injected into the hole through a tube placed at the bottom of the hole. The tube nozzle shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that insures that excess material will be expelled from the hole during dowel installation. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full engagement of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets. After dowels are installed, allow time recommended by epoxy manufacturer for epoxy to cure prior to covering epoxy with concrete.

12-3.02 DRILL AND GROUT DOWELS

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of drilling holes in existing concrete and installing and grouting bar reinforcing steel dowels into such drilled holes in accordance with the details shown on the plans and these special provisions.

PART 2 - PRODUCTS

Grout: Grout shall be a neat cement paste consisting of portland cement and water. The water content of the grout shall be not more than 4 gallons per 94 pounds of cement.

Dowels: Dowels shall be bar reinforcing steel, as specified under "Cast-In-Place Concrete" in Section 12-3, "Concrete and Reinforcement," of these special provisions.

PART 3 - EXECUTION

Installation:

The holes shall be drilled by methods that will not shatter or damage the concrete adjacent to the holes. The diameter of drilled holes shall be 1/4 inch larger than the nominal diameter of the dowels unless otherwise shown on the plans.

Immediately prior to placing the dowels, the holes shall be cleaned of dust and other deleterious materials, shall be thoroughly saturated with water, have all free water removed and the holes shall be dried to a saturated surface dry condition.

Grout shall not be retempered.

Sufficient grout shall be placed in the hole so that no voids remain after the dowels are inserted.

Grout shall be cured by keeping the surface of the grout continuously damp. Grout shall be cured for a period of at least 3 days or until the dowels are encased in concrete.

Dowels or grout which fail to bond or are damaged before new concrete is placed shall be removed and replaced.

SECTION 12-4. (BLANK)

SECTION 12-5. METALS

12-5.01 STRUCTURAL STEEL FOR BUILDINGS

PART 1 - GENERAL

SUMMARY

Structural steel shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications, and these Special Provisions. Where a conflict occurs between the Standard Specifications and the Special Provisions, the Special Provisions shall govern. Where a conflict occurs between the Standard Specifications and the Plans, the Plans shall govern.

This section describes materials, fabrication, and erection of structural steel including connections.

This work includes fabricating, assembling, furnishing, and erecting structural steel.

SUBMITTALS

Action Submittals:

Provide shop drawings showing erection plans, member size and their connections.

Show anchor bolt layouts.

Hardened washer details (if applicable).

Joint details for complete penetration welds.

Schedules for fabrication procedures.

Shop coatings.

Name and address of manufacturer(s).

Product specifications.

Manufacturers' testing procedures and standards.

Preparation and installation or application instructions, as appropriate.

Informational Submittals:

Mill Certificates of tests made in accordance with ASTM A6.

High Strength Bolts (Plain Noncoated and Hot Dip Galvanized):

- a. Certificate of Compliance that products meet chemical and mechanical requirements of standards specified.
- b. Manufacturer's inspection test report results for production lot(s) furnished, to include:
 1. Tensile strength.
 2. Yield strength.
 3. Reduction of area.
 4. Elongation and hardness.

Certified Mill Test Reports for Bolts and Nuts:

- a. Name and address of manufacturer.
- b. Bolts correctly marked.
- c. Marked bolts and nuts used in required mill tests and manufacturer's inspection tests.

Methods proposed to resolve misalignment between anchor bolts and bolt holes in steel members.

Welding Procedures, Qualifications, and Inspection Report

AISC Quality Certification: AISC certificate showing name and address of certified firm, effective date, and category of certification.

Drilled Adhesive Anchors in Concrete:

- a. Manufacturer's product description and installation procedures.
- b. Current I.C.C. evaluation report.

PART 2 - PRODUCTS

STRUCTURAL STEEL

Rolled Plates, Shapes except W-Shapes, and Bars: ASTM A36, unless indicated otherwise.

W Shapes and S Shapes: ASTM A992 $F_y = 50$ ksi, unless indicated otherwise on Plans.

Plate material for frame connections shall be ASTM A572, Grade 50, where indicated on Plans.

Steel Pipe: ASTM A53, Type E or S, Grade B.

Square and Rectangular Hollow Structural Sections (HSS): ASTM A500, Grade B ($F_y = 46$ ksi).

FASTENERS

High Strength Bolts: ASTM A325 or ASTM A490, bolt type 1, galvanized. Bolt length and thread length shall be as required for the connection type shown, with hardened washers as required.

Machine Bolts (M.B.): ASTM A307

Nuts: ASTM A563, type to match bolt type and finish.

Hardened Steel Flat and Beveled Washers: ASTM F436, type to match bolt finish.

Anchor Rods: ASTM A193, Grade B7

Headed Studs: ASTM A108, complying with AWS Code Section 7, Type B; minimum yield strength 50,000 psi, minimum tensile strength 60,000 psi.

- a. Uniform diameter.
- b. Heads: Concentric and normal to shaft.
- c. Weld end: Chamfered and solid flux.

Deformed anchor bars: ASTM A496, complying with AWS Code Section 7 Type C. Minimum yield strength 70,000 psi. Minimum tensile strength 80,000 psi.

- a. Straight unless indicated otherwise.
- b. Solid flux.

After welding, remove ceramic ferrules and maintain free from any substance which would interfere with function, or prevent bonding to concrete.

FABRICATION

General:

- a. Fabricate as shown and in accordance with AISC Specification For Structural Steel Buildings and AISC Code of Standard Practice for Steel Buildings and Bridges. Fabricator shall be AISC certified.
- b. Mark and match mark materials for field assembly.
- c. Complete assembly, including bolting and welding of units, before start of finishing operations.
- d. Fabricate to agree with field measurements.

Connections:

- a. Shop Connections: Weld or bolt, as shown.
- b. Meet requirements of AISC Manual of Steel Construction tables for bolted double angle shear connections, unless indicated otherwise.

Welded Construction:

- a. Conform to governing welding codes for type of weld and material for each weld.
- b. Groove and Butt Welds: Complete penetration, unless otherwise indicated.
- c. Interface with other work.
- d. All welding shall be Shielded Arc type and shall be performed by an AWS certified welding fabricator. No field welding allowed.

Holes:

- a. As necessary or as indicated for securing other Work to structural steel framing, and for passage of other Work through steel framing members.
- b. No flame cut holes will be permitted without prior approval of Engineer.

- c. Weld threaded nuts to framing, and other specialty items as shown to receive other Work.

Galvanizing:

- a. Fabricate steel to be galvanized in accordance with ASTM A143, A384, and A385. Avoid fabrication techniques that could cause distortion or embrittlement of steel.
- b. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
- c. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
- d. Hot dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123.
- e. Hot dip galvanize A325 bolts, nuts, washers, and hardware components in accordance with ASTM A153.
- f. Oversize holes to allow for zinc alloy growth.
- g. Shop assemble bolts, nuts, and washers with special lubricant and test in accordance with ASTM A325 and A563.
- h. Galvanize components of bolted assemblies separately before assembly.

PART 3 - EXECUTION

Steel Member Erection

Meet requirements of AISC Specification for Structural Steel Buildings and AISC Code of Standard Practice for Steel Buildings and Bridges, with exceptions as specified.

Contractor is responsible for design and installation of temporary bracing to support components as erection proceeds.

No structural steel member shall be cut for pipes, ducts, etc. unless specifically detailed and approved by Structural Engineer.

High Strength Bolted Connections:

- a. Tighten in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- b. Hardened Washers:
 - 1. Provide at locations required by Washer Requirements section of AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts, to include slip critical connections using slotted or oversized holes or A490 bolts.
 - 2. Use beveled style and extra thickness where required by AISC Specification.
 - 3. Use square or rectangular beveled washers at inner flange surfaces of American Standard beams and channels.
- c. For bearing type connections not fully tensioned (N, X), tighten to snug tight condition. Use hardened washer over slotted or oversize holes in outer plies.

Welded Connections:

- a. Welding and Fabrication by Welding: Conform to AWS D1.1 Structural Welding Code based on material and type of weld.
- b. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

Anchor Bolts

Coordinate installation of anchor bolts and other connectors required for securing structural steel to in place work.

Provide templates and other devices for presetting bolts and other anchors to accurate locations.

Projection of anchor bolts beyond face of concrete and threaded length shall be adequate to allow for full engagement of all threads of hold-down nuts, adjustment of leveling nuts, washer thicknesses, and construction tolerances, unless indicated otherwise.

Placement Tolerances:

- a. As required by AISC Code of Standard Practice for Steel Buildings and Bridges, unless indicated otherwise.
- b. Embedded anchor bolts shall not vary from the dimensions as shown on Plans by more than the following:
 1. Center to center of any two bolts within an anchor group: 1/8 inch.
 2. Center to center of adjacent anchor bolt groups: 1/4 inch.
 3. Variation from perpendicular to theoretical bearing surface: 1:50.

Adhesive anchors shall be selected from the Department's Pre-Qualified Products List, and shall be installed in accordance with a current I.C.C. evaluation report.

An alternate adhesive anchor product may be submitted to the Engineer for approval, provided that it has a current I.C.C. evaluation report and is in accordance with the Department's Pre-Qualified Products List.

All abandoned holes shall be filled with a drypack grout having a minimum 28-day compressive strength of 5,000 psi. The filled hole(s) shall be prepared and cleaned as required by the grout manufacturer.

Located existing reinforcing using a non-destructive method (Pachometer or other), prior to drilling holes for anchors. Maintain a minimum clearance of 1-inch between the reinforcement and the anchor.

Setting Bearing Plates

Clean concrete bearing surfaces of bond reducing materials and roughen to improve bond to bearing surfaces.

Clean bottom surface of bearing plates.

Set loose and attached bearing plates for structural members on wedges, shims, leveling nuts, or other adjustable devices. Use leveling plates where indicated on Plans.

Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to placing grout. Weld plate washers to base plates where indicated in Plans.

Field Assembly

Set structural frames accurately to lines and elevations shown.

Clean bearing surfaces and other surfaces that will be in permanent contact before assembly.

Align and adjust various members forming a part of a complete frame or structure before permanently fastening.

Level and plumb individual members of structure within tolerances shown in AISC Code of Standard Practice for Steel Buildings and Bridges.

Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be completed and in service.

Perform necessary adjustments to compensate for minor discrepancies in elevations and alignment.

Provide additional field connection material as required by AISC Code of Standard Practice for Steel Buildings and Bridges.

Splice members only where indicated and accepted on shop drawings.

Misfits at Bolted Connections

Where misfits in erection bolting are encountered, immediately notify the Engineer for approval of one of the following methods of correction:

- a. Ream holes that must be enlarged to admit bolts and use oversized bolts.
- b. Plug weld misaligned holes and redrill holes to admit standard size bolts.
- c. Drill additional holes in connection, conforming with AISC Standards for bolt spacing and end and edge distances, and add additional bolts.
- d. Reject member containing misfit, incorrect sized, or misaligned holes and fabricate new member to ensure proper fit.

Do not enlarge incorrectly sized or misaligned holes in members by burning or using a drift pin.

Misfits at Anchor Bolts

Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved submittal.

Do not flame cut to enlarge holes without prior approval of the Engineer.

Gas Cutting

Do not use gas cutting torches in field for correcting fabrication errors in structural framing.

Secondary members not under stress and concealed in finished structure may be corrected by gas cutting torches, if approved by the Engineer.

Finish flame cut sections equivalent to sheared and punched appearance.

Repair and Cleaning

Immediately after erection, clean field welds, bolted connections, and abraded areas of shop primer.

Remove and grind smooth tack welds, fit-up-lugs, and weld runoff tabs.

Remove weld back-up bars and grind smooth where indicated on Plans.

Repair of Damaged Hot-Dip Galvanized Coating

Conform to ASTM A780

For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780.

For flame cut or welded areas, use zinc based solder, or zinc sticks, conforming to ASTM A780.

Use magnetic gauge to determine that thickness is equal to or greater than base galvanized coating.

12-5.02 BUILDING MISCELLANEOUS METAL

PART 1 - GENERAL

Scope: This work shall consist of fabricating, furnishing, and installing building miscellaneous metal in accordance with the details shown on the plans and these special provisions.

Building miscellaneous metal shall consist of the following:

- a. Handrails
- b. Ladders
- c. Metal Grating

Including all anchors, fastenings, hardware, accessories, and other supplementary parts necessary to complete the work.

REFERENCES

Codes and Standards: Welding of steel shall be in accordance with American Welding Society (AWS) D 1.1, "Structural Welding Code - Steel" and D 1.3, "Structural Welding Code - Sheet Steel."

QUALITY ASSURANCE

Shop Assembly: Preassemble items in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark all units for reassembly and installation.

Inspection and Tests: Materials and fabrication procedures shall be subject to inspection and tests by the Engineer, in mill, shop, and field. Such tests will not relieve the Contractor of responsibility of providing materials and fabrication procedures in compliance with specified requirements.

HANDRAILS

GENERAL

Handrail shall conform to the provisions in Section 83-1, "Railings," of the Caltrans Standard Specifications, and these special provisions. Where a conflict occurs between the Standard Specifications and the Special Provisions, the Special Provisions shall govern. Where a conflict occurs between the Standard Specifications and the Plans, the Plans shall govern.

Safety Chain shall conform to the provisions in Section 55, "Steel Structures" and Section 83-1, "Railings," of the Standard Specification. Safety Chain and Snap Clip shall resist 1000 lbs of force in any direction. Safety Chain is considered incidental to the Handrail work.

SUBMITTALS

Shop drawings:

Indicate handrail profiles, sizes, connections, anchorage, size and type of fasteners, and accessories. Project-specific scaled plans and elevations of handrails.

Manufacturer's literature and catalog data of handrail components or connectors.

Design Data: Calculations or test data using Building Code required design loads, including the following:

- a. Bending stress in, and deflection of, posts in accordance with ASTM E985.

- b. Stress in post base connection.
- c. Comparison of required design anchorage forces to either California Building Code allowable embedded anchor loads or ICC Approved loads based on product's current ICC report.

Handrail manufacturer's assembly and installation instructions.

Design Performance:

Structural Performance of Handrails: Design, test, fabricate, and install handrails to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in each of the respective components comprising handrails.

Top Rail of Handrails: Capable of withstanding the following load cases applied: Concentrated load of 200 pounds applied at any point and in any direction in accordance with ICBO CBC; uniform load of 50 pounds per linear foot applied horizontally in accordance with ICBO CBC; and concentrated load need not be assumed to act concurrently with uniform loads in accordance with ICBO CBC.

In-Fill Area of Railing Systems: Capable of withstanding a horizontal concentrated load of 200 pounds applied to 1 square foot at any point in the system including panels, intermediate rails, balusters, or other elements composing the in-fill area; and horizontal concentrated load need not be assumed to act concurrently with loads on top rails of handrails.

PRODUCTS

Galvanized Steel Handrails:

Pipe: Hot-dip galvanized carbon steel, ASTM A53/A53M, Type E or S, Grade B; or ASTM A501, 1 1/2 inch NPS with 1.900 inch outside diameter and a minimum 0.145 inch wall thickness for rails and a minimum of 0.200 inch wall thickness for posts.

Fittings: Anchor Bolts and Fasteners: Stainless steel. Handrail Post Welded Connection Plate: Connection Plate, carbon steel ASTM A36/A36M. Toeboards and Accessories: ASTM A36/A36M steel; and fasteners: Stainless steel.

Fasteners: Stainless steel.

Anchor Bolts and Fasteners:

Locknuts, Washers, and Screws: Elastic Locknuts, Steel Flat Washers, RHMS Round Head Machine Screws: Type A304 or Type A316 stainless steel. Flat Washers: Molded nylon.

Bolts and Nuts for Bolting Handrail to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type A 316 stainless steel with minimum yield strength for bolts of 95,000 psi, unless otherwise shown.

Fabrication of Galvanized Steel Handrails:

Shop Assembly: Post Spacing: Maximum 5 FT horizontal spacing. Handrail Offset Connection to Platform Stringers: Steel connection plate shop welded to platform stringer; and welded connection plate to be located at mid-depth of stringer web. Handrail post field welded to steel connection plate. Grind welds prior to hot-dip galvanizing of railing sections.

Remove burrs from cut edges.

Form elbow bends and wall returns to uniform radius, free from buckles and twists, with finished surfaces smooth.

Cover exposed ends of steel pipe by welding 3/16 inch thick steel plate in place or use prefabricated fittings.

Welding: Thoroughly fuse without undercutting or overlap. Remove weld splatter, grind exposed welds to blend, and contour surfaces to match adjacent surfaces.

Furnish explosion-prevention holes at closed ends of pipes.

Form and assemble joints to prevent water and moisture from penetrating.

Shop/Factory Finishing: Hot-dip galvanize all components in accordance with ASTM A123/A123M after fabrication.

Tolerances: Cut pipe square within 2 degrees and within 1/8 inch of required length. Welding: Miter and cope intersections of posts and rails within 2 degrees, fit to within 0.020 inch, and perform continuous welds around joints. Repair of Defective Work: Remove stains and replace defective Work.

EXECUTION

Handrail Installation:

Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.

Protection from Entrapped Water: Make provisions in interior installations subject to high humidity/moisture to drain water from railing system.

Posts and Rails: Set posts plumb and aligned to within 1/8 inch in 12 feet. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet. Install posts and rails in same plane. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports. Support 1 1/2 inch rails directly above platform stringers with offset fittings.

Toeboard: Provide at all handrails except at gates. Accurately measure in field for correct length, after handrail post installation, cut and secure to posts. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch. Steel Toeboards: Between each post cut toeboard and provide slotted holes for expansion and contraction.

LADDERS

GENERAL

This section describes materials, fabrication, and erection of ladders including connections.

SUBMITTALS

Shop Drawings:

Fabrication and/or layout drawings and details:

- a. Submit drawings for all fabrications and assemblies.
 1. Include erection drawings, plans, sections, details, and connection details.
- b. Identify materials of construction, shop coatings, and third party accessories.

Product technical data including:

- a. Acknowledgement that products submitted meet requirements of standards referenced.
- b. Manufacturer's installation instructions.
- c. Expansion Anchors
 1. Provide manufacturer's product description and installation procedures.
 2. Provide current I.C.C. evaluation report.

Contractor designed systems and components, including ladders, as shown on the Contract Plans:
Certification that manufactured units meet all design loads specified.

- a. Shop drawings and engineering design calculations:
 1. Indicate design live loads.
 2. Signed and sealed by a professional Civil or Structural Engineer.
 3. Engineer will review for general compliance with Contract Documents.

Miscellaneous Submittals:

Certification of welders and welding processes:

- a. Submit certificates of welder qualifications for each welder, for each of the weld types to be performed in conformance with AWS D1.1.
- b. Submit Welding Procedure Specifications (WPS) for each of the weld types to be performed in conformance with AWS D1.1.
- c. Qualifications of fabricator's Professional Engineer.

PRODUCTS

Steel:

Ladder rails, rungs, and wall brackets:

- a. ASTM A36/A36M carbon steel for bars and rolled plates.

Welding electrodes:

- a. AWS D1.1, E70 Series.

Expansion Anchor Bolts:

- a. Stainless steel, Type 304 or 316.
- b. Minimum edge distance and embedment as recommended by manufacturer.
- c. Expansion anchors may not be used to resist seismic loads in concrete.
- d. Manufacturers and Products
 1. ITW Red Head; "Trubolt Wedge Anchor"; I.C.C. Report No. 2427.
 2. SimpsonStrong-Tie Company; "Strong-Bolt 2"; I.C.C. Report No. 3037.
 3. Hilti, Inc.; "Kwik Bolt TZ"; I.C.C. Report No. 1917.

Ladders:

Rails:

- a. 1/2x2-1/2 IN steel bar. Punch rails and pass rungs through rails, weld on outside around perimeter of rung.
- b. Spacing: Nominal 18 IN from centerline of rails.
 1. Minimum clear distance between rails to be 16 IN.

- c. Brackets for wall supported units: Provide 1/2x2-1/2 IN x length required bent bar brackets welded to side rails with punched holes for 1/2 IN expansion anchor bolts.
 - 1. Maximum spacing: 4 FT OC.
- d. For floor supported units provide 1/2x2-1/2x4 IN rectangular bracket welded to rails with punched holes for 1/2 IN expansion anchor bolts.
 - 1. Provide wall brackets on floor supported units if vertical run is over 4 FT.

Rungs:

- a. Minimum 3/4 IN DIA, with integral serrated non-slip finish on all sides.
- b. Shop or field-applied grit tape and cap type non-slip finish is not acceptable.

Minimum distance from centerline of rung to wall or any obstruction: 7 IN.

Rung spacing:

- a. Uniform, 12 IN.
- b. Top rung shall be level with landing or platform.
- c. Spacing of bottom rung from grade or platform may vary but shall not exceed 12 IN.

As a minimum, design ladder in accordance with OSHA Standards, ANSI A14.3.

- a. Ladders shall be designed to support a minimum concentrated live load of 200 LBS.
- b. Maximum allowable stresses per AISC Specification and AA Specification.
- c. Maximum lateral deflection: Side rail span/240 when lateral load of 100 LBS is applied at any location.

Construction:

- a. Fully welded type.
- b. All welds to be full penetration welds, where applicable.
- c. All ladders of a particular material shall have consistent construction and material shapes and sizes unless detailed otherwise on the Plans.
- d. Rungs shall not extend beyond the outside face of the siderail.
- e. Where a hatch cover is installed over the ladder or indicated on the Plans, a ladder extension shall be furnished and installed on the ladder. The extension shall be a Ladder-Up safety post Model LU-2 (steel, hot-dipped galvanized), as manufactured by the Bilco Co.; or galvanized steel safety post as manufactured by O'keeffe's, Inc; or safety post Model LP-5 (steel, hot-dipped galvanized), as manufactured by JL Industries. The device shall be manufactured with a telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a spring balancing mechanism. Unit shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

Finish:

- a. Galvanize steel members, fabrications, and assemblies after fabrication by hot-dip method in accordance with ASTM A123/A123M .

Safety Climb Device:

General:

- a. Conforms to ANSI A14.3 and OSHA CFR Part 1910.27.
- b. Belt and harness shall withstand minimum drop test of 250 pounds in 6 FT free fall.
- c. Fall Prevention System Material: 6061-T6 Aluminum.

Components and Accessories:

- a. Main Components: Sleeve or Trolley, Safety Harness, and Carrier or Climbing Rail.
- b. Ladder rung clamps with hot-dip galvanized steel mounting brackets and hardware.
- c. Removable extension kit with tie-down rod or trolley gate, mandrel, and carrier rail for ladders under manholes and hatches.

EXECUTION

Ladder:

Anchor ladder to concrete with minimum 1/2 IN DIA stainless steel expansion anchor bolts with 3-1/2 IN embedment, unless noted otherwise on Plans.

Install expansion anchors in accordance with manufacturer's instructions.

An alternate expansion anchor product may be submitted to the Engineer for approval. The product alternative must have a current I.C.C. evaluation report.

All abandoned holes shall be filled with a drypack grout having a minimum 28-day compressive strength of 5,000 psi. The filled hole(s) shall be prepared and cleaned as required by the grout manufacturer.

Locate existing reinforcing using a non-destructive method (Pachometer or other), prior to drilling holes for anchors. Maintain a minimum clearance of 1-inch between the reinforcement and the anchor.

Safety Climb Device:

Provide for each ladder where unbroken height between levels exceeds 20 feet, or at lesser height where indicated on Plans.

Install in accordance with manufacturer's instructions.

Furnish additional accessories required to complete the system for each ladder.

Furnish one harness for each ladder equipped with a safety climb device.

Furnish pivot section at platforms, landings, and roofs.

When installed to required height, fall prevention system shall be rigid and an integral part of the structure.

METAL GRATING

GENERAL

Metal grating shall conform to the provisions in Section 75, "Miscellaneous Metal," of the Caltrans Standard Specifications, and these Special Provisions. Where a conflict occurs between the Standard Specifications and the Special Provisions, the Special Provisions shall govern. Where a conflict occurs between the Standard Specifications and the Plans, the Plans shall govern. This section describes materials, fabrication, and placement of metal grating and connections.

SUBMITTALS

Shop Drawings:

- a. Grating: Show dimensions, weight, and size, and location of connections to adjacent grating, supports, and other Work.
- b. Grating Supports: Show dimensions, weight, size, location, and anchorage to supporting structure.

Catalog information and catalog cuts showing standard allowable load table.

Manufacturer's specifications, to include coatings.

PRODUCTS

Foot Traffic Grating:

Design:

- a. Uniform Service Load of 100 psf minimum or concentrated load of 474 lb/ft maximum, unless otherwise shown.
- b. Maximum Deflection: 1/4 inch, unless otherwise shown.
- c. Space bearing bars at 1 3/16 inch center-to-center.
- d. Banding: 3/16 inch minimum.

Galvanized Steel Bar Type Grating: Press-locked, deep rectangular crossbar design.

- a. Manufacturer and Product
 1. IKG/Borden, Clark, NJ; Type B or Type F.
 2. Grating Pacific, Los Alamitos, CA ; Type 19-4 or 19-2
 3. McNichols Co., Tampa, FL; Type GAA or GBB

Accessories:

Anchor Bolts and Nuts:

- a. Carbon Steel: ASTM A307 or A36.
- b. Stainless Steel: ASTM A193 and ASTM A194, Type 316.
- c. Galvanized Steel Bolts and Nuts: ASTM A153, zinc coating for ASTM A307 or A36.

Flat Washers (Unhardened): ASTM F844; use ASTM A153 for zinc coating.

Removable Fastener Clips and Bolts:

- a. Removable from above grating walkway surface.
- b. Hat Bracket: Type 304 stainless steel.
- c. Bolt: Type 316 stainless steel.
- d. Cast iron, galvanized body.
- e. Manufacturer:
 1. STUCT-FAST
 2. McNichols Co.
 3. Grating Pacific

Partially Removable Anchor:

- a. Bolt: Threaded stud, ASTM A307 or A36.
- b. Manufacturer:
 1. Nelson Stud Welding Div., TRW Inc.
 2. Stud Welding Products, Inc.
 3. Stud Welding & Fasteners, Inc.
- c. Hat Bracket: Type 304 stainless steel.
- d. Manufacturer:

1. STRUCT-FAST
2. McNichols Co.
3. Grating Pacific

Fabrication:

General:

Exposed Surfaces: Smooth finish and sharp, well defined lines.

Furnish necessary rabbets, lugs, and brackets so work can be assembled in a neat, substantial manner.

Conceal fastenings where practical.

Drill metalwork and countersink holes as required for attaching hardware or other materials.

Weld Connections: Not permitted on grating except at banding bars.

Design:

Field measure areas to receive grating, verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.

Section Length: Sufficient to prevent it from falling down through clear opening when oriented in the span direction when one end is touching either the concrete or the vertical leg of grating support.

Minimum Bearing: ANSI/NAAMM MBG 531.

Metal Crossbar Spacing: 4 inches maximum, unless otherwise shown or specified.

Crossbars: Flush with top of main bar and extend downward a minimum of 50 percent of the main bar depth.

Swaged Crossbars:

- a. Within 1/4 inch of top of grating with 1/2 inch minimum vertical dimension after swaging, and minimum before swaging dimension of 5/16 inch square.
- b. Crossbar Dimension After Swaging: Minimum 1/8 inch wider than the opening at minimum of two corners at each side of each square opening in main bar.
- c. Crossbars may be a special extruded shape so that after swaging the top will be flat, 3/16 inch wide and will be flush with the top surface of the bearing bars for a minimum of 5/8 inch at center between bearing bars.
- d. Flush crossbar meeting all of the above except that after swaging shall overlap one corner by a minimum of 1/8 inch. A Sample of one bearing bar and one crossbar shall be tested by holding the bearing bar and pulling on the crossbar. The crossbar to bearing bar shall sustain a minimum of 300 pounds without pullout of the bearing bar.

Banding: Same material as grating; ANSI/NAAMM MBG 531 and ANSI/NAAMM MBG 532.

Furnish carbon steel ASTM A307 or A36 threaded anchor studs, as fasteners for grating attachment to metal supports.

Supports:

- a. Seat angles and beams where shown:
- b. Support members shall be the same material as rectangular bar grating.
- c. Coordinate dimensions and fabrication with grating to be supported.

- d. Welded Frames With Anchors: Continuously welded.

Foot Traffic Grating: Any single grating section, individual plank, or plank assembly shall be not less than 1 foot 6 inches or greater than 3 feet 0 inch in width or weigh more than 150 pounds.

Finish:

- a. Hot dip galvanize all components in accordance with ASTM A123/A123M after fabrication.

EXECUTION

Installation:

Install supports such that grating sections have a solid bearing on both ends, and that rock and wobble grating movement does not occur under designed traffic loading.

Install plumb or level as applicable.

Install welded frames with anchors to straight plane without offsets.

Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.

Completed installation shall be rigid and neat in appearance.

Install in accordance with manufacturer's recommendations.

- a. Secure grating to support members with fasteners.
- b. Welding is not permitted.
- c. Fasteners: Field locate and install
- d. Install to allow each grating section or plank style grating assembly to be easily removed and replaced.

SECTION 12-6. (BLANK)

SECTION 12-7. THERMAL AND MOISTURE PROTECTION

12-7.01 WATER REPELLENT COATING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and applying water repellent coating to concrete surfaces in accordance with these special provisions.

The water repellent coating shall be applied to all exterior concrete surfaces.

SUBMITTALS

Product Data: Manufacturer's descriptive data, application instructions and general recommendations for water repellents shall be submitted for approval.

QUALITY ASSURANCE

Codes and Standards: Water repellent coatings shall comply with all rules and regulations concerning air pollution in the State of California.

Certificates of Compliance: Certificates of Compliance shall be furnished with each shipment of water repellent coating materials in accordance with Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

PART 2 - PRODUCTS

Water Repellent Coating: Water repellent coating shall be clear, colorless, water-based sealer. Water repellent coating shall be Hydrozo Inc., Clear Double 7; Euclid Chemical Co., Architectural Seal VOX; Tamms Industries Co., Chemstop; or equal.

PART 3 - EXECUTION

Preparation: All surfaces to receive water repellent coating shall be dry and cleaned by removing contaminants that block pores of the surface. Cleaning methods shall be as recommended by the water repellent manufacturer.

Application:

The water repellent solution shall be applied in accordance with the manufacturer's printed instructions

The time period between applications of water repellent coating shall be not less than 24 hours.

Protection: Surfaces of other materials surrounding or near the surfaces to receive the water repellent coating shall be protected from overspray or spillage from the waterproofing operation. Water repellent coating applied to surfaces not intended to be waterproofed shall be removed and the surfaces restored to their original condition.

SECTION 12-8. (BLANK)

SECTION 12-9. PAINTING AND COATING

12-9.01 PAINTING

PART 1 - GENERAL

Scope: This work shall consist of preparing surfaces to receive coatings, and furnishing and applying coatings, in conformance with the schedules and details shown on the plans and these special provisions.

The coatings specified in this section are in addition to any factory finishes, shop priming, or surface treatment specified elsewhere in these special provisions.

DEFINITIONS

Detergent Wash: Removal of dirt and water-soluble chemicals by scrubbing with a solution of detergent and water, and removal of all solution and residues with clean water.

Hand Cleaning: Removal of dirt, loose rust, mill scale, excess base material, filler, aluminum oxide, chalking paint, peeling paint, or paint that is not firmly bonded to the surfaces by using hand or powered wire brushes, hand scraping tools, power grinders, or sandpaper and removal of all loose particles and dust prior to coating.

Mildew Wash: Removal of mildew by scrubbing with a solution of detergent, hypochlorite-type household bleach, and warm water, and removal of all solution and residues with clean water.

Abrasive Blasting:

Removal of loosely adhering paint, dirt, rust, mill scale, efflorescence, weak concrete, or laitance, shall be by the use of airborne abrasives. Loose particles, dust, and abrasives shall be removed by blasting with clean, oil-free air.

Abrasives shall be limited to mineral grit, steel grit, or steel shot, and shall be graded to produce the surface profile recommended in the manufacturer's data sheet.

Steam Cleaning: Removal of oil, grease, dirt, or other foreign matter by using steam generated by commercial steam cleaning equipment, from a solution of water and steam cleaning compounds, and removal of all residues and cleaning compounds with clean water.

TSP Wash: Removal of oil, grease, dirt, paint gloss, and other foreign matter by scrubbing with a solution of trisodium phosphate and warm water, and removal of all solution and residues with clean water.

Water Blasting: Removal of dirt, loose scale, chalking, or peeling paint by low-pressure water cleaning. Water blasting shall be performed in conformance with the requirements in SSPC-SP12 and shall produce a surface cleanliness meeting the requirements of SSPC-SP12-WJ4. Equipment used shall have a minimum flow rate of 1.5 GPM. If a detergent solution is used, it shall be biodegradable and shall be removed from all surfaces with clean water.

Protection:

The Contractor shall provide protective devices, such as tarps, screens or covers, as necessary to prevent damage to the work and to other property or persons from all cleaning and painting operations.

Paint or paint stains on surfaces not designated to be painted shall be removed by the Contractor at the Contractor's expense and the original surface shall be restored.

SUBMITTALS

Manufacturer's descriptive data, a materials list, and color samples shall be submitted for approval.

Product descriptive data shall include product description, manufacturer's recommendations for product mixing, thinning, tinting, handling, site environmental requirements, product application, and drying time.

Materials list shall include manufacturer's name, trade name, and product numbers for each type coating to be applied.

Color samples shall be manufacturer's color cards, approximately 2" x 3", for each color of coating shown on the plans. Color samples for stains shall be submitted on wood of the same species, color, and texture as the wood to receive the stain.

QUALITY ASSURANCE

Certificates of Compliance: Certificates of Compliance shall be furnished when products are required to conform with the requirements of The Society for Protective Coatings (SSPC) in conformance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

REGULATORY REQUIREMENTS

Coatings and applications shall conform to the rules for control of Volatile Organic Compound (VOC) emissions adopted by the air quality control district in the air basin in which the coatings are applied.

SITE ENVIRONMENTAL REQUIREMENTS

Coatings shall be applied in conformance with the environmental constraints specified in the manufacturer's printed instructions. These conditions shall be maintained until the coating has cured and is ready for recoat.

Continuous ventilation shall be provided during application of the coatings.

Adequate lighting, as determined by the Engineer, shall be provided while surfaces are being prepared for coatings and during coating applications.

DELIVERY, STORAGE, AND HANDLING

Products shall be delivered to the site in sealed, labeled containers and stored in a well-ventilated area at an ambient air temperature of not less than 45°F. Container labeling shall include manufacturer's name, type of coating, trade name, color designation, drying time, and instructions for tinting, mixing, and thinning.

MAINTENANCE STOCK

Upon completion of coating work, a full one-gallon container of each type and color of finish coat and stain used shall be delivered to the location at the project site designated by the Engineer. Containers shall be tightly sealed and labeled with color, texture, and room locations where used, in addition to the manufacturer's standard product label.

PART 2 - PRODUCTS

Products for each coating system shall be from a single manufacturer and shall conform to the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI). Each product shall be shown on the MPI Approved Products List unless otherwise specified in these special provisions.

Surfaces Not To Be Painted

Unless noted otherwise, the following surfaces shall not be painted and shall be fully protected when adjacent areas are painted.

1. Stainless Steel
2. Metal letters
3. Nameplates and grease fittings
4. Aluminum grating
5. Brass and copper tubing, submerged
6. Buried pipe, unless specifically required in the piping specifications

Surfaces To Be Coated

Surfaces shall be coated as described below:

1. Above Ground and Exposed Piping: Above ground and exposed piping or piping in vaults and structures shall be coated as described in the various piping specifications and as specified herein. Color shall be as specified herein.
2. Valves: Valves shall be coated as described in the various valve specifications. Above ground valves, or valves in vaults and structures, shall match the color of the connecting piping.

3. Buried Items: Buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar from thrust blocks, and valve boxes shall be coated per System No. D-1 unless otherwise specified in the particular specifications for these items.

COATING SYSTEM

The surfaces to be coated shall be as shown on the plans and as specified in these special provisions. When a coating system is not shown or specified for a surface to be finish coated, the coating system to be used shall be as specified below for the substrate material. The number of applications specified for each coating system listed herein is a minimum. Additional coats shall be applied if necessary to obtain a uniform color, texture, appearance, or required dry film thickness.

Submerged Metal Coating Systems

System No. A-1--Submerged Metal

Type: Two part epoxy-polyamide having a minimum volume solids content of $54 \pm 2\%$, or two-part amido-amine epoxy having a minimum volume solids content of 83%.

Service Conditions: Shall be used on structural steel, tank interiors and piping exposed to fresh potable water.

Surface Preparation: SSPC SP-10

Prime Coat: Apply to a dry-film thickness of 5 mils:

- Tnemec Series 20, or 140 Pota Pox;
- Kop-coat 340 Gold Primer;
- Ameron Amerlock 400 Epoxy;
- International Interline 785 HS;

Finish Coats: Two coats of 5 mil dry-film thickness for each coat:

- Tnemec Series 20, or 140 Pota Pox;
- Kop-coat Super Hi-gard Epoxy;
- Ameron Amerlock 400 Epoxy;
- International Interline 785 HS;

Exposed Metal Coating Systems

System No. B-1--Exposed Metal, Severely Corrosive Environment

Type: Inorganic zinc prime coat with polyamide cured epoxy paint finish coat.

Service Conditions: Shall be used on metal structures, piping, fittings, and appurtenances subjected to continuous water condensation, or occasional immersion or splashing.

Surface Preparation: SSPC SP-10.

Prime Coat: Two-component inorganic zinc rich primer recommended by the manufacturer to be coated with polyamide epoxy paint finish coating. Minimum zinc content shall be 14 pounds per gallon. Apply to a dry-film thickness of 3 mils. Products:

- Kop-coat Carbo Zinc II HS;
- Ameron Dimetcote 9;
- Tnemec 90-96 Tneme-Zinc;
- International Interzinc 437 WB

Intermediate Coat: Apply to a dry-film thickness of 3 mils:

- Kop-coat Super Hi-gard Epoxy;
- Ameron Amerlock 400 Epoxy;

Tnemec 69 Hi-build Epoxoline II;
International Interseal 670 HS

Finish Coat: Two coats of 4 mil dry-film thickness for each coat:
Kop-coat Hi-gard;
Ameron Amerlock 400 Epoxy;
Tnemec Series 69 Hi-build Epoxoline II;
International Interseal 670 HS

System No. B-2 --Exposed Metal, Atmospheric Weathering Environment

Type: Aliphatic Polyurethane having a minimum volume solids content of 73% with amido-amine epoxy primer.

Service Conditions: Shall be used on exterior steel and piping, fittings, and appurtenances subject to sunlight and weathering.

Surface Preparation: SSPC SP-6.

Prime Coat: Apply to a dry-film thickness of 5 mils:
Ameron Amerlock 400 Epoxy;
Tnemec Series 135 Chembuild;
International Interseal 670 HS;
Minimum volume solids shall be 75%.

Finish Coats: One coat of 5 mil dry-film thickness:
Ameron Amershield;
Tnemec Series 75 Endura-shield;
International Interthane 870;
or a total dry film thickness of system equal to 10 mils

System No. B-3 --Exposed Non-ferrous Metal and Galvanized Steel

Type: High solids epoxy coating having a minimum volume solids of 83%, with aliphatic polyurethane finish coat having a minimum volume solids of 73%.

Service Conditions: Shall be used to coat non-ferrous and galvanized steel pipe, fittings, and appurtenances.

Surface Preparation: SSPC SP-1. Aluminum and galvanized surfaces shall be brush blasted or acid etched to provide an etched surface prior to application of prime coat.

Prime Coat: Apply to a dry-film thickness of 5 mils:
Tnemec Series 135 ChemBuild;
Ameron Amerlock 400 Epoxy;
International - no primer required

Finish Coat: Apply to a dry-film thickness of 5 mils:
Tnemec Series 75 Endura-Shield;
Ameron Amershield;
International Interthane 870

Buried Metal Coating Systems

System No. D-1--Buried Metal, Corrosive Groundwater Exposure

Type: Coal-tar epoxy having a minimum volume solids of 78% and complying with MIL-P-23236.

Service Conditions: Shall be used to coat buried metal (flanges, bolts and nuts, fittings, flexible pipe couplings, structural steel etc.) especially subject to corrosive groundwater (low pH, high sulfate and chloride concentrations.)

Surface Preparation: SSPC SP-10.

Prime Coat: Apply to a dry-film thickness of 8 mils:

Kop-coat 300-M;
Ameron Amercoat 78 HB;
Tnemec 46H-413 Tneme-Tar;
International Intertuf 132

Finish Coats: Two coats of 8 mils dry-film thickness for each coat:

Kop-coat 300-M;
Ameron Amercoat 78 HB;
Tnemec 46H-413 Tneme-Tar;
International Intertuf 132

PVC Pipe Coating System

System No. F-1—Exposed PVC Pipe

Type: High solids Epoxy coating having a minimum volume solids of 83%

Service Conditions: Shall be used to coat exposed PVC piping in pump stations.

Surface Preparation: Surfaces shall be cleaned and dried prior to application of coating.

Finish Coat: Apply to a dry-film thickness of 5 mils:

Ameron Amerlock 400 Epoxy;
International Interseal 670 HS;
Kop-coat Hi-gard Epoxy;
Tnemec Series 69 Hi-build Expoxoline

Valve Interior System

System No. G-1--Interior Surface of Ferrous-Metal Valves

Type: Thermosetting powdered epoxy coating.

Service Conditions: Shall be used to coat interior surfaces of ferrous metal valves, excluding seating areas and bronze and stainless steel pieces.

Surface Preparation: SSPC SP-5. Protuberances which may produce pinholes in the coating shall be removed. Sharp edges shall be rounded. Surface contaminants which may prevent bonding of the coating shall be removed.

Coating: Apply to a dry-film thickness of 12 mils in accordance with manufacturer's recommendation:

3M Scotchkote 134

PART 3 - EXECUTION

INSPECTION

Coatings shall not be applied until surface preparation has been approved by the Engineer. The Contractor shall notify the Engineer at least 3 working days prior to the application of coatings.

SURFACE PREPARATION

Surfaces scheduled to be coated shall be prepared in conformance with the coating manufacturer's printed instructions unless otherwise specified in these special provisions.

Hardware, cover plates, light fixture trim, and similar items shall be removed prior to preparing surfaces for coating. Following the application of the finish coating, the removed items shall be reinstalled in their original locations.

Galvanized Metal:

New surfaces shall be roughened by hand sanding or light abrasive blasting. Galvanizing shall not be removed during cleaning or roughening.

Damaged or corroded areas shall be cleaned and given 2 spot applications of a coating that conforms to the requirements in the Detailed Performance Standards of the MPI, and listed on MPI List "Number 18, Primer, Zinc Rich, Organic."

Steel and Other Ferrous Metals: Surface shall be cleaned in conformance with the requirements in SSPC-SP 1. Surface profile shall be as required for the coating system specified.

Aluminum and Other Non-ferrous Metals: Surface shall be cleaned in conformance with the requirements in SSPC-SP 1.

SSPC Specifications: Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," or "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structures Painting Council, Surfaces Preparation Specifications, ANSI A159.1) specifications listed below:

SP-1	Solvent Cleaning
SP-2	Hand Tool Cleaning
SP-3	Power Tool Cleaning
SP-5	White Metal Blast Cleaning
SP-6	Commercial Blast Cleaning
SP-7	Brush-Off Blast Cleaning
SP-8	Pickling
SP-10	Near White Blast Cleaning

Sandblasting: The Contractor shall provide suitable enclosure, exhaust system, and bag house for sandblasting operations to prevent violations of applicable air quality requirements.

Previously Coated Surfaces:

Dirt, oil, grease, or other surface contaminants shall be removed by water blasting, steam cleaning, or TSP wash. Minor surface imperfections shall be filled as required for new work. Mildew shall be removed by mildew wash. Chalking paint shall be removed by hand cleaning. The surfaces of existing hard or glossy coatings shall be abraded to dull the finish by hand cleaning or light abrasive blasting. Abrasive blasting shall not be used on wood or non-ferrous metal surfaces.

Chipped, peeling, blistered, or loose coatings shall be removed by hand cleaning, water blasting, or abrasive blasting. Bare areas shall be pretreated and primed as required for new work.

APPLICATION

Coatings shall be applied in conformance with the printed instructions and at the application rates recommended by the manufacturer to achieve the dry film thickness stated in the coating technical data sheet.

Mixing, thinning and tinting shall conform to the manufacturer's printed instructions. After thinning, the coating shall conform to the regulatory requirements in these special provisions.

Coatings shall be applied only when surfaces are dry and properly prepared.

Cleaning and painting shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

Materials required to be coated shall have coatings applied to all exposed surfaces, including the tops and bottoms of wood and metal doors, the insides of cabinets, and other surfaces not normally visible from eye level.

Surface Finish Application:

Each coat shall be applied to a uniform finish. Finished surfaces shall be free of surface deviations and imperfections such as skips, cloudiness, spotting, holidays, laps, brush marks, runs, sags, curtains, ropiness, improper cutting in, overspray, drips, ridges, waves, and variations in color and texture.

Each application of a multiple application finish system shall closely resemble the final color coat, except each application shall provide enough contrast in shade to distinguish the separate applications.

Work Required Between Applications:

Each application of material shall be cured in conformance with the coating manufacturer's printed instructions before applying the succeeding coating.

Stain blocking primer shall be spot applied whenever bleeding substances are visible through the previous application of a coating.

Timing of Applications: The first application of the coating system shall be during the same work shift that the final surface preparation was performed. Additional coats shall be applied as soon as the required drying time of the preceding coat, specified in the coating manufacturer's printed instructions, has been met.

Application Methods:

Coatings shall be applied by brush, roller or spray. Rollers shall be of a type which do not leave a stippled texture in the paint film. Extension handles for rollers shall not be greater than 6 feet in length.

If spray methods are used, surface deviations and imperfections such as overspray, thickness deviations, lap marks, and orange peel shall be considered as evidence the work is unsatisfactory and the Contractor shall apply the remainder of the coating by brush or roller, as approved by the Engineer.

Back Priming:

The first application of the coating system shall be applied to all wood surfaces (face, back, edges, and ends) of wood materials that are not factory coated, immediately upon delivery to the project site. Surfaces of interior finish woodwork that adjoin concrete or masonry shall be coated with one application of exterior wood primer before installation.

Patches in Previously Coated Surfaces: Where patches are made on surfaces of previously coated walls or ceilings, the entire surface to corners on every side of the patch shall be coated with a minimum of one application of the finish coat.

Finishing Mechanical and Electrical Components:

Shop primed mechanical and electrical components shall be finish coated in conformance with the coating system specified for the substrate material. Louvers, grilles, covers, and access panels on mechanical and electrical components shall be removed and coated separately.

Interior surfaces of air ducts which are visible through grilles or louvers shall be coated with one application of flat black enamel, to limit of the sight line.

Conduit, piping, and other mechanical and electrical components visible in the finished work shall be painted.

Both sides and all surfaces, including edges and back of wood mounting panels for electrical and telephone equipment shall be finish coated before installing equipment.

CLEANING

Upon completion of all operations, the coated surfaces shall be thoroughly cleaned of dust, dirt, grease, or other unsightly materials or substances.

Surfaces marred or damaged as a result of the Contractor's operations shall be repaired, at his expense, to match the condition of the surfaces prior to the beginning of the Contractor's operations.

DRY-FILM THICKNESS TESTING

1. Coating Thickness Testing: Coating thickness specified for steel surfaces shall be measured with a magnetic-type dry-film thickness gage. Dry-film thickness gage shall be provided as manufactured by Mikrotest or Elcometer. Each coat shall be checked for the correct dry-film thickness. Measurement shall not be made until a minimum of eight hours after application of the coating. Non-magnetic surfaces shall be checked for coating thickness by micrometer measurement of cut and removed coupons. Contractor shall repair coating at all locations where coupons are removed.
2. Holiday Testing: The finish coat (except zinc primer and galvanizing) shall be tested for holidays and discontinuities with an electrical holiday detector of the low-voltage, wet-sponge type. Detector shall be provided as manufactured by Tinker, asor or K-D Bird Dog.
3. Repair: If the item has an improper finish color, insufficient film thickness, or holidays, the surface shall be cleaned and top-coated with the specified paint material to obtain the specified color and coverage. Visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

COLOR SCHEDULE

Facility	Enclosed	Above Grade/Exposed	At Grade
Piping	Safety Green	Safety Green	N/A
Valves	Safety Green	Safety Green	N/A

SECTION 12-10. (BLANK)

SECTION 12-11. (BLANK)

SECTION 12-12. (BLANK)

SECTION 12-13. (BLANK)

SECTION 12-14. CONVEYING SYSTEMS

12-14.01 TROLLEY HOIST

PART 1 - GENERAL

A complete single trolley, single-girder hoist shall be furnished and installed by the Contractor in the pump station room. The hoist shall be rated for one-ton capacity and shall be capable of moving manually so that each of the trash racks can be lifted. Manual lifting chains shall be operable from pump room floor level.

The hoist supplier shall furnish and install the rail support beam, rails, and wheel stops complete in place, including all fasteners and incidental materials. The rail beam shall be painted the same as the crane.

The trolley hoist shall be Yale Load King LTP2, Harrington NTH Low Headroom Trolley, or Columbus McKinnon Series 648 Cyclone Low Headroom Trolley.

MANUFACTURER'S QUALIFICATIONS

Equipment provided shall be designed, fabricated, and installed in accordance with best industry standards and shall be a standard design of manufacturer. The Contractor shall provide evidence that the selected manufacturer has made other satisfactory installations of equipment of the size and type proposed.

SHOP DRAWINGS

The Contractor shall submit shop drawings for the hoist showing general arrangement to the Engineer for approval. The Contractor shall also submit for Engineer approval, six (6) copies of structural calculations, load ratings, and manufacturer's data clearly defining the equipment. Both the drawings and the calculations shall be signed by a State of California registered Civil or Structural Engineer.

CODES AND STANDARDS

All equipment furnished shall meet or exceed CMAA, HMI, OSHA and all other applicable state and local codes. Where there is a conflict between these specifications and any state requirements, whichever provides the largest safety factor shall be used.

PART 2 - PRODUCTS

Material not definitely specified shall be of the best quality used for the purpose in commercial practice. Material shall be free from all defects and imperfections that may affect the finished product. Structural steel shall conform to ASTM A36.

SPECIFIC REQUIREMENTS

Trolley and Hoisting Unit: Hoist shall be furnished with an automatic overload limit device to guard against accidental overloading of unit. This safety feature shall help prevent any severe damage to hoist components.

Hook Heights and Limits of Travel: All equipment proposed to be furnished and installed shall be capable of safely operating at full crane rated capacity within the limits shown. The maximum lift shall not be less than 8 feet.

MANUFACTURING REQUIREMENTS

Design Safety Factors and Other Requirements:

1. Calculations of all structural members shall include allowance for vertical impact of 25 percent of live load and for lateral impact of 20 percent of combined weight of hoist, trolley, and live load.
2. Live load deflection of bridge girder shall not exceed 1/800 of the span.

3. All equipment utilizing structural steel or supporting structures shall be designed in accordance with the specifications of the American Institute of Steel Construction, current edition, and where welding is employed, such work shall be designed in accordance with the standards of the American Welding Society.

GIRDER SECTIONS

The girder structure shall be designed and fabricated as a complete integral structure comprised of girder, end trucks, and appurtenances with only such parts removable as required to facilitate the erection or maintenance of equipment.

HOISTING CHAIN

The lifting and hoisting chains shall be zinc plated and of a proper size to give a safety factor of at least five when loaded to its maximum rating.

HOISTING TACKLE AND HOOK

The hook shall have a safety clasp, spring loaded, to protect the load from being released from the hook when the tension on the chains is released.

TROLLEY STOPS

To prevent any part of the crane trolley projecting beyond the end of the crane bridge, rubber bumper trolley stops shall be provided on the rail.

MEASUREMENTS AND CLEARANCES

Provisions shall be made to provide suitable clearances overhead and at each end of the crane so there will be no interference between the crane and any parts of the building or building obstructions.

OPERATING TESTS AND ADJUSTMENTS

Upon completion of installation, the entire system shall be thoroughly lubricated, aligned, and adjusted. The bridge crane installation shall be inspected and proof load tested by an agency accredited by the State of California. The crane shall be tested according to the provisions of Sections 5021 through 5023 of the State Industrial Safety Orders. The testing agency shall provide a State certificate that the bridge crane meets all the requirements of the State Division of Industrial Safety.

PAINTING

All exposed ferrous metal surfaces except those in rolling or sliding contact shall be thoroughly cleaned and given one coat of primer followed by two coats of machinery enamel. The hook and the supporting load block shall be painted safety yellow. All painted surfaces shall be touched up as necessary after installation.

NAMEPLATES

Nameplates shall be permanently attached to the bridge and load block showing capacity in short tons (one [1] short ton = 2,000 lbs.).

MAINTENANCE AND OPERATION MANUALS

The Contractor shall furnish six (6) operating manuals, repair, and parts catalogs.

SECTION 12-15. MECHANICAL

12-15.01 DRAINAGE PUMPING EQUIPMENT

PART 1 - GENERAL

SUMMARY

This section includes specifications for drainage pumping equipment.

Drainage pumping equipment must conform to the specifications in Section 74-2, "Drainage Pumping Equipment" of the Standard Specifications and these special provisions.

SUBMITTALS

Data To Be Furnished For All Drainage Pumping Equipment:

Submit product data for the following items:

- A. Drainage Pumps
- B. Aluminum Access Hatches
- C. Centrifugal Roof Fan
- D. Ductile Iron Pipe and Fittings
- E. Fiberglass Reinforcement Plastic Duct

QUALITY CONTROL AND ASSURANCE

Regulatory Requirements:

Drainage pumps must be factory certified under ANSI/HI 11.6. Each pump certification must be of the actual motor, pump, and trimmed impeller combination delivered to the job site.

Impeller balancing must be factory certified under ISO 1940-1, ISO Balance Quality Grade G6.3, at the supplied motor rpm.

DRAINAGE PUMPS

SUBMITTALS:

Drainage pump data must include:

- A. Dimensions of Pump components
- B. Representative pump curve showing the motor does not develop more than 95 percent of its nameplate horsepower anywhere on the curve
- C. Hp, kVA, kW, power factor, and voltage
- D. Starting and running currents
- E. Thermal and magnetic trip settings
- F. Starter overloads current setting
- G. Wiring diagrams for electrical and instrumentation
- H. Factory test reports for factory no load current, speed and locked rotor current
- I. Motor nameplate data, including:
 - 1. Full load speed
 - 2. Full load current
 - 3. Voltage
 - 4. Locked rotor kVA per rated horsepower or code letter

J. Operation and Maintenance Manual

Certificates:

Submit certificates for factory certified impeller balancing and factory certified drainage pump tests. Certification documents must be in US customary units.

Submit the factory original hard copy and 2 copies as pdf files on 2 CDs or DVDs. Send to the Offices of Structure Design, Documents Unit. The Department will not accept a facsimile copy. Notify the Engineer of the submittal. Include in the notification the date and contents of the submittal.

Certified Test Documents: Each pump shall be fully tested on water at the manufacturer's plant before shipment. Tests shall consist of laboratory testing at shutoff and five points over the operating range of the pump. One of the points will be the specified primary design point. Certified test data will include head, capacity, motor output HP, RPM, pump efficiency, final impeller diameter and be charted and graphed. All tests will be under the direction of a registered engineer and be conducted in accord with the applicable Hydraulic Institute Standards and Procedures according to Level "B" and be submitted as requested.

It is required that the pump manufacturer list the guaranteed efficiency for his pump at the specified design heads and submit curves showing the performance characteristics of the pump. In the event of failure of the pump to meet the guaranteed efficiency or to operate to the Engineer's satisfaction, the Contractor shall make such modifications and repairs as are necessary to make the unit conform to specification requirements and shall receive no additional compensation therefore.

Warranty: The Contractor shall ensure that the pump manufacturer warrants a minimum 100 percent full payment coverage of all parts and labor during the first 60 months of operation.

All pumps supplied shall meet or exceed the latest standards for pumps set by AWWA Standards. In addition, the pumps are to be engineered and manufactured under the certification of ISO-9001:2000.

Product Handling:

Delivery and Storage: Each pump shall have a permanent tag engraved with equipment name and number furnished by the manufacturer firmly attached to the pump.

Replacements and Repairs: It is the Contractor's responsibility to protect the equipment from damage during shipment, storage and construction. Prior to acceptance of the completed work by the Engineer, any damaged equipment or work shall be replaced or repaired by the Contractor at his expense and such replacement or repair shall be reviewed by the Engineer.

PRODUCTS

General – Pumps

Pump(s) shall be vertical wet pit, centrifugal non-clog submersible units capable of handling wastewater and shall be fully guaranteed for this use.

Pump(s) shall be designed for easy removal and reinstallation without the need for the removal of bolts, nuts, or other fasteners. The pump(s) shall automatically and firmly connect to the discharge connection, guided by no less than two parallel, non-load bearing, 316 stainless steel guide rails extending from the top of the pump station to the wet well mounted discharge connection. There shall be no need for personnel to enter the tank or wet well.

Sealing of the pumping unit to the discharge connection shall be non-sparking accomplished by a machined metal-to-metal watertight contact or a Viton profile gasket.

The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.

Power and pilot cable supports shall be provided and consist of a wire braid sleeve with attachment loops or tails to connect to the underside of the access frame.

OPERATION CRITERIA – MAIN PUMP

Design Conditions	Flow GPM	TDH FT	Max Pump RPM	Min Pump (Hydraulic) Efficiency%	Brake HP Required	Min Shut-Off TDH	Max Motor Size HP	Max Motor RPM
2 Duty 1 Standby								
Main Pump	4000	47	1200	80	58.1	80	75	1200

MAIN PUMP CRITERIA

Minimum Suction Diameter 12-inches
 Minimum Discharge Diameter 12-inches
 Maximum NPSHR @ Design Point 21.5 feet
 Minimum non-compressible solids handling 3-inches

OPERATION CRITERIA – SUMP PUMP

Design Conditions	Flow GPM	TDH FT	Max Pump RPM	Min. Pump Efficiency%	Brake HP Required	Min Shut-Off TDH	Max Motor Size HP	Max Motor RPM
Sump Pump	196	63	3600	55	5.8	105	10	3600

SUMP PUMP CRITERIA

Minimum Suction Diameter 4-inches
 Minimum Discharge Diameter 3-inches

The sump pump shall be vertical wet pit, centrifugal non-clog submersible unit capable of handling wastewater and shall be fully guaranteed for this use. Sump pump shall follow the standards utilizing the materials and methods of the Main Pump(s).

The pumps shall be designed to be non-overloading throughout the entire pump curve.

Pumps

Major pump components (pump casing, impeller, intermediate housing, motor housing) shall be cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities.

All exposed nuts or bolts shall be ASTM A-276 Type 316 stainless steel.

All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Pump/motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Viton O-rings. Joint sealing will be the result of controlled compression of O-rings in two planes and O-ring contact on four sides without the requirement of a specific bolt torque limit. Rectangular cross-sectioned rubber, paper or synthetic gaskets that require specific torque limits to achieve compression shall not be considered equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

Main pumps shall be Wemco Hidrostral, Fairbanks Morse, or Flygt.

Internal Components:

Bearings: The pump shaft shall rotate on two oil-lubricated bearings. The upper bearing, provided for radial forces, shall be a single ball bearing. The lower bearing shall consist of ball bearings for axial thrust. Bearing shall be designed for an L-10 rating life of at least 50,000 hours at any operating condition.

Mechanical Seal: Each pump shall be provided with a positively driven tandem mechanical shaft seal system consisting of two seal seats, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring or silicon-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring or silicon-carbide ring. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent material from packing around them, limiting their performance.

Both seals shall be dimensionally interchangeable with standard off the shelf John Crane mechanical seals to allow for emergency repairs. Manufacturers supplying proprietary seals shall not be acceptable.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior or the motor unit. The seal system shall not rely upon the pumped media for lubrication.

The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

Ceramic seals will not be acceptable. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counterclockwise direction of rotation without damage or loss of seal. The lower seal shall be isolated from the pumped media by a labyrinth fit between the backside of the impeller and the back plate. The pump shall be capable of continuous submergence without loss of watertight integrity to a depth of 65 feet.

Pump Shaft: Pump and motor shaft shall be a solid continuous shaft. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be used. The pump shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves are not acceptable.

Impeller: Impeller(s) shall be cast iron, ASTM A48, Class 35B, dynamically balanced, centrifugal non-clogging design having long throughlets without acute turns. The impeller shall be of one piece, single suction, enclosed, two vane, radial flow design with well-rounded leading vanes and then tapered toward the trailing edge for a circular flow pattern. The waterways through the impeller will have extremely

smooth contours, devoid of sharp corners, so as to prevent rags or stringy, fibrous material from catching or clogging. Impeller(s) shall be keyed to the shaft, retained with an expansion ring and shall be capable of passing the minimum diameter solid indicated in the pump design criteria.

Wear Rings or Insert Rings: A wear or insert ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Both the impeller and pump casing shall be fitted with ASTM A276 Series 400 stainless steel wear or insert rings having a minimum Brinell Hardness Rating (BHR) of 300. The pump shall also have a stainless steel impeller wear or insert ring heat-shrink fitted onto the suction inlet of the impeller.

Volute/Casing: The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. The volute shall have a replaceable volute insert ring containing spiral-shaped, sharp-edge groove(s). The volute shall be side flanged tangential discharge and capable of rotation in 45 degree increment to accommodate piping orientation. Diffusion vanes are not permitted. The volute shall be furnished with large cleanout opening located at the impeller centerline to allow access to the impeller. Volute priming, drain and 1/2" minimum gauge connection shall be provided. Flanges shall be 125 lbs. flat faced flanges per ANSI drilling. The casing shall be designed to permit the removal of the rotating assembly without disturbing the suction or discharge piping. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head, whichever is greater.

Mounting: The manufacturer shall provide a fast-out fixture which shall be permanently mounted in the wet well as shown on the plans. The fixture shall cantilever the entire pump volute and motor from the volute discharge flange, providing an unobstructed sump floor under the pump; supports from underside of pump volute or pump suction to sump floor will not be acceptable. The fixture shall include 90 degree cast iron epoxy lined piping elbow to connect to the vertical piping, and shall provide mounts for a minimum of two galvanized steel rails of standard schedule 40 pipe, which will guide the pump into position. The pump shall be supported by a positive metal-to-metal interlocking flange, which is additionally sealed by a leak proof nitrite rubber ring pressed against the fixture flange by the weight of the pump.

Guide Rails: Guide rails shall be ASTM A276 Type 316 stainless steel provided by the Contractor. Diameter shall be as specified by the pump manufacturer.

Guide Rail Support: Upper and lower guide rail supports shall be ASTM A276 Type 316 stainless steel provided by the pump manufacturer. It shall be the responsibility of the pump manufacturer to determine the exact locations of the guide rail supports.

Lifting Chain or Lifting Cable: Lifting chain and cable should be provided to lift pumps from the wet well. Lifting chain shall be ASTM A-276 Type 316 stainless steel provided by the pump manufacturer. Length as required. Lifting cable shall be Type 316 stainless steel provided by the pump manufacturer. Length as required.

Lifting Cables: A minimum diameter of .50-inch (for main pumps) and .375-inch (for sump pump) stainless steel, wire rope lifting cables capable of extracting the pump.

Chain Holder: Chain holder shall be type 316 stainless steel provided by the pump manufacturer.

Controls: Refer to the P &ID's for the instrumentation and control.

Slide Rail Brackets: Slide rail brackets shall incorporate a two-rail system for assured rigidity. The upper and intermediate rail brackets (where necessary) shall be 316 stainless steel.

Painting:

All pumps shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Spare Parts:

Provide one (1) basic repair kit for each type of pump provided. Repair kit(s) shall be clearly labeled as to which pump they are provided for.

- 2 sets of all gaskets
- 2 sets of all bearings
- 2 sets of mechanical seals

EXECUTION

General: The Contractor shall follow instructions of the manufacturer of all items covered in this section regarding installation, alignment and lubrication.

Inspections:

Prior to initial operation, inspect equipment for compliance with drawings, specifications, and manufacturer's submittals.

Preliminary Tests:

Perform tests on pumps, drivers, and equipment, including visual equipment checks to ensure compliance with approved detail drawings; pump start-run to ensure proper operation and to detect leakage of piping, valves, and fittings; sequence of operation check; verification that required pump accessories have been provided; test of pump alarm devices; and additional inspections and tests necessary to ensure that the entire pump installation is correct, complete, and ready for operation.

Formal Inspection and Tests:

The Engineer and the City of Burbank shall witness formal tests and approve all systems before they are accepted. Submit the request for formal inspection at least 15 days prior to the date the inspection is to take place. An experienced technician regularly employed by the pump installer shall be present during the inspection. Tests shall include 100 percent and 150 percent capacity flows and pressures for compliance with manufacturer's characteristic curves. At this inspection, repeat the required tests as directed. Correct defects in the work provided by the Contractor, and make additional tests until the Contractor has demonstrated that the system complies with the contract requirements. Manufacturer's certified shop test characteristic curves for each pump being tested must be furnished by the Contractor at the time of the pump acceptance test. The Contractor shall furnish appliances, equipment, instruments, connecting devices, and personnel for the tests.

Installation and Start-up:

The manufacturer's representative shall visit the work site during the installation and at the completion of the work. A written report covering the manufacturer's representative's findings, or approval of the installation shall be submitted to the Engineer covering all inspection and outlining in detail any deficiencies noted. The Contractor shall perform all necessary adjustments and maintenance in accordance with the instruction of the manufacturer's representative. An appropriate allowance for this supervision shall be included by the Manufacturer in the price of this equipment.

Instructing Operating Personnel:

Upon completion of the work and at a time designated by the Engineer and the City of Burbank, provide for a period of not less than one (1) 8-hour working day, the services of experienced technicians regularly employed by the Manufacturer of the pumps, to instruct operating personnel in the proper operation and maintenance of the equipment.

Submersible Electric Motors

PRODUCTS

Motors shall be of the explosion-proof design, approved by Factory Mutual for uses in Class I, Groups C&D, hazardous locations.

The motors shall be of the immersible type, suitable for full-load, continuous operation either completely dry or fully submerged in the pumped liquid of up to 65 foot depths. Motors shall be of the "oil-filled" type, to optimize efficiency, with stator and rotor housed in a watertight chamber containing only air. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.

Motors shall incorporate a separate heat-exchanger circuit, with a shaft-mounted cooling pump circulating oil from a jacket surrounding the stator housing to a heat-exchanger surface cast into the pump backplate. The circulating oil shall transfer excess motor heat directly to the pumped media inside the pump volute, without the need of submergence for adequate motor cooling at any continuous power output up to and including rated powers in ambient of 40°C. Alternately, motors shall dissipate heat directly (by convection) from the exposed stator housing to surrounding ambient air, without the need of submergence for adequate motor cooling at any continuous power output up to and including rated power in ambient of 40°C.

Motor stator windings and leads shall be insulated with moisture-resistant Class H insulation for operation at temperatures up to 155 degrees Celsius.

Motors shall have the stator varnish applied by the "vacuum-pressure impregnation" method to ensure thorough and complete varnish penetration. The stator shall be heat-shrink fitted into the stator housing.

Motor cable-entry sealing assembly shall consist of the following five components to ensure a positive, redundantly watertight seal:

- a. The sealing components shall be mechanically isolated from cable strains by a two-piece restraining clamp, which will securely grip the cable above the moisture-sealing components and bear any mechanical forces applied to the cable.
- b. The cable moisture seal shall consist of an elastomer grommet, prevented from extruding past the cable by stainless-steel retaining washers on either side. The grommet shall be compressed tightly against the cable outside diameter (and the entry assembly inner diameter) by a screwed follower gland.
- c. Each individual conductor shall be interrupted by a solid-copper isolation dam to prevent wicking of moisture through the conductor strands.
- d. The cable insulation shall be sealed by an epoxy poured into the cable entry and totally encapsulating the stripped-back insulation and the individual copper dams. This poured epoxy seal shall also function as a redundant seal for the cable outside diameter.
- e. The cable free end shall be sealed from moisture-entry during shipping, storage, and prior to connection to the control panel by a plastic sleeve securely clamped over the cable end.

The thrust bearings shall be designed to take the full axial load of the impeller. Motors for main pumps shall be immersible, 3 phase, 60 cycle, with HP, RPM, and voltage as follows: 75 HP, 1,200 RPM, 460 Volts.

Protection Devices:

The motor shall be provided with the following protection devices:

- a. Three normally closed thermal sensors embedded in the stator windings, wired in series, will open a protective circuit if winding temperature exceeds rated operating temperature. These sensors automatically reset when winding temperature has cooled to a safe operating temperature.

- b. A conductivity probe to monitor the moisture content of the oil in the chamber between the outer and the inner mechanical seals. The probe shall be wired to a separate protective circuit, which, when connected to a conductivity-sensitive relay in the control panel, will trip an alarm if moisture content of the oil indicates a failure of the outer mechanical seal.

Cables:

Cables shall include both power and control wires and be provided by motor manufacturer.

The power cable shall be of sufficient length to reach from the pump to the control panel terminal block without splicing. The cable shall have enough slack such that it can be routed and secured out of the way of any equipment in the wet well. It shall be the Contractor's responsibility to coordinate the cable length. Power cable shall be field replaceable if damaged. When the lead jam nut is tightened, the lead's connection to the motor shall be made watertight by the compression of a rubber bushing. Design the internal connections of the lead to eliminate any possibility that water entering a damaged portion of the lead or supply wires will wick down into the motor.

Size the power cable such that the voltage drop will not exceed 3-percent at the motor rated full-load current and voltage. Cables shall be designed specifically for submersible pump service and shall consist of either three single conductors individually insulated or three individual conductors individually insulated, all covered with an outer jacket.

The control cable shall have the necessary number of conductors for the functions indicated on the schematic diagrams. Design cable specifically for submersible applications. Cable shall consist of conductors individually insulated and covered with an outer jacket.

Sealing design shall incorporate metal-to-metal contact between machined surfaces, additionally sealed by a leak-proof nitrile rubber ring. The cable entry system shall be such that the sealing components shall be mechanically isolated from cable strain by a two-piece restraining clamp. The cable moisture seal shall consist of an elastomer grommet, tightly compressed against the cable outside diameter by a screwed follower gland. The cable insulation shall be sealed by an epoxy poured into the cable entry and totally encapsulating the stripped back insulation. Motors which use just a grommet design or just the epoxy seal are not acceptable.

Nameplates:

The motor shall have a stainless steel nameplate which shall provide the following information: manufacturer's type and frame construction, insulation system, temperature rise, horsepower output, rated load amperes, rpm, voltage, time rating, "continuous" frequency, number of phases, NEMA code letter for locked rotor kva, NEMA design letter, service factor, thrust bearing load capacity, full-load efficiency and power factor at full load, and essential bearing information such as bearing type and bearing numbers.

Factory Tests:

Motor shall be given routine factory tests to determine that it is free from electrical or mechanical defects and to provide assurance that it meets the design specifications.

Tests shall be as follows and a certified test report provided to the Engineer and the City of Burbank's Representative:

- a. No load readings of current and speed at rated voltage and frequency.
- b. Current at rated frequency with rotor at standstill.
- c. High potential.
- d. Stator winding resistance.
- e. Bearing inspection.

EXECUTION

Installation:

Install motor with pump as specified in these Special Provisions.

Provide controller for installation in the motor starter as specified in these Special Provisions and as shown in the Plans.

Field Tests:

Motor shall be subjected to a field test as follows:

- a. Megger test before installation.
- b. Run motor with its control as nearly as possible under operating conditions to demonstrate correct rotation direction, wiring capacity, and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.
- c. Record current in each phase and submit to Engineer and the City of Burbank. Repair or replace motor or driven equipment if current exceeds motor nameplate current.

PUMP ACCESS HATCHES, SUPPLY FAN, AND DUCTWORK

Access Hatches

SUMMARY

Where a conflict occurs between the Plans and these Special Provisions, the Plans shall govern.

This section describes materials and fabrication of flush-mounted H-20 rated aluminum access hatches.

SUBMITTALS

Shop Drawings:

- a. Submit drawings for all fabrications and assemblies. Include profiles, accessories, location, dimensions, and connection details.
- b. Identify materials of construction and shop coatings.

Product technical data including:

- a. Acknowledgement that products submitted meet requirements of standards referenced.
- b. Manufacturer's installation instructions.
- c. Provide manufacturer's standard allowable load tables for the following:
 1. Aluminum diamond plate
 2. Castings and accessories

Miscellaneous Submittals:

Certification of welders and welding processes: Submit certificates of welder qualifications for each welder, for each of the weld types to be performed in conformance with AWS D1.1. Submit Welding Procedure Specifications (WPS) for each of the weld types to be performed in conformance with AWS D1.1. Qualifications of fabricator's Professional Engineer.

PRODUCTS

General:

Stainless Steel:

Minimum yield strength of 30,000 psi and minimum tensile strength of 75,000 psi.

- a. Bars, shapes: ASTM A276, Type 316.
- b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 316.
- c. Strip, plate and flat bars: ASTM A666, Type 316, Grade A.
- d. Bolts: ASTM F593, Type 316.
- e. Nuts: ASTM F594, Type 316.

Minimum yield strength of 25,000 psi and minimum tensile strength of 70,000 psi.

- a. Strip, plate and flat bar for welded connections, ASTM A666, Type 316L.

Welding electrodes: In accordance with AWS for metal alloy being welded.

Aluminum:

- a. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
 1. ASTM B221 and ASTM B308 for shapes including beams, channels, angels, tees and zeos.
 2. Weir plates, baffles and deflector plates, ASTM B209.
- b. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
 1. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
- c. ASTM B26 for castings.
- d. ASTM F468, alloy 2024 T4 for bolts.
- e. ASTM F467, alloy 2024 T4 for nuts.
- f. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.

Fabrication:

General:

- a. Structural and miscellaneous aluminum shall be fabricated in accordance with the Aluminum Association Specification for the Design, Fabrication and Erection of Structural Aluminum for Buildings. Fabricator shall be a local Building Department approved shop.
- b. Material may be sheared, sawed, cut with a router or arc cut. All edges which have been cut by the arc process shall be planned to remove edge cracks. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided whenever possible. If used, they shall be filleted by drilling prior to cutting.
- c. Oxygen cutting of aluminum alloys shall not be permitted.
- d. Holes for bolts in aluminum shall be of same diameter of bolt +1/16-inch maximum.
- e. All welding shall conform to the latest edition of the American Welding Society AWS D1.2-94, Structural Welding Code for Aluminum. All welding shall be performed by a certified welder in a local Building Department approved shop.

Access Hatch Door:

Furnish and install where indicated on the Plans access hatch door with the following size and quantity:

width	x	length	quantity
4'-0"		6'-6"	(1 Total)
4'-0"		6'-0"	(3 Total)
4'-0"		4'-0"	(6 Total)
2'-6"		4'-0"	(1 Total)
3'-6"		3'-6"	(1 Total)

Length denotes hinge side. Unless indicated otherwise, all access hatch doors shall be double leaf. The direction of swing of door leaves shall be indicated on the plans. Sizes given shall be for clear opening. Access hatch shall be pre-assembled from the manufacturer.

Where access hatches are called for on the Plans to be mounted on a concrete slab (including top slabs, which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein.

All hatches shall be fabricated from Aluminum 6061 T6 unless otherwise indicated. All hatch hardware shall be Type 316 stainless steel. Hatches shall be gutter-type, or as shown.

Performance characteristics:

- a. Covers: Shall be reinforced to support AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span. (Note: For installation in an off-street location where not subject to high density, fast moving traffic.)
- b. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing
- c. Operation of the covers shall not be affected by temperature.
- d. Entire door, including all hardware components, shall be highly corrosion resistant.

Covers: Shall be 1/4" (6.3 mm) aluminum diamond pattern.

Frame: Channel frame shall be 1/4" (6.3mm) extruded aluminum with bend down anchor tabs around the perimeter.

Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

Hatches shall be designed to be water-tight and shall be equipped with a joint gutter and moat-type edge drain. A 1½ inch diameter (minimum) drain connection shall be provided and located by the Engineer.

Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" gusset support plate.

A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the covers and the latch release shall be protected by a flush, gasketed, removable screw plug.

Hardware:

- a. Hinges: Heavy forged Type 316 stainless steel hinges, each having a minimum 1/4" (6.3 mm) diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.

- b. Covers shall be equipped with a hold open arm that automatically locks the covers in the open position.
- c. Covers shall be fitted with the required number and size of compression spring operators. Springs and spring tubes shall be Type 316 stainless steel.
- d. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
- e. Hardware: Shall be Type 316 stainless steel throughout.

Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame which shall be in contact with concrete when installed.

Access hatch manufacturer and product: Bilco-Type JD-ALH20; U.S.F. Fabrication, Inc. – Type AHD; Jensen MetalTech-Model CA1H20; Syracuse Castings – Model DT-HD.

EXECUTION

No structural aluminum member shall be cut for pipes, ducts, etc. unless specifically detailed and approved by Structural Engineer.

Aluminized, hot-dip galvanized or electro-galvanized steel placed in contact with aluminum need not be painted. Stainless steel (300 series) placed in contact with aluminum need not be painted except in high chloride containing environments.

Aluminum to be placed in contact with wood or other porous material that may absorb water shall be given a heavy coat of alkali resistant bituminous paint or other coating providing equivalent protection before installation. Aluminum in contact with concrete shall be similarly protected.

Install access hatch covers and frames in accordance with approved shop drawings and manufacturer's installation instructions.

The Contractor shall check installation conditions for access hatches and verify the manufacturer's flush access hatch details for accuracy to fit the specific application prior to fabrication. The Contractor shall comply with the access hatch manufacturer's installation instructions.

The Contractor shall furnish mechanical fasteners consistent with the vault access door manufacturer's instructions.

Centrifugal Roof Exhaust Fan

SUBMITTALS:

Manufacturer's product data including materials, primary and ancillary equipment. The shop drawing shall include mechanical and control diagrams, supports, vibration isolators, bracing calculations and details. Submit fan performance curves showing specified operating conditions.

QUALITY ASSURANCE:

Provide fans that are listed by UL and rated in accordance with AMCA and bear the AMCA certified rating seal.

PRODUCTS

Provide belt-driven centrifugal roof exhaust fan. The performance requirements: 4,200 CFM @ 0.25 SP, 1 hp, 1136 RPM, three phase, 460 volts.

The fan shall be bolted and welded construction utilizing corrosion resistant fasteners. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength. Galvanized rigid wires shall be used to protect the fan's discharge.

The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Each wheel shall be statically and

dynamically balanced. The bearing and drive components shall be isolated from the air stream. The bearing cover shall be easily removed for service.

Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

Belts, pulleys and keys shall be sized for a minimum of 150-percent of driven horsepower. The unit shall be provided with a NEMA 1 disconnect switch. A disconnect device/switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment.

Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance.

A fan conduit chase shall be provided through the curb cap to the motor for ease of installation.

The unit shall be coated with a epoxy coating (high pro-polyester) per the manufacturer's recommendations.

All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.

Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

EXECUTION

Install and wire unit fan and controls in accordance with manufacturer's recommendations.

Provide anchoring and support for fans and appurtenances per the manufacturer's recommendations.

An authorized service representative shall attend start-up of fan and shall check all equipment, controls, and apparatus for proper operation and adjustment.

Adjust alignment of ducts where necessary.

Paint exposed surface of the fan per Section 12-9 Painting and Coating.

Fiberglass Reinforced Plastic Duct

DATA TO BE FURNISHED:

Fabrication drawings shall have details on Laminate Sequence used.

A letter from the resin supplier stating that the material is used for this project complies with the specification and meets all corrosion requirements.

Design calculations performed by the manufacturer and stamped by a Professional Engineer for record purposes.

Duct manufacturer shall submit certified test results in accordance with ASTM 2992. Engineer will confirm that supplier has completed ASTM 2992 testing.

Samples shall be representative of the ductwork (construction method and material used) to be supplied on this project.

PRODUCTS

General:

Provide FRP duct as manufactured by Belco Manufacturing, Fibercast, or Champion. All equipment (duct, fittings) shall be the product of a single manufacturer.

Service conditions: Buried duct shall be designed per AWWA M-45 standards and be rated for H-20 loading. The wall thickness for shall be determined by ASTM 2310 using duct manufacturer Certified ASTM 2992 HDB test results.

Resin: Joints: Unless otherwise called out on the Plans or these Special Provisions.

- a. Resin shall be premium corrosion resistant and fire retardant brominated vinyl ester. Resin shall not contain pigments, dyes, colorants or fillers. Product should have a class 1 flame spread rating (25 or less).
- b. Thixotropic agents may be added to control resin viscosity per resin manufacturer's recommendation.
- c. Resins shall be AOC Vipel K022, Ashland Chemical Hetron FR992, or U.S. Composites.

Reinforcement:

- a. Surfacing veil shall be C glass veil with a silane finish and a styrene soluble binder.
- b. Chopped strand mat shall be Type E glass minimum 1-1/2 ounces per square foot with silane finish and styrene soluble binder.
- c. Continuous roving for chopper gun spray shall be Type E glass.
- d. Woven roving shall be Type E glass minimum 24 ounces per square yard with a five by four weave.
- e. Continuous roving for filament winding shall be Type E glass with a silane finish.

Construction:

All FRP ductwork shall be of filament wound construction for sizes >10-inches diameter and hand lay-up or filament wound construction for 10-inches and smaller. Cast pipe with no reinforced internal corrosion barrier or press molded fittings will not be accepted.

Maximum allowable deflection for any size ductwork shall be 1/2 inch between supports and for any size of duct under worst case operating conditions.

FRP ductwork shall be designed using a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum without exception.

Out-of-roundness of duct shall be limited to 1-percent of the diameter.

Length of all flanged duct sections shall not vary more than $\pm 1/2$ inch at 70 F.

All un-flanged duct shall be square on the ends in relation to the center axis within $\pm 1/8$ inch up to and including 24-inch diameter and within $\pm 3/16$ inch for all diameters greater than 24-inch.

Laminates:

- a. All ductwork shall have a resin-rich inner surface, an interior corrosion barrier, an interior structural layer and an exterior corrosion layer and UV • resistant coating.
- b. Inner surface: Nominal 10 mils thick composed of a single ply of the C glass surfacing veil embedded in a resin-rich surface. Resin content shall be 90-percent.
- c. Interior layer: Nominal 90 mils thick composed of at least two layers of chopped strand mat or equivalent chopped strand. Resin content shall be 75-percent.
- d. Structural layer: Type E glass to meet minimum wall thickness as specified. The total wall thickness includes the inner surface.

1. Contact molded structural layer shall include alternate layers of chopped strand mat and woven roving.
 2. Filament wound structural layer shall be preceded by a layer of chopped strand mat or spray chop. The structural layer shall consist of a minimum of two complete cross hatched layers of continuous filaments applied in a helix angle of 55 to 65 degrees for above-ground ductwork and 75 deg. for any buried ductwork.
- e. Exterior corrosion layer: Single A or C Veil shall be applied to all duct exterior.
- f. Exterior UV resistant coating: Factory applied paraffinated gel coat with UV inhibitors. Color shall be determined by the Engineer.

Fittings:

All fittings shall be hand lay-up construction fabricated from the same resin and have the same strength as hand lay-up FRP ductwork.

The internal diameter of all fittings shall be equal to the adjacent duct.

The tolerance on angles of all fittings shall be ± 1 degree up to and including 24 inch diameter and $\pm 1/2$ degree for 30 inch diameter and above.

Elbows:

The centerline radius of all elbows shall be 1-1/2 times the diameter.

Elbows 24-inch diameter and smaller shall be smooth radius. Elbows 30-inch and larger shall be mitered. Provide a minimum of two mitered joints (3-piece) for all elbows above 45 Deg.

Flanges:

Provide flanged connections to flexible connectors, expansion joints, vessels, demisters, fans, silencers and other locations as shown on the Plans.

Flanges shall be hand lay-up construction. Dimensions shall be in accordance with ASTM D 3982, Table 1, and the Duct Dimension Schedule.

Flanges shall be drilled in accordance with ASTM D 3982, Table 1. Backs of flange face shall be flat so that washer seats fully on bolt face and flange backing.

Flange tolerances shall be in ASTM D 3982, Section 8, Tolerances.

Gaskets shall be EPDM, full face and minimum 1/8 inch thickness.

All bolts, nuts and washers shall be Type 316 stainless steel.

Joints:

Provide all butt and strap joints in accordance with ASTM D 3982, Table 2, and manufacturer's drawings.

Field weld kits shall be supplied by the duct manufacturer. All necessary fiberglass and reinforcing material shall be supplied pre-cut and individually packaged for each joint. Bulk Glass rolls will not be acceptable.

All resin, catalyst and putty shall be supplied in quantities to complete all field joints plus 20-percent extra for waste.

Duct Supports:

All duct supports shall be located as shown on the Plans.

The Contractor shall be responsible for the design of additional supports and for the overall stability of the entire support system. Support and hanger details and a detailed layout showing the location of all duct supports and hangers shall be submitted in the shop drawings.

EXECUTION**General:**

All FRP pipes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary, all piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. All installations shall be acceptable to the Engineer. The Contractor shall obtain training by the pipe manufacturer's field representative in the correct installation and support of all FRP piping.

Supports and Anchors: All ducting shall be firmly supported with fabricated or commercial hangers or supports in accordance with the Plans and Specifications herein. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for duct expansion due to temperature differences.

Pipe Preparation:

Prior to installation, each duct length and all fittings shall be carefully inspected, flushed clean of any debris or dust, and straightened, if not true. All duct and fittings shall be equally cleaned before assembly.

Pipe Joints:

Butt and Wrap Joints: Prior to joining, ends shall be ground smooth. All dust and debris must be fully removed. Ends shall be resin-coated to prevent corrosion, in pipe 24" Diameter and above an interior corrosion wrap is required. The joint should be of equal strength as the pipe. A butt and wrap sequence and thickness chart should be shown on the fabrication Plans. The laminate sequence for each size duct should be supported by a separate section in the design calculations.

Supports and Anchors: All piping shall be firmly supported with fabricated or commercial hangers or supports. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.

Inspection and Field Testing:

Inspection: All finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interference, and damage to pipe, fittings, and coating. Damage shall be repaired to the satisfaction of the Engineer.

Field Testing: Prior to enclosure or buying, all piping systems shall be pressure tested at 1-1/2 times the maximum working pressure. The Contractor shall furnish all test equipment, labor, materials and devices at no extra cost.

- a. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.
- b. Leaks shall be repaired to the satisfaction of the Engineer and the system shall be retested until no leaks are found.

PIPE, FITTINGS, AND VALVES

SUMMARY:

This work shall consist of furnishing and installing pipes, fittings and valves in accordance with the details shown on the plans and these Special Provisions. Pipe, fittings and valves shall include such piping accessories and appurtenances, not mentioned, that are required for the proper installation and operation of the piping systems.

The pipe sizes shown on the plans are nominal inside diameter. No change in the pipe size shown on the plans shall be permitted without written permission from the Engineer.

The pipe and fitting classes and material descriptions shall be as specified herein. No change in class or description shall be permitted without written permission from the Engineer.

PIPING

General

The pipe sizes shown on the Plans are nominal inside diameter. No change in the pipe size shown on the Plans shall be permitted without written permission from the Engineer.

Submittal

Affidavits of compliance with standards referenced in this specification, e.g., AWWA C-151, shall be provided.

Layout drawings showing the locations and dimensions of pipe and fittings shall be submitted. Include laying lengths of valves and other equipment determining piping dimensions. For pipe sizes larger than 20-inches in diameter, label or number each fitting or piece of pipe.

Lining, coating and wall thickness for all piping shall be provided.

Joint details for all types of joints used, e.g., push-on joints shall be submitted.

Calculations and test data proving that each proposed restrained joint arrangement can transmit the required forces shall be submitted.

MATERIALS

Ductile-Iron Pipe

Ductile-iron pipe shall be manufactured in accordance with ANSI/AWWA C-151/A-21.51. Gray-iron fittings will not be substituted for ductile-iron.

The minimum wall thickness for ductile-iron pipe shall be as specified in AWWA C150 for the design pressure class, and thickness Class 53 for flanged spools, unless indicated otherwise on the Plans or in the Special Provisions.

Unless otherwise called out on the plans or these special provisions, a "push-on" joint shall be used. The joint dimension and gasket shall be as specified in ANSI/AWWA C-111/ A-21.11.

Flanges for ductile-iron pipe, when required, shall be "screwed-on" type in accordance with ANSI/AWWA C-115/A-21.15.

Where restrained joints are called for on 8-inches in diameter and smaller pipe, push-on joints shall be restrained with locking gasket rated for 250 psi operating pressure. Joint restraint shall be push-on joint with "Fast-Grip" as manufactured by American Cast Iron Pipe Company, "Sure-Stop" as

manufactured by Pacific States Cast Iron Company or "Field-Lok" gaskets as manufactured by U.S. Pipe.

Where restrained joints are called for on 10-inches in diameter and larger pipe, use a "Flex-Ring" as manufactured by American Cast Iron Pipe Company, "Thrust-Lok" as manufactured by Pacific Cast Iron Pipe Company or "TR Flex" restrained joint pipe as manufactured by U.S. Pipe. The restrained joint shall be a boltless restrained push-on joint design and shall contain a positive axial locking restrained system and be capable of deflection after assembly. Field cut pipe (used only for connections to pipe joints) shall be restrained by using "Field-Flex" Rings as manufactured by American Cast Iron Pipe Company, "Field-Lok" Adaptor Rings as manufactured by Pacific Cast Iron Pipe Company or "TR Flex" Gripper Rings as manufactured by U.S. Pipe as long as field weldments are not required under any circumstances. Restraint of field cut pipe shall be kept to a minimum.

Ductile-iron pipe shall be as manufactured by American Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, or U.S. Pipe.

Ductile-Iron Fittings

Ductile-iron fittings shall be manufactured in accordance with ANSI/AWWA C-110/A-21.10. Ductile iron compact body fittings may be used for fitting sizes 4-inches through 12-inches in diameter and shall be manufactured in accordance with ANSI/AWWA C153/A21.53.

Restrained joints shall be as called for on the Plans. Joint restraint type shall be as specified in this Section for ductile iron pipe, and shall be either:

1. Flanged fittings
2. Manufactured locking restraint pipe fittings
3. Mechanical joints with mechanical joint restraints
4. Grooved pipe and fittings. Wall thickness beneath the groove shall be equal to or greater than the minimum specified wall thickness and shall be sufficient to meet the maximum pressure.

For pipe sizes 8-inches in diameter and smaller, push-on joint fittings shall be restrained with locking gasket rated for 250 psi operating pressure. Joint restraint shall be push-on joint fittings with "Fast-Grip" as manufactured by American Cast Iron Pipe Company, "Sure-Stop" as manufactured by Pacific States Cast Iron Pipe Company or "Field-Lok" gaskets as manufactured by U.S. Pipe.

For pipe sizes 10-inches in diameter and larger, restrained joint fittings shall either be "Flex-Ring" as manufactured by American Cast Iron Pipe Company, "Thrust-Lok" as manufactured by Pacific States Cast Iron Pipe Company, "TR-Flex" restrained joint fitting as manufactured by U.S. Pipe or mechanical joint ductile iron fittings fitted with joint restraints. Mechanical joint restraint shall be incorporated with the design of the follower gland and shall include a restraining mechanism which, when activated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. The joint shall maintain flexibility after burial. Follower glands shall be manufactured of ductile iron conforming to ASTM A536-80. The mechanical joint restraint shall be EBBA IRON, Inc., MEGALUG, UNIFLANGE Series 1400, or The Ford Meter Box Co., Inc. Any restrained joint fitting which will require a pipe field weldment will not be permitted.

Each fitting shall be tested before lining to one and one-half times the operating pressure for a duration of 10 seconds. Suitable controls and recording devices shall be provided so that the test pressure and duration may be adequately ascertained. Any fitting that does not withstand the test pressure shall be rejected. The Contractor shall be required to notify the Engineer in advance of the date, time, and place of inspection and testing of the fittings in order that the Engineer may be represented at the tests.

Unless otherwise shown on the Plans, all fittings with flanged ends shall comply with ANSI/AWWA C110/A21.10, with a pressure rating of 250 psi and a Class 125 ASME/ANSI B-16.1 flange or an ANSI/AWWA C-115/A-21.15 Class 125 flange. The gasket surface shall have a serrated finish of approximately 16 serrations per inch, approximately 1/32-inch deep, with serrations in either a concentric or spiral pattern. In addition, all flanges shall meet the following tolerances:

Bolt circle drilling.....	+1/16 inch
Bolt hole spacing.....	+1/32 inch
Eccentricity of bolt-circle & facing with respect to bore center.....	.+1/32 inch

Fittings shall be manufactured by American Pipe, Pacific States Cast Iron Pipe Company, or U.S. Pipe.

Gaskets

Gaskets for flanged joints shall be 1/8 inch thick, cloth-inserted rubber. Gaskets shall be suitable for a water pressure of 350 psi at a temperature of 180°F.

Full face type gaskets with pre-punched holes shall be used where both flanges are flat face. Ring gaskets extending to the inner edge of the bolts may be used where a raised face flange is present.

Gaskets for push-on, mechanical, and restrained joints shall be synthetic or natural rubber in accord with AWWA C-111.

Gaskets shall be manufactured by John Crane Company, Style 777, Johns Manville No. 109, Specification Rubber Products, Inc.

Bolts, Nuts, and Washers

Bolts and nuts for all flanges (including mechanical joints) and flanges located in vaults and structures shall be Type 316 stainless steel conforming to ASTM A-193, Grade B8M for bolts, and ASTM A-194, Grade 8M for nuts.

A Type 316 stainless steel washer shall be provided for each nut.

The length of each bolt or stud shall be such that between 1/4 inch and 3/8 inch will project through the nut when drawn tight.

Grooved-End Fittings and Couplings

Grooved-end fittings shall conform to AWWA C-606, rigid radius-cut groove. Grooved-end couplings shall be ductile iron, ASTM A-536, Grade 65-45-12. Bolts shall be Type 316 stainless steel and conform to ASTM A-183, minimum tensile strength of 110,000 psi. Gaskets shall be EPDM and shall conform to ASTM D-2000. Coupling shall be Victaulic Style 31, Anvil Gruvlok or Grinnell. All of the threaded parts shall be Type 316 stainless steel and shall be lubricated with anti-seize compound. Where the restrained joint is of the grooved type, the wall thickness beneath the groove shall be equal to or greater than the minimum specified wall thickness.

Lining For Pipe and Fittings

The interior of all pipe and fittings shall be lined with cement-mortar per ANSI/AWWA C-104/A-21.4. Lining shall be the double thickness listed in AWWA C-104, Section 4.8. Lining materials shall conform to ASTM C-150, Type II.

Coating For Pipe and Fittings

Buried pipe and fittings shall be coated with an asphaltic material in conformance with ANSI/AWWA C-110/A-21.10, and ANSI/AWWA C-151/A-21.51. The coating shall be free from blisters and holes; shall adhere to the metal surface at ambient temperatures encountered in the field.

Buried mechanical joint bolts, nuts and glands, and restrained joint bolts for field-cut closure pipe shall be coated accordance with 12-9 Painting and Coating. Stainless steel parts shall not be coated except for the threaded portion, which shall be assembled with a liberal coat of anti-seize compound.

Pipe and fittings within the wet well and valve vault shall be painted in accordance with 12-9 Painting and Coating.

Polyethylene Encasement

Unless specified otherwise, pipe and fittings shall be polyethylene encased in accord with ANSI/AWWA C-105/A-21.5. Contractor shall encase the pipe and fittings in two layers of polyethylene.

CONSTRUCTION

General

Ductile-iron pipe and ductile iron fittings shall be installed in accord with the applicable sections of AWWA C-600 and as specified herein.

Installation

For restrained joints, deflection of the joint shall not exceed the manufacturer's recommended maximum deflection.

The pipe shall be laid true to the line and grade shown on the Plans within acceptable tolerances. The tolerance on grade is 1-inch. The tolerance on line is 2-inches.

All exposed flanges and other metal surfaces and all damaged coatings shall be coated after assembly in accordance with 12-9 Painting and Coating. Stainless steel bolts shall not be coated.

All Exposed Piping Installation/Support

All exposed pipe shall be adequately supported with devices of appropriate design. Where details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all piping shall be complete and adequate as herein specified, whether or not supporting devices are specifically called for.

Grooved-end pipe and fittings shall be installed in accordance with the coupling manufacturer's recommendations and the following:

1. Loose scale, rust, oil, grease, and dirt shall be cleaned from the pipe or fitting groove. Lubricate the coupling gasket in accord with the manufacturer's recommendations.
2. Coupling shall be tightened alternately and evenly until coupling halves are seated properly.

Installation of Bends, Tees, and Reducers

Fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fittings interior for handling. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

Flanged Connections

Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C-115 and shall be individually fitted and machine tightened in the shop.

Joints

Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, threads shall be lubricated with oil and graphite, and nuts shall be tightened uniformly and progressively. If flanges leak under pressure

testing, nuts and bolts shall be loosened or removed, the gasket shall be resealed or replaced, the bolts and nuts shall be reinstalled or re-tightened, and the joint retested. Joints shall be watertight.

Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

Wrapping Pipe with Polyethylene Encasement

All ductile-iron pipe and fittings buried underground shall be protected with a double layer of polyethylene encasement wrap in accordance with AWWA C105. Wrap shall be a loose 8-mil-thick polyethylene tube. All joints between plastic tubes shall be wrapped with 2-inch-wide, 10-mil thick, polyethylene adhesive tape, Polyken 900, Scotchwrap 50, or Grainger. Installation of plastic film shall conform to the following procedure, and wrapping shall be applied to the pipe in the field in the following manner:

1. Using a sling, the pipe shall be picked up with a crane at the side of the trench and raised about 3 feet off the ground. The polyethylene tube, cut approximately 2 feet longer than the length of pipe, shall be slipped over the spigot end of the pipe and bunched up, accordion fashion, between end of the pipe and the sling.
2. The pipe shall be lowered into the trench. The spigot shall be seated into the bell of the adjacent installed pipe, and the pipe lowered into the trench bottom. A shallow bell hole shall be provided in the trench bottom to facilitate the wrapping of the joint.
3. The pipe joint shall then be made up as described herein.
4. The sling shall be removed from the center of the pipe and hooked into the bell cavity. The bell shall be raised approximately 12 inches and the tube of polyethylene film slipped along the full length of the pipe barrel. Enough of the film shall be left bunched up, accordion fashion, at each end of the pipe to overlap the adjoining pipe about 1 foot. Care shall be taken to ensure that soil that adheres to the pipe is removed as the polyethylene film is placed around the pipe.
5. To make the overlapped joint wrap, the film shall be pulled over the bell of the pipe, folded around the adjacent spigot, and wrapped with about three circumferential turns of the plastic adhesive tape in order to seal the tube of film to the pipe. The tube on the adjacent pipe shall be then pulled over the first wrap on the pipe bell and sealed in place behind the bell, using about three circumferential turns of the polyethylene adhesive tape.
6. The resulting loose wrap on the barrel of the pipe shall be pulled snugly around the barrel of pipe, the excess material folded over the top and the fold held in place by means of short strips of the 2-inch wide, 10-mil thick adhesive tape at intervals 3 feet apart along the pipe barrel.

VALVES

SUBMITTALS

Valves: Submit manufacturer's catalog data and detail construction sheets showing all valve parts and describing material of construction by material and specification (such as AISI, ASTM, SAE, or CDA). Show valve dimensions including laying lengths. Show dimensions and orientation of valve operators, as installed on the valves. Show valve linings and coatings. Only signed factory submittals shall be accepted. Manufacturer's warranty shall be included.

PRODUCTS

General

Valves shall be provided complete with operating hand-wheels required for operation. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached corrosion-resistant plate.

Valve Operators – Valve Actuators

Standard Opening Direction: Valve operators and hand wheels shall open by turning counterclockwise. (Commonly stated as, "open-left – close-right".)

Handwheels: Valves for below-ground applications within a vault shall be provided with a handwheel. The handwheel shall have an arrow thereon, indicating the direction of the opening. The handwheel shall be suitably fastened to the actuator input shaft. Operating Torque Requirement: Actuators equipped with handwheels shall be designed to produce the specified torque with a maximum pull of 80 pounds of the handwheel rim. Submittals shall include factory torque sheets minimally supplying operator output and valve input torque requirements. Torque safety factors shall comply with the latest versions of AWWA Standards.

Position Indicators: Submerged and buried valves shall have a water tight seal plate in place of the valve position indicator.

Operators – Actuators for Valves 6-inches and Larger: Butterfly valves less than 24-inches in diameter (4" thru 20"): Butterfly valves less than 24-inches in diameter shall have gear operators of the "traveling nut type." Traveling-nut operators shall be furnished on all valves in this size range unless torque or pressure conditions dictate otherwise.

General Requirements for Gear Operators – Actuators: Gear operators shall be enclosed, suitable for running operating in oil grease with seals provided on shafts to prevent entry of dirt and water into the operator. Valves located in vaults shall have hand wheels. Minimum hand wheel diameter shall be 12-inches. External trim and all threaded parts of the actuator shall be type 316 stainless steel material. Gear operators shall be of the totally enclosed design, proportional to permit operation of the valve under full operating head in either direction, with a maximum pull of 80 pounds on the hand wheel or with a maximum input of 150 ft-lbs applied to the AWWA wrench nut. Design and torque capacity shall consider flow and shut-off in "BOTH" directions at the valve full rated pressure and velocity. Submittals shall include factory torque sheets minimally supplying operator output and valve input torque requirements. Method for calculating input torque shall be the same as per AWWA class 150B designation. Operators shall be provided with "open" and "closed" position stop limiting devices. Operators shall be of the self-locking type to prevent the valve disc or plug from creeping.

Specific Requirements for Traveling Nut Gear Operators – Actuators: Traveling nut actuators shall withstand 450 foot pounds of input torque against the stop limiting devices without causing damage. Signed factory compliance shall accompany submittal. All exposed threaded parts, including cap screws, case bolts, carriage bolts, cover screws, machine screws, set screws, bonnet bolts on the worm gear housing or any other exterior location on the actuator, its cover or housing shall be type 316 stainless steel. Traveling nut type gear operators shall be able to rotate the valve element (disc, plug, or ball) from the fully "closed" position to fully "open" position with a number of turns of the operator nut or wheel, not fewer than thirty (30) turns and not more than three (3) times the number of diameter inches.

Bolts, Nuts, and Gaskets For Flanged Valves

Bolts and nuts for flanged valves shall be heavy hex head type 316 stainless steel (B8M) and shall be as described in the section for flanged connections.

Valve operators, handwheels, or levers shall open by turning counterclockwise.

Painting and Coating for Valves and Extensions

Exterior Coating for All Metallic Valves: All Valves shall be lined and coated with thermally set fusion-bonded epoxy material in accord with AWWA C-550. Minimum dry film thickness shall be 12 mils and valves shall be holiday free. The specified prime coat shall be applied at the place of manufacture. Intermediate and finish coats shall be applied in field. Finish coat shall match the color of the adjacent piping. Hand wheels shall receive the same coating as the valves. Exposed portions of the valve shaft shall not be coated.

Interior Coating: Metal valves 4-inches and larger shall be coated on the interior metal parts, excluding seating areas and bronze and stainless steel pieces in accordance with Section 12-9, "Painting and

Coating." Coating shall be factory applied by the valve manufacturer. Valve coatings will be field spark tested and shall be holiday-free.

Resilient Seated Gate Valves, 3-Inches through 12-Inches

Resilient seated wedge-type, gate valves shall conform to AWWA C-509 and the following requirements:

Valve shall have a wedge-type resilient seat fully encapsulated in peroxide-cured EPDM.

Valves shall be designed for a minimum working pressure of 150 psi, and shall not leak at that pressure.

Valves shall have non-rising stems fabricated of stainless steel of Type 304 or Type 316 alloy. As an alternate stem material may be high strength bronze alloy. Stem nuts shall be independent of the gate and shall be made of bronze.

Materials of construction shall be as follows:

Component	Material	Specification
Body Operating Nut,	Cast Iron	ASTM A-126, Class B
Bonnet, Seal Plate	Ductile Iron	ASTM A-536, Grade 65-45-12
Gate	Cast Iron	ASTM A-126, Class B
	Ductile Iron	ASTM A-536, Grade 65-45-12
Stem	Stainless Steel	AISI 430F, ASTM A-582
	or	Type 304 or Type 316
	high-strength,	
	low zinc Bronze	ASTM B-584 CDA 867
Stem Nut	Bronze	ASTM A-584 CDA 844
Bonnet & Seal Plate	Stainless Steel	ASTM A-276, Type 316
or Gland Nuts & Bolts		
Valve Seat	EPDM Rubber	ASTM D-412
O-Rings	Synthetic Rubber	ASTM D-2000

Low friction, torque reduction thrust bearings shall be provided both above and below the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar.

Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Gates shall be of the wedge-type and shall be encapsulated in peroxide-cured EPDM rubber.

Valves shall be M&H, Mueller, or Clow RW.

Butterfly Valves 4-Inches and Larger

Butterfly valves shall be short body, flanged type, conforming to AWWA C-504, Class 150B with a hand wheel. Wafer style valves shall not be used.

Unless otherwise noted, minimum working differential pressure across the valve disc shall be 150 psi.

Valve ends shall be as shown on the Plans and in all cases shall match the class rating of the valve (ie., class 150 valves shall have 150 lb. flanges). Flanged ends shall be Class 125, ANSI B-16.1 unless otherwise specified. Note that all butterfly valves 12-inches in diameter and larger are required to have flanged ends to meet the requirements for valve leakage testing. Refer to the Construction Section for testing requirements.

Valve shafts shall be Type 304 or 316 stainless steel for class 150 valves. Valve shafts may be stub shaft or one-piece units extending completely through the valve disc.

Valve bodies shall be tested at a pressure equal to twice the design working pressure. Refer to the Execution Section of this specification for valve leakage testing requirements.

Materials of construction shall be as follows:

Component	Material	Specification
Body	Ductile Iron	ASTM A-126, Class B; or ASTM A-536, Grade 65-45-12
Valve Shaft (Cl. 150)	Stainless Steel	Type 304 or Type 316
Exposed body cap screws, bolts & nuts (including squeeze-pins)	Stainless Steel	ASTM A-276, Type 316
Discs	Cast iron, Ductile Iron	ASTM A-48, Class 40; ASTM A-536, Grade 65-45
Valve Seat	EPDM Rubber	ASTM D-412
O-Rings	Synthetic Rubber	ASTM D-2000

The rubber seat shall be made from peroxide-cured EPDM rubber and shall be fastened integrally with the valve body. Rubber seats fastened to the disc by any means shall not be allowed.

Factory signed and dated certification of compliance shall accompany all submittals. Signatures of agents or distributors of the factory will not be accepted.

Valves shall be Pratt Groundhog, Dezurik, or Kennedy.

Check Valves 4-Inches and Larger

Swing Check Valves: Swing check valves shall conform to AWWA C-508, and shall be iron body, bronze mounted with the following materials of construction:

Component	Material	Specification
Disc or clapper, seat ring, valve body seat ring	Bronze or brass	ASTM B-62, B-16, or B-584 (alloys C-84400 or C-87600)
Body and Cap	Cast iron or Ductile iron	ASTM A-126, Class B
Disc and Hinge	Cast iron or or Arm bronze	ASTM A-126, Class B ASTM B-62
Hinge Pin	Stainless steel	ASTM A-276, Type 303, 304 or 410
Cover Bolts & Nuts	Stainless steel	ASTM A-193, Grade B8M; ASTM A-194, Grade 8M

Ends shall be flanged, Class 125, ANSI B-16.1. Valves shall be designed for a minimum working pressure of 150 psi.

Valve shall be equipped with outside lever and spring.

Valves shall be Clow, M&H, or Pratt Groundhog.

EXECUTION

Valve Installation:

Valves in Horizontal Piping: Unless otherwise indicated on the Plans, valves in horizontal runs of pipe shall be installed with their operating stems horizontal.

Valve Supports: Valves shall be anchored in concrete as shown on the Plans.

Valve Leakage Testing:

Field Hydrostatic Testing: Valves shall be tested for leakage at the same time that the connecting pipelines are hydrostatically tested.

Valve Leakage Witness – Pressure Testing: All butterfly valves 12-inches in diameter and larger, shall be flanged to facilitate testing. Valves 12-inches in diameter through 30-inches in diameter may be tested in a horizontal position. All valves shall be tested bi-directionally after the actuator / operator is installed and the adjustment stops are set. Each side of the valve is to be tested for a duration of at least 5 minutes at the pressure class rating of the valve with zero loss or leakage. The pressure test shall be witnessed by the Engineer. A minimum of 72 hours advance notice to the Engineer for test scheduling is required. If factory hydrostatic testing is conducted in advance of the final leakage testing, the Engineer shall be given an opportunity to send a representative to witness the factory test. Factory testing requiring travel requires 14-day advance notice; although 21-day advance notice is preferred.

SECTION 12-16. ELECTRICAL

12-16.01 PUMPING PLANT ELECTRICAL WORK

PART 1 - GENERAL

SUMMARY

This work shall consist of performing electrical work including furnishing all labor, materials, equipment and services required to construct, connect and install the complete electrical system in accordance with the details shown on the plans and these special provisions.

Related Work: Earthwork, foundations, sheet metal, painting, mechanical and such other work incidental to and necessary for the proper installation and operation of the electrical system shall be done in conformance with the provisions elsewhere in these special provisions.

SYSTEM DESCRIPTION

System layouts are generally diagrammatic and location of equipment is approximate. Exact routing of conduits and other facilities and location of equipment is to be governed by structural conditions and other obstructions, and shall be coordinated with the work of other trades. Equipment requiring maintenance and inspection shall be located where it is readily accessible for the performance of such maintenance and inspection.

QUALITY ASSURANCE

Regulatory Requirements: All electrical work performed and materials installed shall be in conformance with the provisions in Section 74-1.02, "Regulations and Code," of the Standard Specifications, and the requirements in the CA Code of Regs, Title 24, Part 6, "California Energy Code."

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

TESTING

After the installation work for the various systems has been completed, each electrical system shall be tested in the presence of the Engineer to demonstrate that the electrical systems function properly. The Contractor shall make necessary repairs, replacements, adjustments and retests at his expense.

Final inspection for the completed electrical system will take place after all the various systems have been tested.

12-16.02 PUMPING PLANT ELECTRICAL EQUIPMENT

PART 1 - GENERAL

SUMMARY

This section includes specifications for pumping plant electrical equipment.

Pumping plant electrical equipment must conform to the Standard Specifications and these Special Provisions.

Drainage pump automatic operation must be controlled by the water level monitoring system and the pump controller.

DPDT: Double pole, double throw.

NRTL: Nationally Recognized Testing Laboratory as defined by OSHA in 29 CFR 1910.

SPDT: Single pole, double throw.

DATA TO BE FURNISHED

Submit product data for:

1. Power and Metering Equipment
2. Pump Control
3. Conduit
4. Conductors and Cables
5. Nameplates and Warning Plates
6. Electrical Testing
7. Grounding
8. Wiring Devices
9. Transfer Switches
10. Panels
11. Panelboards
12. Dry-Type Transformers

QUALITY CONTROL AND ASSURANCE

Regulatory Requirements: Electrical equipment must comply with Section 86-1.02, "Regulations and Code," of the Standard Specifications and be NRTL listed. Materials and workmanship must comply with Section 86-1.02, "Regulations and Code," of the Standard Specifications and the following:

1. 8 CA Code of Regs § 3200 et seq.
2. 19 CA Code of Regs § 1.00 et seq.
3. NFPA 820, "Standard for Fire Protection in Wastewater Treatment and Collection Facilities"

Manufacturer's Field Services: At Contract acceptance, provide 12 months of full maintenance for the pump controller by qualified employees of the pump controller manufacturer's designated service organization. Maintenance must include the manufacturer's routine preventive maintenance, adjustments for proper operation, and all required parts and supplies.

Field Quality Control: A factory-authorized service representative must inspect, test, and adjust the pump controller for proper installation, operation, components, and connections.

ELECTRICAL WORK

This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections, but are subject to the general requirements of this section. The electrical Plans and schedules included in this project manual are functional in nature and do not specify exact locations of equipment or equipment terminations.

The Contractor shall examine all mechanical and civil Plans and Specifications to determine actual locations, sizes, materials, and ratings of all equipment provided by others.

Items of work shown on Plans and not specified, or mentioned in the specifications and not shown on the Plans, shall be considered required as if they had been both specified and shown on the Plans. In the event of conflicting specified or drafted requirements the more stringent requirement shall govern. Any work or material omitted from the description of the work but which is clearly implied shall be furnished by the Contractor as though specifically stated. The Plans and Specifications contemplate a finished piece of Work of such character and quality as described in and reasonably inferred from them, and fitting with the Work of other Contractors, the Engineer and the City of Burbank. The Contractor agrees that the failure to show details or repeat on any Plans the figures or notes given on another shall not be cause for additional charges or claims.

When record drawings are provided with the contract drawing set, they constitute the best available information pertaining to the relevant systems at the time of design. Their accuracy is specifically not guaranteed and they are provided only for the Contractor's convenience. It is the Contractor's responsibility to field verify these record drawings prior to use. Actual field conditions are specifically and entirely the responsibility of the Contractor. Deviation of the record drawings provided from actual field conditions shall not constitute a basis for any increase in time allowed for completion or compensation for the Contractor.

The Contractor shall notify the Engineer in writing of perceived discrepancies, errors, or omissions in the Contract Documents prior to bid. The Engineer shall provide clarification to resolve these issues prior to bid. The Contractor shall resolve his questions regarding the perceived inconsistency, errors, or omissions in the Contract Documents prior to bid. Failure of the contractor to resolve his questions prior to bid shall result in the residual issues of the aforementioned kind providing no basis of claim for an increase in compensation for the Work or the time allowed for the completion of the contract and the Engineer's interpretation shall govern.

DATA TO BE FURNISHED

Electrical submittals shall be submitted, bound in a three-ring binder, labeled with the project name and Contractor's name, and Project Manager's name. An index sheet shall be provided showing each product being submitted. Submittals shall be provided with section tabs per the electrical specifications by section and paragraph or equipment. Each equipment submittal sheet shall be labeled with the individual equipment name and number.

Submittals shall include:

1. Manufacturer's name, address, and telephone number
2. Trade name, catalog model or number, nameplate data and size
3. Layout dimensions, capacity, project specification and paragraph reference
4. Local manufacturers representative (if applicable) name, address and telephone number

Submittals shall be largely complete prior to the first submittal. Long lead items may be submitted separately. Each item shall be clearly marked and provided with adequate sales and technical information

to clearly show conformance with all aspects of the specification. Packages not provided as described above or largely incomplete shall be returned to the Contractor, without review or comment.

The Contractor shall ensure that the material being proposed conforms to the Contract requirements. In the event of any variance, the Contractor shall state specifically which portions vary and shall request a variance in writing.

The Contractor shall certify that all furnished equipment can be installed in the spaces allocated by stating on each item:

"This equipment can be installed in the spaces allocated."

The Contractor shall provide shop drawings on 11" x 17" sheets (maximum), and shall be scaled using standard engineering or architectural scales. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.

Failure to submit a specified item does not relieve the Contractor from meeting the requirements of the Specification.

The Engineer will review the original submittal and one re-submittal on each item. Subsequent submittal reviews shall be conducted at the Contractor's expense. The Contractor shall be billed at the Engineer's current hourly rates for these subsequent submittal reviews.

Definitions:

Provide: Furnish and install.

Contractor: The party who furnishes and installs all tools, materials, and equipment to complete the work shown and implied in the Plans and these Specifications. This includes the Prime Contractor, the Electrical Contractor, Control System Integrator, and all other Contractors and Subcontractors.

Control System Integrator / System Integrator/ Integrator: The party that furnishes all control components and designs, the detailed control wiring diagrams, and layout and assembly of the custom control panels. See Instrumentation and Control Systems Section.

Control System: All equipment, instruments, and wiring for control and monitoring of all operating equipment. This shall also include custom control panels, packaged control panels, and control equipment furnished with other systems and mechanical equipment. All sensing, transmitting, indicating, control and recording of all functions as specified and shown shall also be included in the control system.

Elementary or Schematic or Control Diagram: Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram shows all circuit functions without regard to the actual physical size, shape, or location of the component devices or parts.

Single-Line Diagram/ One-Line Diagram: Shows, by means of lines and graphical symbols, the course of the electrical distribution system and the components, devices, or parts used therein.

Wiring Diagram or Connection Schematic: Includes all of the devices in a system and shows their physical relationship to each other, including terminals and interconnecting wiring in assembly. This diagram shall be (a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or (b) a panel layout diagram showing the physical location of devices plus the elementary diagram.

Interconnection Diagram: Shows all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams that interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry / exit of the individual wires clearly shown. Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual

terminal identification. All jumpers, shielding and grounding termination details not shown on the equipment connection diagrams shall be shown on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Spare wires and cables shall be shown.

Arrangement, Layout, or Outline Drawings: Shows the physical space and mounting requirements of a piece of equipment. Diagrams may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

Quality Assurance:

Regulatory Requirements: All electrical work performed and materials installed shall be in conformance with the provisions in Section 74-1.02, "Regulations and Code," of the Standard Specifications, and the requirements in the CA Code of Regs, Title 24, Part 6, "California Energy Code."

General Description of Work:

The Contractor shall provide all labor, material, tools, equipment and services required to complete the furnishing, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical equipment, devices and components as indicated and implied by the plans and these Specifications. General descriptions include:

1. Complete the procurement, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical devices, components, accessories and equipment that is not shown or specified but which is nonetheless required to make the systems shown and specified function properly.
2. Complete the wiring to, connection to, adjustment and calibration of, and testing of furnished electrical components.
3. Install all equipment so it shall be readily accessible for maintenance. Installations shall have electrical clearances in accordance with NEC and shall be installed in locations that will provide adequate cooling.
4. Check electrical equipment prior to installation so that defective equipment is not installed. Acceptance testing for electrical equipment shall be performed in the Electrical Field Testing Specification.
5. Provide field services of qualified technicians to supervise and check out the installation of the equipment, to supervise and check out interconnecting wiring, to conduct start-up of operation of the equipment, and to correct any problems that occur during start-up.
6. Provide circuit breakers, conduit, wire and installation for all items that require electrical power.
7. The Contractor shall provide all permits, licenses, approvals and other arrangements for work on this project and all fees shall be paid for by the Contractor. The Contractor shall include these fees in the bid price.

Seismic Requirements:

The equipment and major components including, but not limited to, motor control centers, switchboards, and control panels, shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the 2007 California Building Code (CBC). Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment's. Equipment certification acceptance criteria shall be based upon the ability of the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs. Seismic anchorage calculations shall be submitted for each major component. These calculations shall be signed and stamped by structural engineer licensed in the State of California.

Utility Company Requirements and Fees:

1. The Contractor shall follow up on electric application initiated by the Consultant in the name of the City of Burbank. A copy of the application will be made available to the successful bidder. The Contractor shall pay and the City of Burbank will reimburse Contractor for utility company fees, cable charges, and added facility charges.

2. The Contractor shall make any service and installation agreements that the utility companies may require.
3. Install electric service entrance equipment in accordance with the serving utility's requirements. Coordinate with the serving utility to ensure timely connection by the utility. Obtain utility company approval of service entrance and metering equipment shop drawings prior to starting fabrication.
4. The Contractor shall apply and obtain cellular service from a telephone company. The Contractor shall pay for all initiation fees, and the City of Burbank will reimburse the Contractor.

Temporary Operation and Construction Power:

The Contractor shall provide a separately metered temporary power service for construction power. The temporary service shall provide:

1. Power for operation of all equipment during testing
2. Power for operation of all equipment including lighting and HVAC equipment until certificate of occupancy is obtained

All coordination with the utility and associated construction costs for temporary construction power shall be paid for by the Contractor. The Contractor shall pay for the energy costs as billed by the utility on the construction power meter.

Thermal (Temperature) Ratings of Equipment Terminations:

All materials shall conform to the National Electrical Code Article 110-14C. Wiring and circuit breakers on this project are designed for 75°C operation above 100 amperes; 60°C for 100 amperes and below. All products furnished on this project shall have electrical terminations rated for 60°C for ampacities of 100 amperes and below, and rated for 75°C for ampacities above 100 amperes.

These requirements cover all electrical equipment provided under this Contract.

Standards and Codes:

This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

1. National Electrical Code (NEC)
2. Underwriters' Laboratories, Inc. (UL)
3. National Electrical Manufacturers Association (NEMA)
4. Canadian Standards Association (CSA)
5. Electrical Testing Laboratories (ETL)
6. Factory Mutual (FM)

Identification of Listed Products:

All materials and equipment specified herein shall be within the scope of Nationally Recognized Testing Laboratory (NRTL) examination services, be approved by the NRTL for the purpose for which they are used, and shall bear the appropriate listing label.

Equipment listed/labeled by an NRTL shall be as dictated by the latest printing of the Electrical Testing Laboratories Accreditation Report available from the State of Washington Department of Labor and Industries, Electrical Inspection Division. Any NRTL listing/labeling shall be as accepted by the local authority having jurisdiction.

When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority to undergo a special inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

Site Familiarization:

The Contractor shall become familiar with all features of the site which may affect the execution of the work prior to submitting a bid. The Contractor shall take all field measurements necessary for the work and shall assume full responsibility for their accuracy. The Contractor shall take full responsibility for locating and avoiding all substructures and utilities. Any damage to existing equipment or utilities shall be repaired or replaced by the Contractor at the Contractors expense.

Area Classification:

The following classification of areas shall be used as a reference in determining application of material covered by this Section unless specifically shown otherwise on the Plans. Areas that fall under two or more of the following classifications shall conform to the minimum requirements of all of the area classifications listed for that area.

1. Outdoor and Damp Areas: Vaults, all outdoor areas. Raceways shall be galvanized rigid steel (GRS), or aluminum. Conduit entrances shall be threaded and fittings shall have gasketed covers. Threaded fastening hardware and rods shall be stainless steel. Raceway supports such as channel, clamps, and brackets shall be stainless steel or aluminum. Panels, boxes, and enclosures shall be NEMA 4X - aluminum, stainless steel or FRP (or as shown on the Plans). Enclosures shall be mounted 1 inch from walls to provide an air space unless specifically shown otherwise. Device boxes shall be cast, copper free aluminum.
2. Below Grade Areas: Conduits shall be Schedule 80 PVC, or concrete encased Schedule 40 PVC, as indicated on the Plans.
3. General Purpose Areas: All other areas not described above. Raceways shall be GRS. Raceways concealed in walls or ceilings for general purpose lighting and receptacle circuits may be EMT. Exposed boxes shall be NEMA 12. Concealed boxes may be NEMA 1. Boxes poured in concrete shall be cast copper free aluminum.
4. Hazardous (Classified) Locations: All installations in hazardous locations shall comply with NEC articles 500 through 517. All items and materials installed in classified locations and the methods used to install them shall be listed and approved for the area classification. Conduit installed in Class 1 Divisions 1 and 2 areas shall be PVC coated GRS. Conduit seals shall be installed in all conduit runs leaving classified areas.

Project Record Drawings:

The Contractor shall maintain one set of record drawings at the job showing any deviations in the electrical systems from the original design.

Markings shown on the Plans shall conform with the following color coding (marked with pencil):

1. Red - Additions, changes in routing, etc., showing placement different than shown on the original Plans.
2. Green - Deletions, modifications in routings etc., deleting lines depicting placements different than shown on the original drawing.
3. Black - Dimensional data showing exact placement of concealed or buried equipment, raceways, etc.

Correction of Work:

All work, all materials, whether incorporated in the work or not, all processes of manufacture, and all methods of construction shall be at all times and places subject to the inspection of the Engineer, who shall be the final judge of the quality and suitability of the work, materials, processes of manufacture, and methods of construction for the purposes for which they are used. Should they fail to meet his approval they shall be forthwith reconstructed, made good, replaced, and/or corrected, as the case may be, by the Contractor at his own expense. Rejected material shall immediately be removed from the site. If, in the opinion of the Engineer, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the work injured or not performed in accordance with the Contract Documents, the compensation to be paid to the Contractor hereunder shall be reduced by such amount as in the judgment of the Engineer shall be equitable.

Guarantee:

The Contractor shall guarantee all work and all components thereof, excluding lamps, for a period of 1 year from date of acceptance of the installation. The Contractor shall remedy any defects in workmanship and repair or replace any.

PART 2 - PRODUCTS**General:**

Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

Equipment Finish:

Unless otherwise specified, electrical equipment and materials shall be painted by the manufacturer.

Galvanizing:

Where specified, galvanizing shall be in hot dipped.

Operation and Maintenance Manuals:

The Contractor shall prepare and assemble detailed operation and maintenance (O&M) manuals in accordance with the project general requirements and other requirements in other specification sections. The manuals shall be bound in a 3 ring binder and tabbed with an index. The O&M manual format shall follow the submittal data specified. The manuals shall include, but not be limited to, the following:

1. Catalog data and complete parts list for all equipment and devices
2. All cut sheets of equipment and components
3. Preventative maintenance procedures
4. Trouble-shooting
5. Calibration
6. Testing
7. Replacement of components
8. Automatic mode operation
9. Manual mode operation
10. System schematics / shop drawings and record drawing.
11. As-built wiring diagrams of cabinet and enclosure contained assemblies
12. As-built wiring diagrams of overall system
13. Listing of recommended spare parts
14. Listing of recommended maintenance tools and equipment

PART 3 - EXECUTION**Storage and Installation Environment:**

The Contractor shall store all electrical equipment in a dry environment free from dust, moisture, sprays or vapors which may be detrimental to their new condition. After installation of equipment, the Contractor shall take care to protect all equipment from all dust, moisture, paint and other spray, harmful vapors.

Equipment shall not be installed in indoor areas until the area is covered, dry and finished to the point that other work will not create dust, vapors, or moisture. Equipment with integral heaters and fans shall not be installed until power is available at the location, and the heater and fan shall be energized within 6 hours of the equipment being installed.

Housekeeping:

The premises shall be kept free of accumulated materials, rubbish and debris at all times. Surplus material, tools and equipment must not be stored at the job site. Upon completion of the project, all equipment and fixtures shall be cleaned and in proper condition for their intended use.

Lamps and fluorescent tubes shall be cleaned and defective units replaced at the time of final acceptance.

Tests:

The Contractor shall conduct testing in accordance with Electrical Field Testing Specification and relevant individual specification sections.

The Contractor shall verify motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation.

Final Acceptance:

Prior to final acceptance, the Engineer will perform one or more site observation trips to develop a "punch list" of items deemed incomplete. The Electrical Contractor and Control System Integrator shall be present while these inspections are taking place and shall be available for opening cabinets and operating and adjusting the system as is necessary for the Engineer to verify all equipment is installed and operates to the requirements of the contract documents.

The Contractor shall complete all items of work, including wire markers, nameplates, final tests and final test reports prior to requesting final acceptance inspections. All equipment shall be checked for proper operation and all signals verified for correct calibration and wiring. Fixtures shall have been cleaned, and burned out or defective lamps shall have been replaced.

Training:

The Contractor shall provide training in accordance with the specific requirements in other sections of these Specifications. In addition to training required in other Sections of the Specifications, the Contractor shall conduct specifically organized training sessions in the overall operation and maintenance of the electrical system for personnel employed by the Engineer and the City of Burbank. The training sessions shall be conducted to educate and train the personnel in operation and maintenance of all components of the electrical system outside the training requirements in the other sections of these Specifications. Training shall include, but not be limited to, the following:

1. Preventative maintenance procedures
2. Trouble-shooting
3. Calibration
4. Testing
5. Replacement of components
6. Equipment operation

At least two training sessions, each at least four hours in duration, shall be conducted at the facility after start-up of the system. The Contractor shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Engineer and the City of Burbank at least one week prior to the time of the training.

12-16.03 CONTROL, POWER, AND METERING EQUIPMENT FOR LOW VOLTAGE SWITCHBOARD

PART 1 - GENERAL

DATA TO BE FURNISHED

Submit ratings and characteristics including voltage ratings, busing arrangement, continuous current ratings, fault current withstand ratings, enclosure type, ratings and arrangement of all overcurrent protective devices.

Submit outline and dimensional drawings, conduit entry restrictions, and weights.

Submit ground fault protection system field test results.

Operation and Maintenance Manuals:

Submit operation and maintenance manuals.

Utility Approval:

Shop drawings of service sections shall be approved by the serving utility prior to fabrication.

Manufacturers:

Switchboards shall be manufactured by Eaton, Square D or General Electric Cutler-Hammer.

PART 2 - PRODUCTS

MAIN SERVICE AND DISTRIBUTION SWITCHBOARDS

Main service and distribution switchboards shall be floor standing, dead front and rear enclosure with front removable devices and load connections, front accessible enabling switchboard to be mounted against a wall.

Provide switchboards installed outdoors with a NEMA 3R enclosure.

Construct sections with a minimum thickness of 12-USSG formed sheet steel and of overall dimensions that will fit within the space limitation indicated in the Plans.

Provide service switchboards with metering and current transformer space, pull sections, and fully removable front covers of the widths, depths, and heights required by the service utility and as necessitated by the physical requirements of the conduits and cables entering the sections.

Provide distribution switchboards with circuit breakers, fusible switches, space for controls behind hinged lockable doors (common keyed with panelboards), motor starters, transformers, and other equipment as indicated.

Switchboard shall consist of required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on panels. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

Provide switchboard with adequate lifting means.

Switchboard shall have short-circuit current rating equal to or greater than kAIC rating shown in the Plans.

Switchboards shall comply with EUSERC, NEMA PB-2, and UL 891 and UL 489 standards. Provide UL label on each switchboard section.

Busing:

Provide switchboards with rectangular copper busing. Cross busing shall be full capacity. Vertical busing shall be full height and rated for the load to be carried, but in no case less than one-third the capacity of the main bus. A copper ground bus with a cross section meeting code requirement but not less than 1/4 by 2 inches shall extend the entire length of the distribution sections of the switchboards.

Dimensions and arrangement of vertical buses in the service section shall comply with the serving utility company requirements.

Connections shall be tin plated. Provide conical spring-type washers at each bolted joint.

Provide heavy-duty pressure-type terminal lugs for connections of incoming and outgoing cables. Support cables and internal wiring with bolted cleats.

Main Disconnect:

Main disconnect device shall be as indicated in the Plans. Device shall be capable of being padlocked in the off position. Provide zero-sequence ground fault protection by solid-state relays, field adjustable, with continuous time adjustments. Provide reset and test functions by means of pushbuttons and pilot light or mechanical target to indicate that a ground fault has occurred. Main disconnect shunt trip and relay shall operate from a fused 120-volt a-c control source within the main disconnect compartment.

The disconnect shall be permanently marked to identify it as a service disconnecting means, in accordance with NEC Article 230, Part F and shall be 100 percent rated, capable of carrying continuous loads to 100 percent of its rating.

Molded-Case Circuit Breakers:

Branch and main protective devices shall be of the molded-case circuit-breaker type. Provide quick-make and quick-break toggle mechanism, inverse time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide trip ratings and number of poles as indicated in the Plans. Provide provisions for padlocking external disconnect handles in the OFF position.

Nameplates:

Provide a nameplate for each circuit breaker or fusible switch to indicate load served. The main nameplate shall give the switchboard designation in 1/2-inch-high letters. A second line in 1/4-inch-high letters shall indicate the voltage and phases.

Monitoring Devices:

Provide a microprocessor-based monitoring device that displays voltage, current, and frequency. Device shall be menu driven with high visibility display. Provide current and potential transformers as required. Protect potential transformers with fuses on the primary side. Device shall be Cutler Hammer IQ115, Allen-Bradley 1404 PowerMonitor 3000, or GE EPM2000.

Transient Voltage Surge Suppressor (TVSS):

Provide TVSS as shown on the single-line diagram. TVSS shall be listed in accordance with UL 1449. TVSS shall be solid-state type and shall operate bi-directionally. Surge capacity shall be a minimum of 130,000 amperes/phase with a voltage suppression rating of 1,200 volts L-G for a 480-volt system.

Monitoring and Protective Device:

Provide phase failure monitoring relay where shown in the Plans to protect against loss of any phase, undervoltage, phase unbalance, and phase reversal.

Factory Finish:

Provide a factory-applied, corrosion-resistant finish which shall withstand 3,000 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the scribed test mark.

Alternatively, provide Type 304 stainless steel enclosure.

Seismic Requirements:

The complete assembly including anchoring shall be capable of withstanding seismic forces per electrical work as specified herein.

PART 3 - EXECUTION**INSTALLATION**

Secure switchboards rigidly to walls and floors or mounting pads with anchor bolts or Phillips Drill Company concrete anchors. Anchor bolts or concrete anchors shall be Type 316 stainless steel.

Field Tests:

Ground Fault Protective Equipment: The ground-fault protection system shall be performance tested after installation in accordance with NEC 230-95C. Submit a written record of the test to the Engineer and the City of Burbank's representative. Record current pickup level and time delay settings to which the equipment was finally adjusted. Measure and record relay pickup current and the relay time delay at two values above pickup. Test for correct system operation at 57 percent rated voltage. If relay pickup current is not within 10 percent of the manufacturer's calibration marks or fixed setting or relay timing does not conform to manufacturer's published time-current characteristic curves, repair or replace equipment and repeat test.

Test and calibrate devices and instruments that require testing and calibration for proper operation per manufacturer's instructions.

Voltage:

1. When the installation is essentially complete and the plant is in operation, check the voltage at the point of termination of the power company supply system to the project. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
2. If the unbalance (as defined by NEMA) exceeds 1 percent, or if the voltage varies throughout the day and from loaded to unloaded conditions more than ± 5 percent of nominal, make a written request to the power company that the condition be corrected. If corrections are not made, request from a responsible power company official a written statement that the voltage variations and/or unbalance are within their normal standards.

Operate each switch and circuit breaker at least three times, demonstrating satisfactory operation each time.

LOW VOLTAGE MOTOR CONTROL**Data to be Furnished:**

Submit manufacturer's descriptive and technical literature.

Submit manufacturer's descriptive data including ratings, single-line diagrams, three-line diagrams, control schematic wiring diagrams, dimensional data, weights, conduit entry restrictions, and overload heater ratings.

Submit control schematic diagrams in a "ladder diagram" format that satisfy the following minimum requirements:

1. Show unique rung numbers on left side of each rung. Provide unique wire numbers for all wires between terminals.
2. Show terminal numbers for all devices, relays, timers, contacts, etc.
3. Where the internal wiring diagrams of subassemblies are furnished on separate sheets, show as a rectangle in the schematic diagram with external points identified and cross-referenced to the separate sheets of the control circuit. Show coils and contacts internal to the subassemblies in the rectangle connected to their terminal points.
4. Use a cross-referencing system in conjunction with each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, describe the purpose of the contact on the same sheet. Show spare contacts.
5. Show symbols of external field devices on the schematic (ladder) diagram with utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position. If the equipment is shown in a specific position, identify the position.
6. Show contacts of multiple contact devices, e.g., selector switches, on the line of the schematic diagram where they are connected in a circuit. Indicate a mechanical connection between the multiple contacts by a dotted line or arrow. This does not apply to control relays, starters, or contactors. Use additional charts or diagrams to indicate the position of multiple contact devices.
7. Show the purpose or function of switches adjacent to the symbols. Show the purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram on the right side of the respective rung.
8. The motor control center manufacturer shall review the control schematic diagrams provided in the Plans, shall identify any adjustments that might be required to achieve the intended control features described in the Plans, and shall implement such changes, prior to shipping the equipment. If further adjustments are required, make such adjustments in the field, with the consent of the Engineer and the City of Burbank's representative.

Submit calculations for sizing of control power transformers.

Submit manufacturer's test report of the factory tests. Describe each circuit, logic function, device, or item tested. Describe results of tests and retests. Describe corrective action taken on defective circuits, logic functions, and devices.

Operation and Maintenance Manuals:

Submit operation and maintenance manuals.

Manufacturer's Services:

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. One labor day for motor control center to check the installation and advise during start-up, testing, and adjustment.
2. One labor day to instruct the Engineer and the City of Burbank's personnel in the operation and maintenance of the equipment.

Ratings:

Motor horsepower ratings and enclosures shown are minimum expected. This does not limit the equipment size. When motors furnished differ from the minimum ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the City of Burbank.

PRODUCTS

Motor Control Centers:

Motor control centers shall be dead front, dead rear, floor standing, and front accessible in a NEMA 3R enclosure with locking provisions. The voltage and ampere rating and physical dimensions shall be as indicated in the Plans. Tag control wiring within 2 inches of termination at each device and terminal board. Schematics shall also show terminal numbers and interior and field wire numbers.

Provide channel iron sills and removable lifting angles.

Provide a separate vertical wiring compartment for each motor control center section. Provide cable supports and a hinged door separate from the unit starters.

Provide vertical bus insulated barriers.

Provide hinged pull-apart terminal blocks for control wiring where foreign voltage may be present, in compliance with NEC 430-74.

Provide individual compartments separated by steel barriers and with separate hinged doors for each starter, circuit breaker, or other unit. Locate equipment to enable termination of field wiring from front without equipment removal.

Mechanically interlock starter and circuit breaker doors so doors cannot be opened with unit energized. Provide defater mechanism to allow intentional access while starter or circuit breaker is energized. Make provisions for padlocking external disconnect handles in the OFF position.

Motor control center shall have short-circuit current rating equal to or greater than kAIC rating shown in the Plans.

Bus bars shall be copper. Provide full horizontal bus rating for entire length of the motor control center. Do not taper the bus. Bus bars shall be tin plated.

Provide a continuous, front accessible 200-ampere-minimum ground bus extended the full length of the motor control center. Ground bus shall be tin plated.

Do not mount components or terminals on the sides of cubicles. Only mounting on back panels or front panels is acceptable.

If motor control elevations are shown, cubicles allocated for controllers and other devices are the minimum desired. If sizes are required to be larger, and that results in sections additional to those shown in the elevation, they shall be provided at no extra cost. If motor control center elevation is not shown in the Plans, starter cubicles shall have 6-inch minimum vertical space in addition to manufacturer's published space requirements.

Provide rodent barriers at all sections.

Mount devices without obstruction, to be readily accessible.

Feeder circuit breakers shall be molded-case type. Provide quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual off and on positions. Provide trip ratings and number of poles as indicated in the Plans.

Fusible switch feeder units shall have switch and fuse ratings as indicated in the Plans. Provide rejection feature to accept only Class R fuses. Provide 600-volt, time delay, Class RK-5 fuses. The short-circuit rating shall be at least 100,000 amperes symmetrical.

Motor control centers shall comply with applicable NEMA, UL, and ANSI standards for industrial control.

Exterior finish shall be ANSI 49 gray.

The complete assembly, including anchors, shall be capable of withstanding seismic forces per Electrical Work as specified herein.

Motor control centers shall be Cutler-Hammer Freedom 2100, Allen-Bradley Centerline or Schneider Model 6.

Solid-State Controllers:

Reduced voltage solid-state starter shall be compact and multi-functional with a built-in overload protection and built-in run bypass contactor. It shall be suitable for mounting in the enclosure type specified for the motor control center. Starter shall be capable of controlling the acceleration and deceleration of the motor it will serve to soft-start and soft-stop the motor. After the motor is started, internal run bypass contactors shall close, resulting in the motor running directly across-the-line. The built-in solid-state overload shall protect the motor from overload conditions with adequate algorithms that shall model true motor heating, resulting in better motor protection and fewer nuisance trips. Starter shall have selectable voltage ramp start or current limit start (adjustable from 0 percent to 550 percent FLA, 5 to 180 seconds adjustment time) and kick-start (adjustable from 0 percent to 85 percent initial torque, 0.5 to 180 seconds) capabilities. The soft-stop (adjustable from 0 to 60 seconds) mode shall allow for a ramp stop time that shall be longer than the coast to stop time. A pump control feature shall be included to provide a smooth transition for starting and stopping a motor and eliminating the "water-hammer" effect that can damage pipes, valves, and pumps.

The starter shall use SCRs to control the motor.

Starter may be powered using 24-volt d-c power or 120 volt a-c power. When direct-current power is used, provide a power supply with inherent overload protection. Power supply unit shall be manufactured by the solid-state starter manufacturer.

The starter shall be rated for 3-phase 1.15 service factor motors and be suitable for a three-lead configuration.

Starter shall be rated for 25-second ramp time, four starts per hour, 300 percent starting current limit at 40°C ambient or 15-second ramp time, four starts per hour, 300 percent starting current at 50°C ambient [severe-duty rated for any combination of more than 30-second ramp time, more than four starts per hour, or more than 300 percent starting current limit at 50°C ambient].

Starter shall have a digital interface module (DIM), which shall be door mounted on the front panel of the starter cubicle. The module shall allow the user to configure the device and to read system parameters. The module shall include an LCD display and keypad to scroll through the various menus. The module shall allow the user to modify control parameters, enable or disable protections, set communication variables, and monitor system parameters.

Monitoring shall allow accessing real time process and diagnostic data. Data shall be viewable at the module or through a communications network. It shall be possible to make adjustments through the communications network and accept remote reset signals to tripped devices without the need for manual intervention.

Monitoring shall include:

1. Average of the 3-phase rms line currents.
2. Average rms line current as a percentage of the FLA setting.
3. Individual rms 3-phase line voltages.
4. Real time calculated thermal memory value, with 100 percent value representing the maximum safe temperature of the motor. When the thermal memory value reaches 100 percent, an overload trip shall occur, removing power to the motor.
5. Level of the 24-volt d-c control voltage (if 24-volt d-c control voltage is used).
6. Pole temperature.

7. Device temperature.
8. Start count.
9. Fault Queue: Current fault and a fault queue containing the last nine system faults through the module or communications network, up to 4 different faults.
10. Control Status: Status of the system and the control commands the system requests of the starter.

The starter shall have selectable protective features with variable settings allowing the user to fine-tune the starter to meet specific system requirements.

Protection shall include:

1. Stall: Trip to protect the system in the event that the motor did not achieve the rated speed in the defined soft-start period.
2. Pole Overtemperature: Overtemperature protection shall occur if the device's thermal capacity is exceeded. The solid-state starter shall trip in overtemperature conditions, preventing device failure. The device pole temperature value shall be monitored through the digital interface module or the communications network.
3. Phase Loss: trip at 3 seconds on phase loss.
4. Phase Current and Voltage Imbalance: adjustable.
5. Phase reversal.
6. Shorted SCR detection.
7. Open SCR detection.
8. Low Current: Programmable as a percentage of motor FLA from 0 to 100 percent.
9. Low Voltage: Programmable as a percentage of nominal voltage from 1 to 99 percent with a trip delay from 0.1 to 60 seconds.
10. High Voltage: Programmable as a percentage of nominal voltage from 101 to 120 percent with a trip delay from 0.1 to 60 seconds.

Reset Mode: It shall be possible to set up for automatic or manual reset on trip. The manual reset shall be achieved by means of a reset button located on the starter. It shall also be possible to reset the overload manually through the digital interface module or remotely through the communications network. The automatic reset mode shall allow the starter to be automatically reset as soon as the trip condition is no longer present.

Surge suppressors shall be provided on the line and load sides to clip the line voltage and load side induced voltage.

Standards and Certifications: Starter shall be UL listed.

Manufacturers: Equipment shall be Cutler-Hammer S811 or later model, Allen-Bradley SMC Flex or, Schneider Altistart 48.

Manual Motor Starters:

Provide number of poles and size of thermal overload heaters for the motor being controlled. Provide NEMA 1 enclosure for starters located indoors and NEMA 4 for enclosure for starters located outdoors or as indicated.

Starters shall have provisions for padlocking in the off position and shall be UL listed.

Starters shall be the heavy-duty type with toggle or push-button operation. Arrow Hart Type LL, Allen-Bradley Bulletin 609 or ABB Type MS116.

Relays:

Provide relays with the number of contacts shown on the schematic diagrams. Utilize additional contact blocks or relays to satisfy the required number of contacts shown at no additional cost.

Control relays shall be magnetically held. Control relays shall be UL listed with NEMA A300 rated contacts and coil voltage, number of poles, and pole arrangement as indicated in the Plans. Relays shall be Allen-Bradley Bulletin 700, Cutler-Hammer Type Westinghouse Type AR, or Idec RR Series.

Time-delay relays shall be UL listed with contacts rated 10-ampere noninductive load, 120 volts, with coil voltage, number of poles, pole arrangement, and maximum timing adjustment as indicated in the Plans. Relays shall be adjustment and retaining clip. Provide Potter Brumfield solid-state nonplug-in industrial type. Provide Square D Class 9050, Type FS, Allen Bradley Bulletin 700 or ABB Type CT.

Intrinsically safe relays shall be solid-state electronic type equipped with a variable resistance potentiometer that permits field adjustment of sensitivity. The relays shall have contacts rated at 20 amperes minimum at 120-volt a-c or 24-volt d-c. The contacts shall be double pole, double throw.

Phase failure or phase monitoring relays shall provide protection against loss of any phase, phase unbalance, undervoltage, and phase reversal. Delay and restart delay shall be incorporated in the A locking potentiometer undervoltage adjustment and an LED indicating "relay energized" shall be provided. Unit shall be Time Mark Model 2644, Macromatic Type PMD or ABB Type MC-MPS. Plug-in type units are not acceptable.

Moisture detection control unit shall detect an influx of moisture within the motor. Provide the relay with a test push button and pilot light to check the moisture sensing components without simulating a leak.

Miscellaneous Devices:

Control switches shall be round, oiltight type, complete with legend plates and quantity of contact blocks required for the control function.

Indicating lights shall be LED type, complete with color of lens indicated in Plans and legend plate. Indicating lights shall be push-to-test type.

Elapsed time meters shall be synchronous motor driven, from 0- to 99,999.9-hour range, nonreset type, suitable for semiflush, panel mounting.

Transformer and Panelboard:

Provide a dry-type transformer in the motor control center as shown in the Plans and Dry-Type Transformer Section as specified herein.

Provide a panelboard in the motor control center as shown in the Plans and Panelboards Section as specified herein.

Factory Tests:

Subject the motor control centers to a complete functionality test. Simulate remote inputs and outputs and verify correct operation. Perform these factory tests in the presence of the Engineer and the City of Burbank's representative. Provide 10 days' advance notice of test date.

PART 3 - EXECUTION

INSTALLATION

Install starters and controllers in the motor control center.

Secure motor control centers rigidly to walls and floors or mounting pads with anchor bolts or concrete anchors. Anchor bolts or concrete anchors shall be carbon steel per ASTM A307, Grade B Type 316 stainless steel.

Field Tests:

Test the operation of each interlock to verify that the interlock performs its function.

Test system for correct execution of control logic. Adjust wiring connections in panel to correct errors.

Operate each breaker and verify that all phases of each load are disconnected.

Set adjustable trip circuit breakers two settings above the setting that causes the breaker to trip during motor starting. Do not adjust the setting above 1,300 percent of the motor nameplate current rating.

12-16.04 PUMP CONTROL INSTRUMENTATION AND CONTROL SYSTEMS**PART 1 - GENERAL****DATA TO BE FURNISHED**

Media: All submittals shall be provided in hard copy (paper) in accordance with these special provisions and electronic format. Electronic format shall be PDF format on CD that is compatible with Microsoft Windows / Adobe Reader. One CD shall be provided for each hard copy required per General Requirements.

Organization and Format: Submittal organization shall be the same as the specifications. Provide submittals bound with section coversheets and tabbed dividers with specification section numbers for submittal organization. Bill of materials, cut sheets, shop drawings, schematics, panel layouts, schedules, etc., shall be cross-referenced, indexed, or otherwise related by unique identifier for each item. The project may reject improperly organized or notated submittals. Provide .pdf file page numbers in table of contents as well as bookmark links to section coversheets in pdf file.

Reviews and Re-submittals: Suppliers shall provide re-submittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment. Supplier responses shall indicate how the supplier resolved the issue pertaining to each review comment. Responses that only indicate that the review comment was noted, will be looked into, etc., are not satisfactory. Re-submittals which do not comply with this requirement may be rejected and returned without review. Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non compliant submittals. Submittal review comments not addressed by the contractor in re submittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.

Product Data: Submit catalog cut sheets for all products. Identify all cut sheets by unique bill of material item number, index, or key. Notate catalog cuts to indicate only those items, models, options, or series of equipment to be furnished. Cross out or otherwise obliterate all extraneous materials and information. Clearly identify all configuration options for the equipment to be furnished.

Bill of Materials: Submit bill of materials including all items, products, and assemblies supplied. Documents shall be updated following submittal review, factory test, and commissioning. Updates shall be provided to the Project Representative in a timely manner. Bill of materials shall include the following information:

1. Item number, index, or key relating to submitted cut sheets, drawings, schedules
2. Item manufacturer's name, model, and part numbers. Supplier unique part numbers are not acceptable
3. Description
4. Quantity supplied
5. Supplier contact information

Notated Specifications: Submit copies of all Instrumentation and Control Systems Section as specified herein with each paragraph notated to indicate compliance. A check mark shall indicate complete compliance. Explanations shall be provided for all non-compliant items in accordance with these Special Provisions.

Notated P&ID Drawings: Submit copies of all project Process and Instrumentation drawings with each drawing element notated to indicate compliance. A check mark shall indicate complete compliance. Explanations and markups shall be provided for all non-compliant items and in accordance with General Provision.

Notated Electrical and Instrumentation Drawings: In the case of deviations from the contract documents, particularly related to the impact of the configuration of submitted packaged equipment supplied to the project, submit marked up copies of applicable Electrical and Instrumentation contract drawings notated to identify and explain all proposed deviations from the contract documents. Items not notated on the submitted marked up copies shall be assumed to be 100 percent compliant with the bid documents. This requirement applies to electrical one lines, MCCs, MCC control schematics, panel schedules, and control schematics. This requirement does not apply to plan drawings and conduit schedule which shall be marked up to reflect the as constructed project configuration and submitted as record drawings.

Seismic: Submit Seismic design information per Electrical Work as specified herein for Electrical System. Include a list of equipment weighing 200 pounds or more.

O&M: O&M manuals shall include product data for all materials and items supplied in compliance with the submittal requirements of this section.

Drawings: Submit all drawings described in this and other sections including elementary, loop, schematic, fabrication, installation, field wiring, panel layout and assembly, etc., drawings. Drawings shall be updated following submittal review, factory test, and commissioning. Updates shall be provided to the Project Representative in a timely manner. Cross reference drawing elements with BOM and catalog cut sheet unique references. Drawings shall use project tag formats and numbers.

Packaged Equipment: This shall include packaged equipment purchased under the contract as well as any pre purchased packaged equipment assigned to the contractor.

Component Drawings: Dimensional, installation, and wiring diagrams and drawings for all supplied components.

Spare Parts: Spare parts lists

PART 2 - PRODUCTS

PLC Panel:

The described equipment shall be housed in a UL listed single door NEMA 4X free-standing, type 316 enclosure approximately 90 inches high, 36 inches wide, and 36 inches deep. The enclosure shall be constructed of not less than 12 gauge stainless steel. The enclosure shall include the following:

1. Protection for outdoor installation against rain, sleet, and snow
2. Drip shield top and seam free sides, front, and back
3. 3-point latching mechanism operated by padlocking handle
4. Collar studs for mounting inner panel
5. Hinged inner door painted white enamel
6. Inner panel painted white enamel
7. Condensation Protective Heater: A 100-watt, 120 V(AC) condensation protective heater(s) and high temperature cutout thermoswitch shall be supplied in the PLC panel. The heater's surface area for heat dissipation shall be large enough to prevent a skin burn (if an Operator's hand should inadvertently come in contact with the unit when energized).
8. Convenience Receptacle: A GFI convenience receptacle shall be furnished and mounted on the inner door of the PLC panel. The control power transformer inside the PLC panel shall provide at least 1500 watts of power for the receptacle in addition to the power required for the control logic and heater.
9. Incoming Service: The incoming service for the PLC panel shall be 120 volts, 1 phase, 2 wire, 60 Hertz. A lightning arrestor shall be supplied in the panel and shall be connected to each line of the incoming side of the power input terminals. The arrestor shall protect the control against damage as

the result of transient voltage surges caused by lightning interference, switching loads, and power line interferences.

Microprocessor Pump Based Controller:

A microprocessor logic controller stormwater monitoring/pump controller shall be IntraLink LC3000 by Siemens water group, Modicon M340 by Schneider Electric, or Micrologix 1400 by Allen-Bradley, with required standard system and required port expansion to meet the particular application needs of this project. The unit shall be capable of accepting inputs and outputs as shown on PID and electrical DWG.

The logic controller shall have on-board I/O and expandability up to 256 point.

The logic controller shall operate from a 10 to 30 V(DC) power source.

Logic controller unit provided under this specification shall be capable of performing the necessary logic to control the City of Burbank's local and remote facilities as defined in the contract documents. These inherent capabilities shall include, but not be limited to, the following:

1. Discrete input/output
2. Analog input
3. Analog output
4. Timers
5. Pump controller
6. Pump alternation
7. Mathematical function blocks
8. Stage blocks
9. Trending
10. Latch/unlatch relays
11. Counters
12. Comparators
13. Ladder logic
14. Flow totalization/integration
15. Intrusion detection
16. Time of day control with lockout
17. Ramp blocks
18. Data logging

The watchdog/monitor on/off output shall be controllable by the microprocessor (uP), but also by the on-board watchdog which continuously monitors uP activity. In the event of a cessation of activity, the watchdog shall reset the uP and de-activate the output driver; thus indicating the occurrence of an abnormal condition. This output shall be available to operate an independent alarm system or a redundant control arrangement in a "fail safe control" application.

All job connections shall be made a barriered, wire clamp type, UL-recognized stab-on terminal blocks each accepting one or two AWG 12-22 wires.

The unit shall operate with an off-board, Class 2 isolation transformer having a 120 V(AC) primary. It shall have an isolated on-board DC power supply and an off-board battery back-up system for continued operation under AC power failure conditions. AC/DC conversion, 12 V(DC) regulation, and battery-charging elements shall be on-board.

The controller shall be furnished with all necessary hardware and software to accomplish the monitoring/alarm and control functions specified with software specifically tailored to this project.

It is the specific intention of this functional requirement that a standard process control computer will be employed with features as herein described and that it be a fully-integrated assembly that is, the furnishing of similar functions using a generic programmable controller with custom software, a multiplicity of hardware setpoint control/alarm and telemetry modules or extensive relay/timer logic to accomplish control

sequences, etc. is specifically precluded by this specification and will not be acceptable. The controller shall be fully programmed and tested by the contractor.

The liquid level signals shall be converted to "feet of water and tenths" digital displays. Keyboard-configurable digital setpoints shall be provided for differential-level type pump operation as well as alarm performance as herein described.

The computer shall have its operating program resident in ROM and include full scale ranging and pump-up/down determination.

Input signal conditioning shall provide keypad-selectable averaging of the input signal with one reading taken every second and from 1 to 30 readings being selectable with the Controller displaying and providing control based on a moving average of the selected number of samples.

The on/off adjustments of the pump shall be full-range adjustable through use of an authorized operator access code and the keypad. Review of controller adjustments shall be possible by the operator without use of the access code.

The controller shall be arranged to operate from a transducer that produces a variable output signal proportional to the height of water in the wetwell. As the level increases, the controller shall receive this varying input and provide wetwell level indication, on/off setpoints for high, low wetwell level alarms and the sump pump. The controller shall be arranged to start lead storm water pump when the first set point is reached. When the second set point is reached, the lag storm water pump will start. The pumping will continue until the first falling level is reached. At this point the lag storm water pump will turn off. As the second falling level is reached the lead storm water pump will go off. The sump pump will start and pump the last five feet of water. Refer to plan sheet M-2 for pump control schedule. The storm water pump shall have an automatic alternation and scrolled pump assignment where the stand by pump becomes the lead pump, the lead pump becomes lag pump and the lag pump becomes the standby. Manual override capability and pump failed/replace logic shall be provided.

An alarm acknowledge button shall be provided to allow silencing of the audible device while the digital display shall continue to show the alarm function until the condition has cleared.

When operating a key of the controller, the audible alarm shall chirp briefly to confirm that the selected key has operated.

A door mounted analog wetwell level simulation module shall be supplied to provide a normal/simulated signal to the controller. The module shall include a "Norm/Sim" input signal selector switch and signal simulate potentiometer. The "Norm" input signal shall be initiated from the level/flow sensing transducers. The "Sim" input signal shall be simulated with the potentiometer and used to calibrate/test the control system.

Indicating Lights:

1. A heavy-duty oiltight LED red "Low Wetwell Level" indicating light shall operate from the pump controller.
2. A heavy-duty oiltight LED red "High Wetwell Level" indicating light shall operate from the pump controller.
3. A heavy-duty oiltight LED red "Redundant Control Energized" indicating light shall operate from the pump controller.

A regulated 12 V(DC) power supply shall be provided for the microprocessor based digital controller and other control system components as required. The power supply shall include a terminal block for the incoming AC, output DC, and ground connections. The power supply AC input circuitry shall include integral fusing.

100-watt, 120 V(AC) condensation protective heaters and thermoswitches with high temperature cutout shall be supplied in the control panel.

A 120 V(AC) receptacle and circuit breaker shall be supplied in the control panel.

An intrinsically safe barrier by Siemens, IDEC, or MTL Instruments shall be provided between the upper and lower assemblies. The barrier shall render the level sensing system suitable for use in Class 1, Division 1, Groups A, B, C, and D; Class 2, Division 1, Groups E, F, and G; and Class 3, Division 1 hazardous locations. The module shall provide an intrinsically safe interface for up to six sensors located in a hazardous area rated Class 1, Groups A, B, C, and D, and Class 2, Groups E, F, and G.

Local Operator Interface Terminal (OIT) Unit:

An Operator Interface/Keyboard Display (OIT) shall be Siemens Intralink OI3000, Schneider Electric XBTG, or Allen-Bradley panel view Plus, and supplied for the all microprocessor based logic PLC panel. The OIT unit shall be mounted on the front door of the PLC panel. The OIT shall perform the following functions:

1. Keypad/Display shall allow the Operator to view and modify system variables within the logic controller telemetry unit.
2. Keypad/Display shall be NEMA 4 rated, have 20 system/function keys with tactile feedback, and have a minimum of 64 x 128 pixels capable of displaying graphics and a minimum of 8 lines with 20 characters per line.
3. The display shall be a high contrast backlit LCD display so that it is unaffected by a wide-range of ambient light conditions.

Operator interface shall have sufficient performance to permit real time updates of system data and shall be capable of display update at least 3 times per second. Operator initiated screen change shall occur within 50 msec.

The display shall incorporate a power save feature that shuts down the display after 5 minutes of keyboard inactivity.

The system display shall be pre-configured to reflect system parameters. The display shall support a minimum of 100 customizable main level process system displays. These displays shall be configured with graphical and text based data for the specific application to meet system monitoring and process control needs. The display shall be easily navigated by using a simple menu type format branching down to sub menus/levels.

The display shall allow an operator to return to the main level with a one step push button entry. All system data and parameters shall be security protected. The system shall employ a hierarchical security password system affording a minimum of three levels of password-protected access to the system.

The display system shall incorporate a basic trending package that shall allow sixty samples of time-based single discrete or analog data on a signal screen display. The Operator shall have the ability to scroll through time, forward and backwards, utilizing right and left function keys. The system shall allow trend display of any data point in the system.

The display system shall be able to display current and historical alarms and events. Upon the occurrence of a new unacknowledged alarm, the display shall show the date and time and sound an audible tone indicating the presence of an unacknowledged alarm. Acknowledging the alarm via the display keyboard shall silence the audible tone. Subsequent alarms shall reactivate the alarm audible tone. Historical alarm and event information shall be viewable from the display with the last 1,000 alarms or events including date and time of alarm being available.

Redundant Pump Controller:

An independent High/Low level alarm and redundant control system Siemens CBIT Controller, Warrick 67, or Mercoid QPC with features hereinafter listed shall be provided in addition to the specified primary control system. It shall be powered by a 120 V(AC) circuit breaker (other than the one powering the primary system) and use four direct-acting level-responsive float switches as described:

1. Float switch No. 4 energizes the High/High level alarm.
2. Float switch No. 3 energizes the first storm water pump. If the level continues to rise for more than 30 seconds, the second storm water pump shall start. If the level continues to rise, the controller shall energize the remaining storm water pumps every 30 seconds.
3. Float switch No. 2 de-energizes the storm water pumps, starts the sump and restores the low level alarm circuit.
4. Float switch No. 1 energizes the low level alarm circuits and turns off the sump pump.

The pump level control/alarm module shall connect to the float level sensors through an intrinsically safe module. The module shall provide an intrinsically safe interface for up to six sensors. The module shall contain an LED indicator for each of the six sensors providing visible indication of sensor actuation as well as an LED to indicate barrier "Power On" status. The intrinsic safety barrier shall be UL listed.

Automatic Alarm Monitor/Dialer:

All "Fail" and "Alarm" signals shall be sent out via cellular autodialer. The cellular monitor/dialer shall be a microprocessor based device that shall sense alarm contacts at the site. The system shall be expandable such that additional input and/or outputs may be added to extend total number to 144 I/O points. The unit shall be provided in an 8-channel configuration. In addition, power failure shall be sensed internally and shall not require using any of the alarm channels. Upon detection of any of the alarm conditions or power failure, the device shall commence dialing the first of 8 user programmed phone numbers and deliver a message describing the actual alarm condition. The unit shall be capable of storing and using up to 64 telephone numbers and email addresses, in lists of 8 or 16 numbers per list. Messages shall be delivered in the user's own recorded voice, digitized and stored in a non-volatile memory, not magnetic media.

The dialer shall be capable of working with fixed and cellular telephones, and be capable of signaling pagers and calling.

Message programming shall be accomplished by speaking into the device's built-in microphone, or by utilizing a touch-tone telephone, and shall not be limited to a factory supplied internal synthesized speech vocabulary. Complete programming shall be accomplished using the sealed membrane keypad or the 10-key pad on a touch-tone phone from any location.

The message as heard by the caller shall consist of two parts, the actual device location and the user recorded alarm message. The device will continue to call the phone numbers in succession until acknowledged by the caller depressing a touch-tone key or calling the unit back from any phone. Once acknowledged, the device shall enter a programmable inter call delay to allow the alarm condition to be corrected, before beginning notification again. The device shall, upon receipt of an incoming call, provide the caller with the device identifier and alarm status.

All communications shall utilize standard telephone lines, and shall not require leased or dedicated lines.

The automatic alarm monitor/dialer to be installed in PLC panel shall possess the following physical and functional characteristics:

1. On board battery backup with charging circuit to provide a minimum of 10 hours of telephone calls on loss of power.
2. All programmed variables shall be stored in nonvolatile memory.
3. Individually selectable alarm delay times keyboard programmable from 0 999 seconds.
4. Programmable selection of each alarm input to be either Enabled, Disabled, or Status Only (Status Only will not initiate a call).
5. Each alarm input can be configured to monitor either normally open or normally closed contacts.
6. Each alarm input shall have its own prioritized calling sequence from the programmed telephone list of 64 telephone numbers.
7. Individually programmable inter call delay, from 0-9999 minutes.
8. Tone or pulse dialing format.
9. Visual indications of the following conditions, even when the cover is closed:

- 9.1. Status of all alarm channels
 - 9.2. Power on
 - 9.3. Incoming call
 - 9.4. Low battery
 - 9.5. Run/bypass operation
 - 9.6. Off hook
 - 9.7. Phone fault
10. Transient protection on the telephone and power lines shall be included.
 11. The dialer shall be packaged with all required components, including, but not limited to, antennae and remote access modem for cellular connectivity.
 12. The dialer shall include a standard RS-232 port for connection to a standard serial printer to report all dialer operations and activities, including time and date stamp.
 13. A Standby mode shall disable the dial out function during specific, programmable hours and minutes, based on weekday/weekend times.
 14. A listen-in feature shall allow the incoming caller to monitor the physical activity at the dialer location.

The alarm dialer Raco Verbatim Gateway, Walchem, or Sensaphone SCADA 3000 shall be mounted, wired, and tested in the PLC panel. The dialer LCD, key functions, and indicating lights shall be door mounted.

Submersible Wetwell Level Sensing Transducer:

The liquid level of the wetwell shall be sensed by a Siemens Water Technologies (Flo-Systems) Bulletin A1000, Model 157GSCE, Ametek Model 675, or Mercoird PBLTX Series. The transducer shall be a 3-wire type to operate from a supply voltage of 10.5 to 24 V(DC) and produce a 1 to 5 V(DC) instrumentation signal in direct proportion to the measured level excursion over a factory-calibrated range of zero to 35 feet of water.

The transducer shall be of the solid-state, head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with the manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed 12 inches above the bottom of the wetwell. The sensor shall be mounted using a vertical 1-inch pipe or stainless steel cable system

The transducer housing shall be fabricated of Type 316 stainless steel with a bottom diaphragm 2-5/8-inch diameter of heavy-duty, limp, foul-free, molded Teflon™ bonded to a synthetic rubber back/seal.

A hydraulic fill liquid behind the diaphragm shall transmit the sensed pressure to a solid-state, variable-capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against the diaphragm, which flexes minutely so as to vary the proximity between an internal ceramic diaphragm and a ceramic substrate to vary the capacitance of an electrical field created between the two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser-trimmed, temperature compensated, high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory-calibrated range.

The transducer element shall incorporate high overpressure protection and be designed to withstand intermittent overpressures five times the full-scale range being sensed. Metallic diaphragms shall not be acceptable in that they are subject to damage or distortion. Sensing principles employing LVDTs, resistive or pneumatic elements shall not be acceptable.

The transducer/transmitter shall include easily accessible offset and span adjustments in the upper assembly. Span shall be adjustable from 100 percent down to 15 percent of the sensor range. Fine and coarse adjustments for both span and offset shall be provided, using 25-turn potentiometers. Offset and span adjustments shall be non-interactive, for ease of calibration.

The internal pressure of the lower transducer assembly shall be relieved to atmospheric pressure through a heavy-duty urethane jacketed hose/cable assembly and a slack PVC bellows mounted in the NEMA 4X

vented fiberglass upper assembly. The sealed breather system shall compensate for variations in barometric pressure and expansion and contraction of air due to temperature changes and altitude as well as prevent fouling from moisture and other corrosive elements.

The transducer assembly shall be installed where directed by the Engineer and connected with other system elements and placed in successful operation. It shall be provided with input power and output signal transient protection, associated control elements as specified herein and in accordance with manufacturer's instructions.

Float Switches:

The liquid level shall be sensed by 4 direct acting float switches.

The Contractor shall furnish, install, and wire the float switches as shown on the Plans. Each float shall be a stainless steel float, flexibly supported by a three-conductor neoprene jacketed cable and having a mercury switch inside. The float shall be constructed of Type 316 stainless steel and shall be 5-1/2 inches in diameter, with a stainless steel tube welded into its inside, projecting into the float and several inches out from it. The mercury switch shall be connected across two conductors of the neoprene jacketed Type SO, No. 14 AWG cable, potted in epoxy (to prevent moisture wicking down the cable and shorting out the switch) and shall be inserted, with the end of the cable and neoprene jacketing, into the stainless steel tube where it shall be held in place by dual circular crimp. The cord shall have fine strand conductors made especially for underwater and heavy flexing service and shall be furnished with an additional neoprene jacket from the float to the point where the cable is held in place by a stationary clamp tube.

Each float switch shall have a minimum total net buoyancy of 2 pounds (total net buoyancy = weight of displaced volume of water less weight of float). The float switch level sensors shall have a three-year warranty.

One-Inch Pipe Mounting Clamps (Stainless Steel):

The transducer sensor and float switches shall be mounted using a vertical 1-inch pipe (supplied by the Contractor) and secured in place by type 304 stainless steel mounting clamps.

Push buttons:

Remote-mounted push buttons located outdoors shall be NEMA rated heavy duty, oil-tight type with synthetic rubber boots and any special gasketing required to make the completed station watertight. Provide NEMA Type 4X watertight, corrosion-resistant enclosures constructed of stainless steel or glass polyester.

Install provisions for locking push buttons in the OFF position wherever lockout provisions are indicated. Provide Siemens class 51, Allen-Bradley Bulletin 800H or Eaton 10250T.

Control Relay:

Control relays shall have 120-volt AC or 24-volt DC coils, except as noted; contacts shall be rated for the various circuit applications shown on the Plans. Control relays shall be 10-ampere, multiple-contact, 300-volt, plug-in type with dust cover and sockets. If additional contacts are required, they shall be ganged. Control relays for 120 volt AC application shall be Allen Bradley 700HA series, Eaton D_PF or Schneider PRM.

Intrusion Switches for Doors and Hatch Covers:

Switches shall be Normally Open switches, held closed by the door or hatch and have roller lever. Intrusion switches shall be Eaton CBX, Allen Bradley 802X, or Schneider 9007C series.

Intrusion Override Switches:

Switches shall be 2-Position Key Operator, key removal left and right positions, Eaton 10250T series, GE P9 series, Siemens 3SB3 series.

Intrinsically Safe Barrier:

Intrinsically safe barrier for 24-volt DC dry contacts/relays shall be Ingram. Products Two Channel Relay with Intrinsically Safe Inputs, Model Number: ISR2-24V-10K, 2.

Voltage Converter – 12 V(DC) to 24 V(DC):

DC/DC Converter shall be Manufactured by Phoenix Contact, Analytic Systems, Rhino with 10 A isolated output.

Battery Charger:

Battery Charger shall be manufactured by Phoenix Contact, Xantrex, TrueCharge or TRC Electronics with 10 A output.

Diode Block:

Diode Block, shall be manufactured by Phoenix Contact, Wago or DECA

Surge Protector:

Surge Protector shall be manufactured by Phoenix contact, MTL Instruments or Schneider Electric.

Uninterruptable power Supply:

The UPS shall have 120 volts AC, single phase, 60 Hz input/output power.

The UPS shall be sized to back up instrumentation control panel entirely for at least 2 hours.

The UPS shall provide output as shown on PID.

The UPS system shall be manufactured by Eaton, APC or SOLA HD.

UPS shall be mounted in PLC panel.

PART 3 - EXECUTION**GENERAL INSTALLATION**

Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms. And similar devices shown on the Plans are approximate only. Exact locations shall be as approved by the Engineer during construction. In the field, obtain all information relevant to the placing of process control work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

The installation details on the Plans indicate the designed installation for the equipment specified.

All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances, and regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.

All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the electrical Plans for the locations. All installation shall be in strict accordance with codes.

Unless specifically shown in the contract documents, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail Plans.

All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adapters, and shut-off valves.

Field instruments requiring power supplies shall be provided with local electrical shut-offs and fuses as required.

Brackets and hangers required for equipment mounting shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

The system supplier shall investigate each site through which equipment must pass to reach its final location. The system supplier shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure, and panel to assure proper space and access (front, rear, side).

The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet.

The system supplier shall coordinate the installation, the placing, and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. He shall be responsible to insure that all field wiring for power and signal circuits is correctly done in accordance with best industry practice and provide for all necessary system grounding to insure a satisfactory functioning installation.

System Tests and Acceptance:

A formal system test shall be performed and witnessed by the Engineer and City of Burbank's representative at the system supplier's factory, prior to shipment. The equipment shall include the entire data acquisition and process control system. The purpose of the test shall be to verify the functionality, performance, and stability of the hardware and software. Successful completion of this test shall be the basis for approval of the system to be shipped to the site.

Implicit in the scheduling of the factory test is the assumption that the supplier has determined through his own tests and quality assurance programs that the equipment is ready for shipment. Supplier's internal test procedures for hardware shall be equal to or exceed the requirements set forth in ANSI Standard RP55.1, "Recommended Practice – Hardware Testing of Digital Process Computer," insofar as they apply.

Where hardware items are of standard manufacture, and in current production, the manufacturer shall certify that applicable tests have been performed, and met, in accordance with said standard, and be prepared to supply copies of data to the Engineer upon request. Such statements shall accompany the equipment submittals called for. Any assemblage of devices together with operating programs shall be tested together as provided herein.

The various tests performed during the Engineer and the City of Burbank-witnessed factory test shall be designed to demonstrate that hardware and software fulfill all the requirements of the Specifications. The test conditions shall resemble, as closely as possible, the actual installed conditions. Any additional hardware or software that may be required to successfully verify system operation shall be supplied at no additional cost.

Some of the tests to be performed shall include but not be limited to the following:

1. Demonstrate operability of the interfaces (hardware and software).
2. Demonstrate all system software functions specified.
3. Simulate selected operating conditions to verify the performance of the monitoring and control functions.

During the tests, the Engineer and the City of Burbank's representative shall have unrestricted access to the system, and all faults identified during this period shall be corrected and retested prior to completion of factory test. All test data and procedures followed during testing shall be logged, and certified copies of logs shall be provided to the Engineer and the City of Burbank's representative. The supplier shall notify the Engineer and the City of Burbank a minimum of 30 days in advance of his proposed starting date for the Engineer and the City of Burbank's witnessed factory test. At the time of notification, the system supplier shall submit a detailed test procedure for approval by the Engineer.

After the equipment has been delivered and installed at the City of Burbank's site, a system operability test shall be performed to verify the integrity of the system. Some or all of the tests performed during factory testing shall be repeated. The system must operate without failure for a period of 6 hours before this test will be considered successful.

Before this test is started, the supplier shall satisfy himself that the system is operating correctly. Any malfunction during the test shall be analyzed and corrections made by the system supplier. The Engineer and the City of Burbank will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

Field Tests:

The Contractor shall furnish the services, servicemen, all special tools, calibration equipment and labor to perform the tests. Certified copies of the tests shall be furnished in duplicate to the Engineer.

Following connection, checkout, and final adjustment of all panels, instruments, meters, monitoring, and control devices, a performance check shall be made on each. Analog instruments and system inputs shall be tested at 0 percent, 25 percent, 50 percent, 75 percent, 100 percent and 101 percent of scale, as required. All status and alarm switches as well as all monitoring and control functions shall also be checked. Testing shall be done from the signal source (transmitter) to the data acquisition and process control system including all field wiring.

If, during running of the tests, one or more points appear to be out by more than the specified amount, the system supplier's servicemen shall make such adjustments or alterations as are necessary to bring equipment up to specification performance.

Following each adjustment, the tests shall be repeated for all specified points to ensure compliance.

Instruction – Instrumentation:

The Contractor shall furnish a representative for a field training program to be run at the City of Burbank's site and consist of up to 1 day of instruction for 4 of the City of Burbank's personnel. The program shall cover instrumentation debugging, troubleshooting, calibration and maintenance procedures, and system operation. This training program will be held at a time chosen by the City of Burbank and will be exclusive of any instruction given at the time of system start-up.

Instruction – Staff Training:

The cost of training programs shall be included in the Contract price, to be conducted with the City of Burbank-designated personnel, covering programming, operation, and maintenance of the system as specifically set forth hereinafter. The training and instruction, insofar as practicable, shall be directly related to the system being supplied hereunder.

All technicians and operators will require training on the system. The Contractor shall be responsible for providing detailed operation and maintenance (O&M) manuals and training courses. The O&M manuals shall include specific details of equipment supplied and details of operations specific to this project. The training courses will deal with fundamentals of computers and dialer systems, software and hardware operation, and maintenance. The training courses will be conducted at the City of Burbank's facilities.

The system operation manuals shall include descriptions of all equipment, the nature and intended modes of operation, testing procedures of all units in the system, detailed staff requirements, and safety measures to be taken in operation. All necessary procedures and methods for effective operation of the system shall be included.

Equipment maintenance manuals shall include record drawings and instructions necessary for the planned maintenance of all equipment in the system. The maintenance manuals will incorporate maintenance procedures and schedules and they will coordinate and be cross-referenced to detailed instruction manuals provided by the computer and peripheral manufacturers.

The system training program shall be structured such that the operating personnel will understand the system's operation, and the functions available in the system. The level and amount of training will be based on the understanding of the individual staff members. Preventive and corrective maintenance of software and hardware shall be presented. A number of basic theory courses shall be provided to give the operators an appreciation of how the system can help them perform their jobs.

12-16.05 CONDUIT, RACEWAYS, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

DATA TO BE FURNISHED

The Contractor shall submit catalog data showing material information and conformance with Specifications in accordance with the "Submittals" requirements per Electrical Work as specified herein.

All materials shall be new, free from defects, of current manufacture, of quality specified or shown. Each type of material shall be of the same manufacturer throughout the work.

PART 2 - PRODUCTS

COMPONENTS

General:

Unscheduled Raceway: With the exception of lighting, communication, and receptacle circuits, the type and size of raceway shall be as specified on the Plans or schedules. Lighting and receptacle raceway are unscheduled and shall be sized by the Contractor in accordance with the NEC. Minimum size shall be 3/4 inch for exposed and 1 inch for embedded raceway. The number and size of communication, paging, and security raceways shall be as required for the particular equipment provided subject to the minimum sizes specified above. The type of raceway shall be in accordance with Electrical Work as specified herein.

Scheduled Raceway: The size and type of raceway shall be as specified on the Plans or schedules. In case of conflicts between the Plans and paragraph 3.01, the Plans shall prevail.

Raceway:

Application: All conduits shall be Galvanized Rigid Steel (GRS), unless otherwise noted or specifically allowed per Electrical Work as specified herein, Area Classification. All connections to vibrating equipment or motors shall be liquidtight flexible metallic conduit. PVC installed above grade shall be UV resistant Schedule 80. Underground power, control and telephone conduits shall be concrete encased, schedule 40 PVC. (All sweeps and risers for transition from below grade to above grade shall be PVC

coated, GRS.), unless indicated otherwise. Underground conduits serving non-critical loads such as site lighting, signs, etc. shall be PVC schedule 80.

Rigid Steel Conduit: Rigid conduit shall be steel, hot dipped galvanized. Final conduit terminations shall be by means of threaded hubs or double locknuts and insulating grounding type bushings.

Liquid Tight Flexible Metallic Conduit: Flexible conduit shall be interlocking single strip, hot dipped galvanized and shall have a polyvinyl chloride jacket extruded over the outside to form a flexible watertight raceway.

Nonmetallic Conduit: Nonmetallic conduit shall be rigid PVC, Schedule 40 or 80. Fittings shall be of the same material as the raceway and installed with solvent cement per the manufacturer's instructions. Conduit, fittings and solvent cement shall all be manufactured by the same manufacturer.

PVC Coated Rigid Steel Conduit: Conduit shall be hot dip galvanized, ETL-verified then coated with urethane inside and outside, then covered with 40 mil PVC coating.

Aluminum Conduit: Aluminum conduit shall be rigid ANSI C80.5, threaded.

Electrical Metallic Tubing (EMT): EMT shall be UL 797 and ANSI C80.3, steel tubing, hot-dip galvanized. EMT fittings shall be ANSI/NEMA FB 1, steel, raintight, insulated throat, compression type.

Fittings and Boxes:

Material: Materials for fittings and boxes shall be chosen to satisfy the requirements per Electrical Work as specified herein - Area Classification. All screws, nuts, bolts, and other hardware used with fittings and boxes shall be stainless steel unless installed in general purpose areas.

Unions: All unions of the type designated as UNF and UNY and shall be suitable for use in moist atmospheres. Unions shall be of cast ferrous alloy, electroplated with zinc.

Locknuts: All locknuts used in general purpose areas shall be extra heavy steel electroplated with zinc for sizes 3/4 inch to 2 inches. Locknuts larger than 2 inches shall be of malleable iron, electroplated with zinc. Locknuts used in damp and outdoor areas shall be stainless steel. Locknuts in corrosive areas shall be FRP.

Bushings: All bushings shall be steel or malleable iron threaded type electroplated with zinc or hot-dip galvanized. Bushings shall have a molded-phenolic or nylon insulating collar.

1. **Grounding Bushings:** Grounding-type bushings shall have a projecting portion drilled for the size grounding cable used and shall be provided with a clamp or set screw for securing the cable. In addition, a set screw shall be provided to securely lock the bushing to the conduit. Grounding bushings shall be GEDNEY Type IBC-L-BC, T&B No. 3870 through 3880, or T&B BG Series.
2. **Bushed Openings:** Bushings for protection of cables passing through metal boxes or troughs shall all be phenolic type and shall be OZ/Gedney, T&B or cooper.
3. **Hubs for connection of conduit to boxes** shall be of zinc. Hubs for use in damp or corrosive areas shall be non metallic or aluminum to match the raceway. The hubs shall provide a liquidtight connection to the box and an insulating bushing for the wiring. Hubs shall be Thomas and Betts bullet type, Crouse-Hinds Type Myers, or Halex HX Series.

Liquidtight Flexible Metallic Conduit Connectors: Connectors for liquidtight flexible metallic conduit shall be electroplated zinc malleable iron. An O-ring gasket and an approved grounding insert shall be part of the unit. Where applicable, 45 degree and 90 degree fittings may be used. Liquid-tight connectors shall be by O.Z. GEDNEY, T&B or Cooper.

Expansion Fittings: Expansion fittings in exposed runs shall be weatherproof type and shall be provided with an external bonding jumper. The expansion fittings shall allow for 4 inch longitudinal movement and shall be designed so that when completely assembled the end of each conduit entering the fitting is bushed. Fittings shall be O.Z. GEDNEY, Cooper or T&B. Deflection fittings in embedded runs shall be of the watertight type and shall be provided with an internal bonding jumper. The expansion material shall be

neoprene and shall allow for 3/4 inch movement in any direction. Fittings shall be O.Z. GEDNEY, Cooper or T&B.

Junction Boxes: Junction boxes, device boxes, fixture support boxes, oblong, round and rectangular conduit fittings (condulets) shall be of the same material as required by the area classification for the raceway. Junction boxes for use in general purpose areas shall be zinc electroplated cast ferrous alloy. Integrally cast threaded hubs or bosses shall be provided for all conduit entrances and shall provide for full 5 thread contact on tightening. Drilling and threading shall be complete before finishing. Boxes shall be Crouse-Hinds type FS, FD, T&B or Appleton 7.2. Cover plates shall be of similar cast ferrous alloy material and finish. Full body neoprene gaskets shall be provided with all covers and shall fastened with stainless steel screws. NEMA 12 boxes shall be of heavy gauge sheet steel, or cast metal. All NEMA 12 boxes shall be provided with a 5 mil thick light gray thermo-epoxy finish, and designed so that moisture will drain away from the gasketed cover joint. Covers for sheet steel boxes shall have turned edges, ground smooth to form a tight seal against the gasket when the cover is closed.

Conduit and Cable Supports:

Conduit Supports: Hot-dip galvanized framing channel shall be used to support groups of conduit. Individual conduit supports shall be one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required. Conduit supports for PVC or epoxy coated rigid steel and PVC conduit systems shall be one hole PVC or epoxy coated clamps or PVC conduit wall hangers.

Ceiling Hangers: Ceiling hangers shall be adjustable galvanized carbon steel rod hangers as specified. Straps or hangers of plumber's perforated tape are not acceptable. Unless otherwise specified, hanger rods shall be 1/2-inch all-thread rod and shall meet ASTM A193. Hanger rods in corrosive areas and those exposed to weather or moisture shall be stainless steel.

Racks: Racks shall be constructed from framing channel. Galvanized channels and hanger rods shall be steel, hot dip galvanized, 1.5 oz. / sq. ft. after fabrication. Field cuts shall be re-galvanized by the Galv-A-Weld process or by GAL-VAN-IZE as manufactured by LAWSON Products Inc., T&B or, Fasenal. Channels attached directly to building surfaces shall be 14 gauge minimum thickness, 1-5/8 inch deep. Channel section shall be sufficient to limit deflection to 1/360 of span. Framing channels on all exterior areas and in corrosive areas shall be aluminum stainless steel, or fiberglass. All hardware shall be stainless steel. Channel section shall be sufficient to limit deflection to 1/360 of span. Framing channel shall be as manufactured by Unistrut, FlexStrut or Cooper B-Line.

Conduit Schedule:

Refer to conduit schedule for raceway sizing and routing description.

PART 3 - EXECUTION

INSTALLATION

Conduit:

General:

1. The Contractor shall limit the number of directional changes of the conduit to a total not more than 270 degrees in any run between pull boxes. Conduit runs shall be limited to 300 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction. Bends and offsets shall be avoided where possible but, where necessary, shall be made without flattening or kinking, or shall be factory preformed bends. Turns shall be made with case metal fittings or conduit bends. Welding, brazing or otherwise heating of conduit is not acceptable.
2. Where required for pulling cable and as necessary to meet the requirements of the previous Paragraph, the Contractor shall provide cast junction or pull boxes. Pull boxes used for multiple conduit runs shall not combine circuits fed from different MCCs, switchboards, or switchgear.

3. Unless otherwise specified, conduit entering field equipment enclosures shall enter the bottom or side of the box. Where conduit comes from above, it shall be run down beside the enclosure and a tee conduit and drip leg shall be installed.
4. When new conduit is added to areas which are already painted, the conduit and its supports shall be painted to match the existing facilities. Where new conduit is used to replace existing conduit, the existing conduit and supports shall be removed, resulting blemishes shall be patched and repainted to match original conditions. Similarly, if existing conduits are to be reused and rerouted, resulting blemished shall be corrected in the same manner.

Conduit Penetrations:

1. Unless otherwise specified, conduit routed perpendicular through floors, walls or other concrete structures shall pass through cast-in-place openings wherever possible. In cases where cast-in-place openings are not possible, appropriate size holes shall be bored through the concrete to accommodate the conduit passage. The size and location of the holes shall not impair the structure's integrity. After completion, grout or caulk around conduit and finish to match existing surroundings. Unless otherwise protected, conduits that rise vertically through the floor shall be protected by a 3-1/2-inch high concrete pad with a sloping top.
2. Conduits entering manholes and handholes shall be horizontal. Conduits shall not enter through the concrete bottom of handholes and manholes.
3. Wherever conduits penetrate outdoor concrete walls or ceilings below grade, the Contractor shall provide a watertight seal as manufactured by O.Z. Gedney Co., Type CSM Series; Thunderline Corp., or Link Seal.
4. Wherever conduits enter buildings or structures below grade, seal the conduit opening (after installation of conductors and cables), with conduit sealing material, to prevent water from entering the structure, enclosure, etc. Sealing compound to be a pliable, removable putty-type compound listed for the application.

Conduit Separation: Signal conduits shall be separated from AC power or control conduits. The separation shall be a minimum of 12 inches for metallic conduits and 24 inches for nonmetallic conduits.

Conduit Seals for Hazardous or Corrosive Areas:

1. Each conduit passing from a hazardous or corrosive area into a non-hazardous or non-corrosive area shall be provided with a sealing fitting which may be located on either side of the boundary. The seal shall be located at the boundary in accordance with the NEC.
2. Seal fittings for conduit systems in hazardous atmosphere locations shall be hot-dip galvanized case ferrous alloy. Sealing compound shall be hard type, Chico A, OZ-Gedney Type EYC or Appleton Kwiko, UL listed for explosion-proof sealing fittings. Sealing compound shall be non-hardening type for corrosive areas. Provide reducing bushings and larger seals as required to meet NEC 25 percent fill.

Raceway Numbering:

Each conduit shall be provided with a number tag at each end and in each manhole and/or pullbox. Trays shall be identified by stencils at intervals not exceeding 50 feet, at intersections, and at each end.

Conduit Separation: Signal conduits shall be separated from AC power or control conduits. The separation shall be a minimum of 12 inches for metallic conduits and 24 inches for nonmetallic conduits.

Conduit Seals for Hazardous or Corrosive Areas: Each conduit passing from a hazardous or corrosive area into a non-hazardous or non-corrosive area shall be provided with a sealing fitting which may be located on either side of the boundary. The seal shall be located at the boundary in accordance with the NEC. Seal fittings for conduit systems in hazardous atmosphere locations shall be hot-dip galvanized case ferrous alloy. Sealing compound shall be hard type, Chico A, OZ-Gedney Type EYC or Appleton Kwiko, UL listed for explosion-proof sealing fittings. Sealing compound shall be non-hardening type for corrosive areas. Provide reducing bushings and larger seals as required to meet NEC 25 percent fill.

12-16.06 CONDUCTORS AND CABLES

PART 1 - GENERAL

DATA TO BE FURNISHED

Submit all catalog data in accordance with the submittals requirements per Electrical Work as specified herein. Show material information and confirm compliance with these specifications.

PART 2 - PRODUCTS

General: With the exception of lighting, communication, paging, security and receptacle circuits, the type, size and number of conductors shall be as specified on the Plans or schedules. Lighting and receptacle circuit conductors are unscheduled and shall be sized by the Contractor in accordance with the NEC to limit voltage drop to 3 percent. Number and types of communication, paging, and security cables shall be a required for the particular equipment provided.

Lighting and Receptacle Branch Circuit Conductors:

Lighting conductors shall be stranded except for 12 AWG which shall be solid. Minimum conductor size shall be 12 AWG. Conductors shall be provided with the following characteristics:

1. Voltage: 600 volts
2. Conductor: Bare soft annealed copper, Class B stranded per ASTM-8; solid per ASTM B-3
3. Insulation: THWN/THHN, 90 °C dry, 75 °C wet polyvinylchloride (PVC)
4. Jacket: Nylon
5. Flame resistance: UL 83
6. Manufacturer: Okonite, Southwire or Housron Wire.

Power and Control Conductors and Cable, 600 Volt:

Single Conductor: Single conductor cable shall be stranded and shall be used in conduits for power and control circuits. Conductor shall be provided with the following characteristics:

1. Voltage: 600 volts
2. Conductor: Uncoated, soft annealed copper, Class B stranded per ASTM B-8
3. Insulation: Power: THWN, 90 °C/75 °C continuous rating, wet or dry (as specified)
4. Control: THHN/THWN, 90 °C/75 °C continuous rating, wet or dry
5. Flame resistance: UL 83
6. Manufacturer: Okonite, Southwire or Houston Wire

Multiconductor Cable:

Multiconductor cable shall be used for power and control circuits routed in cable tray. Cables shall be UL labeled, Type TC, designed for cable tray installation in accordance with NEC 340. The type of insulation, number of conductors, and size of conductor shall be as specified.

Power Cable: Multiconductor power cable shall contain three or four conductors, as specified, plus an equipment grounding conductor.

1. Conductors shall be provided with the following characteristics:
 - 1.1. Voltage: 600 volts
 - 1.2. Conductors: Annealed copper, stranded, per ASTM B8
 - 1.3. Insulation: RHH/ RHW or THHN/THWN, 90 °C dry, 75 °C wet, (PVC) with a nylon jacket, ICRA S-61-402 (as specified)
 - 1.4. Jacket: Polyvinylchloride (PVC)
 - 1.5. Flame resistance: UL 1277

- 1.6. Manufacturer: Okonite, Southwire or Houston Wire.
2. Control Cable: Unless otherwise specified multi conductor control cables shall be 14 AWG and meet the following characteristics:
 - 2.1. Voltage: 600 volts
 - 2.2. Conductors: Annealed copper, stranded, per ASTM B8
 - 2.3. Insulation: THHN/THWN, 90 °C dry, 75 °C wet, cross-linked polyethylene (XLP), (CSPE) per ICEA S-66-524
 - 2.4. Jacket: Polyvinylchloride (PVC)
 - 2.5. Flame resistance: IEEE 383, 210, 000 Btu/hr
 - 2.6. Manufacturer: Belden, Southwire, or Houston Wire

Direct Burial:

Direct burial shall be multiconductor type MC cable. Cable shall be suitable for direct burial or encased in concrete, normal or Class 1, Division 2 atmospheres. Cable characteristics shall be as follows:

1. Voltage: 600 volts
2. Conductor: Conductor(s) shall be bare annealed stranded copper. Size and number of conductors shall be as specified on the circuit schedule.
3. Insulation: Insulation shall be Type XHHW, meeting NEMA WC-7 and UL 44.
4. Assembly: The individual conductors shall be cabled together with nonhygroscopic fillers and a binder tape overall. An impervious, continuous, corrugated aluminum sheath shall be welded over the cable core with a black flame-retardant PVC jacket of not less than 50 mils extruded over the armor. Nonwelded type sheath is not acceptable.
The armor shall meet the grounding conductor requirements of Table 250-95 of the NEC and UL requirements.

Signal Cables:

General: Signal cable shall be provided for instrument signal transmission, alarm, communication and any circuit operating at less than 100 volts. Cables shall be color coded black and white for pairs or black, white and red for triads. Circuit shielding shall be provided in addition to cable shielding. Circuits for type a and b signals specified in Instrumentation and Control Systems Section as specified herein, shall be provided in compliance with the instrument manufacturer's recommendations.

Single Circuit: Cable shall consist of one pair or triad, 18 AWG conductors with 15 mils of 90 °C polyvinylchloride (PVC) insulation, 4 mils nylon conduit or jacket, twisted on a 2-inch lay, and covered with a 100 percent 1.35 mil aluminum-Mylar tape shield with 18 AWG 7-strand tinned copper drain wire and a 45 mil PVC jacket overall. Cable shall be UL listed, Type TC, rated 300 volts. Cable shall be Belden, Allied Wire and Cable (AWC) or Draka.

Multiple Circuit: Cable shall consist of four or more pairs or triads which are made up of 18 AWG conductors with 15 mils of 90 °C PVC insulation, 4 mils nylon jacket, twisted on a staggered lay 1-1/2 to 2-1/2 inches, and covered with a 100 percent 1.35 mil aluminum-Mylar tape shield with 22 AWG, 7-strand tinned copper drain wire. Overall cable shield shall be 2.35 mil aluminum-Mylar tape with a 20 AWG, 7-strand tinned copper drain wire. Cable shall be UL listed, Type TC, 600 volts. Cable shall be Belden, AWC, Draka, or Okonite's Okoseal-N Type SP-OS.

Thermocouple Extension: Extension cable shall be provided for the type of thermocouple circuit specified. Conductors shall be 16 AWG, solid alloy, with 15 mils of 90 °C flame-retardant polyvinylchloride insulation, twisted and covered with 100 percent 2.35 mil aluminum polyester tape and a 20 AWG, 7-strand, tinned-copper drain wire and a 35 mil, flame-retardant PVC jacket overall. Cable shall be approved for cable tray installation and shall be Belden, AWC or Draka.

Connectors:

Pre-insulated Connectors for splices and taps in conductors 10 AWG and smaller shall be Ideal Industries "Wing Nut," 3M Company "SCOTCHLOCK," or Wago. For 8 AWG and larger, conductors shall be T&B, O.Z. Gedney, or Hubbel compression connectors. Compress using manufacturers recommended die and tools.

Waterproof silicone filled "wing nut" type connectors or spade/lug type terminations and terminals and coat with liquid insulation shall be used for all connections of wire to cord to removable equipment provided with integral cords (such as floats, transmitters, limit switches, etc.) in junction boxes in underground handholes or outdoor junction boxes. Insulators shall be T&B multi splice insulator MSLT112-4, Cooper, or Hubbel.

Splice Insulation:

Splice insulation shall be equal or greater than the insulation level of the conductor used.

All permanent splices that are underground or in damp or corrosive environments shall be insulated with cast epoxy type insulation which covers the jacket of all cords and the insulation on all wire.

Wiring Schedule:

Refer to cable schedule for description of conductors required.

Motor Terminal Splice Insulation:

Motor terminal splice insulation in the motor connection box shall be provided which will withstand constant vibration and abrasion without degrading the insulation of the splice. A product shall be used that is specifically designed for the purpose of motor terminations in accordance with the following:

1. Motor splices in general purpose areas: bolted splice with a TY-RAP boot type insulator. Splices using wire larger than 8 AWG may be heat shrinkable motor connection stub splices.
2. Motors in outdoor, damp, or corrosive environments: waterproof motor stub insulator. Splices using wire larger than 8 AWG may be heat shrinkable motor connection stub splices.

Wire Markers:

Field installed wire markers shall be T&B SMS, 3M or pre-printed clip-on markers, or pre-printed T&B SMS, 3M or Scotchcode.

PART 3 - EXECUTION**General:**

Each power and control conductor shall be identified at each terminal to which it is connected.

Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the cable insulation. Soapstone, talc or UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete, cleaned, and protected from the weather before cable is placed in the raceway.

600 Volt Conductor and Cable:

Conductors in panels and electrical equipment, 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring duct. Conductors crossing hinges shall be bundled into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.

Slack shall be provided in junction and pull boxes, handholes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box. Amount of slack shall be equal to largest dimension of the box. Where plastic panel wiring duct is provided for wire runs, lacing is not required.

Solid wire shall not be lugged, nor shall electrical spring connectors be used on any except for solid wires in lighting and receptacle circuits. Lugs and connectors shall be installed with a compression tool.

All splices and terminations are subject to inspection by the Engineer prior to and after insulating. Terminations at 460-volt motors shall be made by bolt-connecting the lugged connectors. Connections shall be insulated and sealed with factory-engineered kits. Bolt connection area shall be kept free of mastics and fillers to facilitate rapid stripping and re-entry. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer's tolerances.

In-line splices and tees, where approved, shall be made with tubular compression connectors and insulated as specified for motor terminations, except that conductors 10 AWG and smaller may be spliced using self-insulating connectors. Splices and tees in underground handholes or pull boxes shall be insulated using epoxy resin splicing kits. Terminations at devices with 120 volt pigtail leads shall be made using self-insulating tubular compression connectors.

Terminations at solenoid valves, 120 volt motors, and other devices furnished with pigtail leads shall be made using self insulating tubular compression connectors.

In the case where multiple field located instrumentation and control devices require parallel or series wiring configuration, it shall be done at one location in one junction box or marshalling enclosure with terminals. Interconnection of instrumentation and control devices shall not be done within conduit bodies (i.e., LBs and condulets).

Signal Cabling:

Circuit runs shall be of individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Terminal blocks shall be provided at instrument cable junctions unless otherwise specified. Signal circuits shall be run without splices between instruments, terminal boxes, or panels.

Shields shall not be used as a signal path, except for coaxial cable circuits operating at radio frequencies.

Unless otherwise specified, shields shall be bonded to the signal ground bus at the control panel and isolated from ground and other shields at other locations. Terminals shall be provided for running signal leads and shield drain wires through junction boxes.

Spare circuits shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run. Terminal boxes shall be provided at instrument cable splices. If cable is buried or in raceway below grade at splice, an instrument stand shall be provided as specified with terminal box mounted approximately 3 feet above grade.

Cable for paging, telephone, and security systems shall be installed and terminated in compliance with the manufacturer's recommendations.

Portable Cord:

Portable cord feeding permanent equipment, such as pendant cords, pumps, cranes, hoists and portable items shall have a wire mesh cord grip of flexible stainless steel wire to take the tension from the cable termination. Connection of portable cords to permanent wiring shall be accomplished with the use of terminals. In-line taps and splices shall be used only where specified.

Color Coding:

Wiring shall conform to the following color code, unless otherwise specified.

Insulation on phase conductor sizes 8 AWG and smaller shall be colored, 6 AWG and larger may have black insulation with plastic tape of the appropriate color from the table below.

Insulation on the grounded conductor (neutral) sizes 6 AWG and smaller shall be colored; 4 AWG and larger may have black insulation with plastic tape of white or gray in accordance with the table below.

Description	208Y/120 V	480Y/277 V	Control
Phase A (Left, Top, Front)	Black	Brown	---
Phase B (Center, Center, Center)	Red	Orange	---
Phase C (Right, bottom, Back)	Blue	Yellow	---
Neutral	White	Gray	White
Ground	Green	Green	Green
120 V(AC) Control	---	---	Red
120 V(AC) Control	Neutral	---	White
DC Control (+)	---	---	Purple
DC Control (-)	---	---	Gray
External Source	---	---	Yellow

All control wiring in control panels or other enclosures that is powered from an external source and is not disconnected by the control panel disconnect shall be terminated at a disconnecting terminal block (with energization indicator light) upon entering the enclosure. The color of the wire shall then be changed to yellow to identify it as being powered from an external source. Provide identification nameplate on exterior of enclosure to indicate sources of external power.

All wiring in industrial machines and equipment shall be in accordance with NFPA 79. Notify the Engineer and the City of Burbank of any deficiencies noted during installation.

Terminal Marking:

All terminals in instrument and relay compartments, motor control centers, in control panels, instrument panels, field panels and control stations, as well as connections to mechanical equipment shall have reference number and letter in accordance to the following:

1. h = Control power hot
2. n = neutral
3. g = ground
4. x = PLC input
5. y = PLC output
6. ax = PLC signal/analog input
7. ay = PLC signal/analog output
8. c = control
9. p = power
10. A = signal

Wire Bending Radius:

The radius of bends in all non-shielded wire (conductors and cables) shall not be less than eight times the outside diameter of the wire. Shielded or lead covered wire shall not be bent to a radius less than twelve times the diameter of the wire. Any wire installed with bends less than the allowed diameter and which the Engineer deems has caused that insulation to be damaged, shall be removed and new wire shall be installed.

General Tests:

The Contractor shall perform voltage, current and resistance tests as required to complete the Electrical System Test Report form provided at the end of this section. Test reports shall be submitted to the Engineer prior to final acceptance by the Engineer and the City of Burbank. The Contractor shall inform the Engineer of scheduled testing a minimum of 5 days prior to the testing. Testing shall not take place unless the Engineer or the City of Burbank representative is present to witness the testing.

The Contractor shall undertake all such corrective measures if the test results indicate corrective measures are required. No additional compensation will be paid for corrective measures

Test Scope: The Contractor shall provide all material, equipment, labor and technical supervision to perform tests and inspections as specified herein. It is the intent of these tests to assure that all electrical equipment as supplied and installed by the Contractor is operational within the industry and manufacturer's tolerances and is installed in accordance with the design documents. The tests and inspection shall determine the suitability for energization.

Conductor Tests: Following the completion of installation, the following conductors shall be tested in accordance with Electrical Testing Section as specified herein. All 480 volt power feeders scheduled in Conduit and Cable Schedule. Service conductors and feeder conductors. All new grounding; measure ground resistance at each ground rod.

Visual and Mechanical Inspections: Inspect exposed section for physical damage. Verify cable is supplied and connected in accordance with specifications and one line diagram, and that phases are labeled correctly.

Electrical Tests: Perform insulation resistance test on each cable in reference to ground and adjacent conductors in the same raceway. Perform continuity test to ensure proper cable connection.

Test Values: Insulation resistance tests shall be performed at 1000 volts DC for one-half minute. Minimum megger readings at 20 °C shall be one megohm. The maximum acceptable reading for an individual ground rod shall be 25 ohms as required by the NEC and measured by the three rod method. The composite ground electrode shall have a maximum acceptable reading of 15 ohms.

ATTACHMENT: ELECTRICAL SYSTEM TEST REPORT - 600V CABLE
ELECTRICAL SYSTEM TEST REPORT - 600V CABLE

**ELECTRICAL SYSTEM
DESCRIPTION DATA**

SERVICE DESCRIPTION:

nominal voltage, phase to phase _____
 phase to neutral - single or three phase- _____
 number of conductors _____

SERVICE CONDUCTORS:

phase size and insulation type _____
 neutral size and insulation type _____
 ground size and insulation type _____

SERVICE DISCONNECT DESCRIPTION:

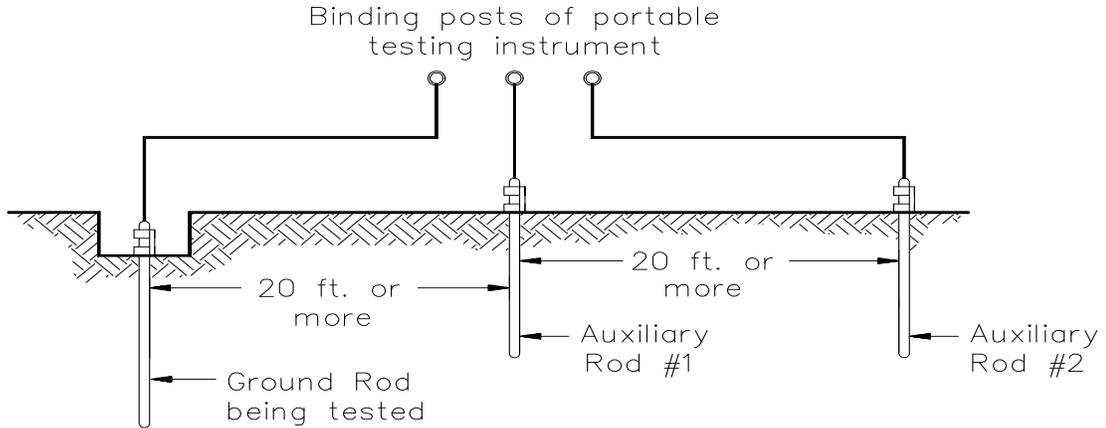
circuit breaker or disconnect switch _____
 size (amps) _____
 fuse (amps) _____

MEASURED CONDITIONS

DATA

Operating Load Voltage	Volts	Vab_____ Vbc_____	Vca_____
		Van_____ Vbn_____	Vcn_____
Operating Load Feeder Current	Amps	Ia_____ Ib_____ Ic_____	
Conductor Insulation Resistance (record the indicated measurement for each of the following circuits:)	Megohms	a-b_____ b-c_____	c-a_____
	Megohms	a-g_____ b-g_____	c-g_____
		Service Feeder	
		Pump Feeders	

ELECTRICAL GROUND ROD TEST REPORT



GROUND ROD RESISTANCE TESTING

Procedure:

To measure ground resistance, two additional temporary grounds, consisting of short rods 2 or 3 foot long, shall be driven in the ground at least 20 foot. away from the rod being tested. A direct-reading ground resistance tester shall then be connected to the three ground rods by means of insulated leads. The battery operated ground resistance tester reads the resistance of the ground rod being tested directly in ohms. The ground rod location / designation and its measured ohm value shall be recorded in chart below.

GROUND ROD LOCATION / DESIGNATION	OHM VALUE
1.	*
2.	*
3.	*
COMPOSITE GROUND	*

* Ohm value of a single ground rod shall not exceed 15 ohms. If additional ground rod(s) are added, the "composite" ground electrode shall have a maximum acceptable reading of 15 ohms which shall be recorded in chart above.

12-16.07 ELECTRICAL IDENTIFICATION OF UNITS AND CONDUCTORS

PART 1 - GENERAL

DATA TO BE FURNISHED

Product Data: For each electrical identification product indicated.

Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

PART 2 - PRODUCTS

Power and Control Raceway Identification Materials:

Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable. Markers for tags shall meet the following:

1. Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

Armored and Metal-Clad Cable Identification Materials:

Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

Colors for Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER HIGH VOLTAGE WIRING."

Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 °F. Comply with UL 224.

Power and Control Cable Identification Materials:

Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

Conductor Identification Materials:

Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

Floor Marking Tape:

2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

Underground-Line Warning Tape:

Tape: Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines. Printing on tape shall be permanent and shall not be damaged by burial operations. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

Color and Printing: Comply with ANSI Z535.1 through ANSI Z535.5. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

Warning Labels and Signs:

Comply with NFPA 70 and 29 CFR 1910.145.

Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. "Arc Flash and Shock Hazard Warning". Include flash protection boundary, incident energy, working distance, and required PPE level.

Instruction Signs:

Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 square inches and 1/8 inch thick for larger sizes. Engraved legend with black letters on white face. Punched or drilled for mechanical fasteners. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

Equipment Identification Labels:

Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

Cable Ties:

General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon. Minimum Width: 3/16 inch. Tensile Strength at 73 °F, According to ASTM D 638: 12,000 psi. Temperature Range: Minus 40 to plus 185 °F. Color: Black except where used for color-coding.

UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon. Minimum Width: 3/16 inch. Tensile Strength at 73 °F, According to ASTM D 638: 12,000 psi. Temperature Range: Minus 40 to plus 185 °F. Color: Black.

Minimum Width: 3/16 inch. Tensile Strength at 73 °F, According to ASTM D 638: 7000 psi. UL 94 Flame Rating: 94V-0. Temperature Range: Minus 50 to plus 284 °F. Color: Black.

Miscellaneous Identification Products:

Paint: Comply with requirements in painting sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

INSTALLATION

Verify identity of each item before installing identification products.

Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

Apply identification devices to surfaces that require finish after completing finish work.

Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

Identification Schedule:

Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at 30-foot maximum intervals.

Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits
 - 2.1. Phase A: Black.
 - 2.2. Phase B: Red.
 - 2.3. Phase C: Blue.

3. Colors for 480/277-V Circuits

- 3.1. Phase A: Brown.
- 3.2. Phase B: Orange.
- 3.3. Phase C: Yellow.
- 3.4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.

Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

Coordinate identification with Project Plans, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Limit use of underground-line warning tape to direct-buried cables. Install underground-line warning tape for both direct-buried cables and cables in raceway.

Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - 4.1. Power transfer switches.
 - 4.2. Controls with external control power connections.
 - 4.3. Switchgear.
 - 4.4. Switchboards.
 - 4.5. Motor Control Centers.

Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions

- 1.1. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- 1.2. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- 1.3. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- 1.4. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to be Labeled

- 2.1. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
- 2.2. Enclosures and electrical cabinets.
- 2.3. Access doors and panels for concealed electrical items.
- 2.4. Switchgear.
- 2.5. Switchboards.
- 2.6. Transformers: Label that includes tag designation shown on Plans for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- 2.7. Emergency system boxes and enclosures.
- 2.8. Motor-control centers.
- 2.9. Enclosed switches.
- 2.10. Enclosed circuit breakers.
- 2.11. Enclosed controllers.
- 2.12. Push-button stations.
- 2.13. Power transfer equipment.
- 2.14. Contactors.
- 2.15. Remote-controlled switches, dimmer modules, and control devices.
- 2.16. Battery-inverter units.
- 2.17. Battery racks.
- 2.18. Power-generating units.
- 2.19. Monitoring and control equipment.
- 2.20. UPS equipment.

12-16.08 ELECTRICAL TESTING

PART 1 - GENERAL

DATA TO BE FURNISHED

Submit schedules and sample copies of inspection forms in accordance with Electrical Work as specified herein.

Administrative Submittals: Submit 30 days prior to performing inspections or tests:

1. Schedule for performing inspection and tests.

2. List of references to be used for each test.
3. Sample copy of equipment and materials inspection form(s).
4. Sample copy of individual device test form.
5. Sample copy of individual system test form.
6. Copies of all testing personnel's certifications.

Quality Control Submittals: Within 30 days after completion of test and prior to substantial completion of project, submit test or inspection reports and certificates for each electrical item tested.

Contract Closeout Submittals (Operation and Maintenance Data):

1. In accordance with electrical work as specified herein.
2. After test or inspection reports and certificates have been reviewed by the Engineer and the City of Burbank's representative and returned, insert a copy of each in operation and maintenance manual.

Sequencing and Scheduling:

1. Perform inspection and electrical tests after equipment has been installed.
2. Perform tests with apparatus de-energized whenever feasible.
3. Notify the Engineer and the City of Burbank's representative at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 - PRODUCTS

GENERAL

Tests and inspection shall establish that:

1. Electrical equipment is operational within industry and manufacturer's tolerances.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of contract documents and NFPA 70, NFPA 70E, and ANSI C2.
5. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
6. Set, test, and calibrate protective relays, circuit breakers, and other applicable devices as required to coordinate with next upstream and downstream devices.
7. Adjust mechanisms and moving parts for free mechanical movement.
8. Adjust adjustable relays and sensors to correspond to operating conditions or as recommended by manufacturer.
9. Verify nameplate data for conformance to contract documents.
10. Realign equipment not properly aligned and correct unlevelness.
11. Properly anchor electrical equipment that is found to be inadequately anchored.
12. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations or as otherwise specified.
13. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
14. Provide proper lubrication of applicable moving parts.
15. Inform the Engineer and the City of Burbank's representative of working clearances not in accordance with NFPA 70.
16. Investigate and repair or replace.
17. Electrical items that fail tests.
18. Active components not operating in accordance with manufacturer's instructions.
19. Damaged electrical equipment.

Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.

4. Repair or replace, as determined by the Engineer and the City of Burbank's representative, door and panel sections having dented surfaces.
5. Repair or replace, as determined by the Engineer and the City of Burbank's representative, poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.

Finish: Provide matching paint and touch up scratches and mars. If required due to extensive damage, as determined by the Engineer and the City of Burbank's representative, refinish the entire assembly.

Replace fuses and circuit breakers that do not conform to size and type required by the contract documents.

PART 3 - EXECUTION

SWITCHBOARD ASSEMBLIES

Visual and Mechanical Inspection:

1. Insulator damage and contaminated surfaces.
2. Proper barrier and shutter installation and operation.
3. Proper operation of indicating devices.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
 - 7.1. Closure attempt of device when door is in open position.
 - 7.2. Opening attempt of door when device is in on position.
8. Check nameplates for proper identification of:
 - 8.1. Equipment title and tag number with latest single-line diagram.
 - 8.2. Circuit breaker.
9. Verify that fuse and circuit breaker ratings, sizes, and types conform to those specified.
10. Check bus and cable connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints.
 - 10.1. Ohmic value to be zero.
 - 10.2. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
11. Verify performance of each control device and feature.
12. Control Wiring:
 - 12.1. Compare wiring to local and remote control and protective devices with elementary diagrams.
 - 12.2. Proper conductor lacing and bundling.
 - 12.3. Proper conductor identification.
 - 12.4. Proper conductor logs and connections.
13. Exercise active components.
14. Perform phasing check to ensure proper bus phasing from each source.

Electrical Tests:

1. Insulation Resistance Tests:
 - 1.1. Applied megohmmeter d-c voltage in accordance with NETA ATS, Table 7.1.1.
 - 1.2. Each phase of each bus section.
 - 1.3. Phase to-phase and phase to-ground for one minute.
 - 1.4. With breakers open.
 - 1.5. With breakers closed.
 - 1.6. Control wiring except that connected to solid-state components.
 - 1.7. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Overpotential Tests: Applied a-c or d-c voltage and test procedure in accordance with ANSI C37.20.1, C37.20.2, and C37.20.3. Each phase of each bus section. Phase to-phase and phase to-ground for one minute. Test results evaluated on a pass/fail basis.
3. Current Injection Tests: For entire current circuit in each section. Secondary injection for current flow of 1 ampere. Test current at each device.
4. Control Wiring: Apply secondary voltage to control power and potential circuits. Check voltage levels at each point on terminal boards and each device terminal.
5. Operational Test: Initiate control devices. Check proper operation of control system in each section.

DRY-TYPE TRANSFORMERS

Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
 - 2.1. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
 - 2.2. Defective wiring.
 - 2.3. Proper operation of fans, indicators, and auxiliary devices.
 - 2.4. Removal of shipping brackets, fixtures, or bracing.
 - 2.5. Free and properly installed resilient mounts.
 - 2.6. Cleanliness and improper blockage of ventilation passages.
 - 2.7. Verify that tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
 - 2.8. Verify proper secondary voltage phase to-phase and phase to-ground after energization and prior to loading.

Electrical Tests:

Insulation Resistance Tests:

1. Applied megohmmeter d-c voltage in accordance with NETA ATS, Table 7.2.3 for each:
 - 1.1. Winding-to-winding.
 - 1.2. Winding-to-ground.
2. Ten minute test duration with resistances tabulated at 30 seconds, one minute, and ten minutes.
3. Results temperature corrected in accordance with NETA ATS, Table 7.2.4.
4. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
5. Insulation resistance test results to compare within 1 percent of adjacent windings.

Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

LOW-VOLTAGE CABLES, 600 VOLTS MAXIMUM

Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable for:
 - 1.1. Physical damage.
 - 1.2. Proper connections in accordance with single-line diagram.
 - 1.3. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - 1.4. Color coding conformance with specifications.
 - 1.5. Proper circuit identification.
2. Inspect mechanical connections for:
 - 2.1. Proper lug type for conductor material.
 - 2.2. Proper lug installation.
 - 2.3. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
3. Inspect shielded instrumentation cables for:
 - 3.1. Proper shield grounding.
 - 3.2. Proper terminations.
 - 3.3. Proper circuit identification.
4. Inspect control cables for:
 - 4.1. Proper termination.
 - 4.2. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify that neutrals and grounds are terminated for correct operation of protective devices.

ELECTRICAL TESTS FOR CONDUCTORS NO. 6 AND LARGER

1. Insulation Resistance Tests:
 1. Utilize 1,000 volt d-c megohmmeter for 600 volt insulated conductors.
 2. Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for one minute.
 3. Evaluate ohmic values by comparison with conductors of same length and type.
 4. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

DISCONNECT SWITCHES, 600 VOLTS MAXIMUM

Visual and Mechanical Inspection:

1. Proper blade pressure and alignment.
2. Proper operation of switch operating handle.
3. Adequate mechanical support for each fuse.
4. Proper contact to-contact tightness between fuse clip and fuse.
5. Cable connection bolt torque level in accordance with NETA ATS, Table 10.1.
6. Proper phase barrier material and installation.
7. Verify that fuse sizes and types correspond to single-line diagram.

8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

Electrical Tests:

1. Insulation Resistance Tests:
 - 1.1. Applied megohmmeter d-c voltage in accordance with NETA ATS, Table 10.2.
 - 1.2. Phase to-phase and phase to-ground for one minute on each pole.
 - 1.3. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Contact Resistance Tests:
 - 2.1. Contact resistance in microhms across each switchblade and fuse holder.
 - 2.2. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

MOLDED AND INSULATED CASE CIRCUIT BREAKERS

General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.

Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.
3. Feeder designation according to nameplate and single-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 10.1.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or single-line diagram.
8. Verify that terminals are suitable for 75 °C rated insulated conductors.

Electrical Tests:

1. Insulation Resistance Tests:
 - 1.1. Utilize 1,000 volt d-c megohmmeter for 480 and 600 volt circuit breakers and 500 volt d-c megohmmeter for 240 volt circuit breakers.
 - 1.2. Pole to-pole and pole to-ground with breaker contacts opened for one minute.
 - 1.3. Pole to-pole and pole to-ground with breaker contacts closed for one minute.
 - 1.4. Test values to comply with NETA ATS, Table 10.2.
2. Contact Resistance Tests:
 - 2.1. Contact resistance in microhms across each pole.
 - 2.2. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Primary Current Injection Test to Verify:
 - 3.1. Long-time minimum pickup and delay.
 - 3.2. Short-time pickup and delay.
 - 3.3. Ground fault pickup and delay.
 - 3.4. Instantaneous pickup by run-up or pulse method.
 - 3.5. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3.6. Trip times shall be within limits established by NEMA AB 4, Table 5 3.
 - 3.7. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5 4.

INSTRUMENT TRANSFORMERS

Visual and Mechanical Inspection:

1. Visually check current, potential, and control transformers for:
 - 1.1. Cracked insulation.
 - 1.2. Broken leads or defective wiring.
 - 1.3. Proper connections.
 - 1.4. Adequate clearances between primary and secondary circuit wiring.
2. Verify mechanically that:
 - 2.1. Grounding and shorting connections have good contact.
 - 2.2. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

Electrical Tests:

1. Current Transformer Tests:
 - 1.1. Insulation resistance test of transformer and wiring to-ground at 1,000 volts d-c for 30 seconds.
 - 1.2. Polarity test.
2. Potential Transformer Tests:
 - 2.1. Insulation resistance test at test voltages in accordance with NETA ATS, Table 7.1.1 for one minute on:
 - 2.1.1. Winding to-winding.
 - 2.1.2. Winding to-ground.
 - 2.3. Polarity test to verify polarity marks or H1 X1 relationship as applicable.

Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 7.1.1.

METERING

Visual and Mechanical Inspection: Verify meter connections in accordance with appropriate diagrams. Verify meter multipliers. Verify that meter types and scales conform to contract documents. Check calibration of meters at cardinal points. Check calibration of electrical transducers.

GROUNDING SYSTEMS

Visual and Mechanical Inspection: Equipment and circuit grounds in motor control centers and panelboards assemblies for proper connection and tightness. Ground bus connections in motor control centers and panelboard assemblies for proper termination and tightness. Effective transformer core and equipment grounding. Accessible connections to grounding electrodes for proper fit and tightness. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

Electrical Tests:

1. Fall-of-Potential Test:
 - 1.1. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - 1.2. Main ground electrode system resistance to ground to be no greater than 3 ohms.

2. Two-Point Direct Method Test:

- 2.1. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
- 2.2. Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.

Testing per Grounding Section as specified herein.

A-C INDUCTION MOTORS

General: Inspection and testing limited to motors rated 1/2 hp and larger.

Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
 - 4.1. Excessive mechanical and electrical noise.
 - 4.2. Overheating.
 - 4.3. Correct rotation.
 - 4.4. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionality and proper operation.
 - 4.5. Excessive vibration.
5. Check operation of space heaters.

Electrical Tests:

1. Insulation Resistance Tests:
 - 1.1. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 10.2 for motors 200 hp and less for one minute duration with resistances tabulated at 30 and 60 seconds.
 - 1.2. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.
3. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

LOW-VOLTAGE MOTOR CONTROL

Visual and Mechanical Inspection:

1. Proper barrier and shutter installation and operation.
2. Proper operation of indicating and monitoring devices.
3. Proper overload protection for each motor.
4. Improper blockage of air cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
 - 7.1. Closure attempt of device when door is in OPEN position.
 - 7.2. Opening attempt of door when device is in ON position.
8. Check nameplates for proper identification of:

- 8.1. Equipment title and tag number with latest single-line diagram.
 - 8.2. Push buttons.
 - 8.3. Control switches.
 - 8.4. Pilot lights.
 - 8.5. Control relays.
 - 8.6. Circuit breakers.
 - 8.7. Indicating meters.
9. Verify that circuit breaker sizes and types conform to contract documents.
 10. Verify that current and potential transformer ratios conform to contract documents.
 11. Check bus connections for high resistance by low-resistance ohmmeter and calibrated torque wrench applied to bolted joints:
 - 11.1. Ohmic value to be zero.
 - 11.2. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
 12. Check operation and sequencing of electrical and mechanical interlock systems by:
 - 12.1. Closure attempt for locked open devices.
 - 12.2. Opening attempt for locked closed devices.
 - 12.3. Key exchange to operate devices in OFF-NORMAL positions.
 13. Verify performance of each control device and feature furnished as part of the motor control center.
 14. Control Wiring
 - 14.1. Compare wiring to local and remote control and protective devices with elementary diagrams.
 - 14.2. Check for proper conductor lacing and bundling.
 - 14.3. Check for proper conductor identification.
 - 14.4. Check for proper conductor lugs and connections.
 15. Exercise active components.
 16. Inspect contactors for:
 - 16.1. Correct mechanical operations.
 - 16.2. Correct contact gap, wipe, alignment, and pressure.
 - 16.3. Correct torque of all connections.
 17. Compare solid-state overload setting with full-load current for proper size and setting.
 18. Compare overload heater rating with full-load current for proper size.
 19. Compare motor protector and circuit breaker with motor characteristics for proper size.
 20. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.

Electrical Tests:

1. Insulation Resistance Tests:
 - 1.1. Applied megohmmeter d-c voltage in accordance with NETA ATS, Table 10.2.
 - 1.2. Bus section phase to-phase and phase to-ground for one minute on each phase.
 - 1.3. Contactor phase to-ground and across open contacts for one minute on each phase.
 - 1.4. Starter section phase to-phase and phase to-ground on each phase with starter contacts closed and protective devices open.
 - 1.5. Test values to comply with NETA ATS, Table 10.2.
2. Overpotential Tests:
 - 2.1. Maximum applied a-c or d-c voltage in accordance with NETA ATS, Table 7.1.2.
 - 2.2. Phase to-phase and phase to-ground for one minute for each phase of each bus section.

- 2.3. Test results evaluated on pass/fail basis.
3. Current Injection Through Overload Unit at 300 percent of Motor Full-Load Current and Monitor Trip Time:
 - 3.1. Trip time in accordance with manufacturer's published data.
 - 3.2. Investigate values in excess of 120 seconds.
4. Control Wiring Tests:
 - 4.1. Apply secondary voltage to control power and potential circuits.
 - 4.2. Check voltage levels at each point on terminal boards and each device terminal.
 - 4.3. Insulation resistance test at 1,000 volts d-c on control wiring except that connected to solid-state components. Insulation resistance to be 1 megohm minimum.
5. Operational test by initiating control devices to affect proper operation.

ENGINE-GENERATOR

Visual and Mechanical Inspection:

1. Compare equipment nameplate data with Plans and Specifications.
2. Inspect physical and mechanical condition.
3. Inspect correct anchorage and grounding.

Electrical and Mechanical Tests:

1. Perform an insulation-resistance test on generator winding with respect to ground in accordance with ANSI/IEEE 43.
2. Calculate polarization index.
3. Test protective relay devices in accordance with NETA ATS, Section 7.9.
4. Perform phase-rotation test to determine compatibility with load requirements.
5. Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other features as applicable.
6. Perform vibration baseline test. Plot amplitude versus frequency for each main bearing cap.
7. Conduct performance test in accordance with ANSI/NFPA 110, Section 5-13 (Installation Acceptance).
8. Verify correct functioning of governor and regulator.

Test Values:

1. Polarization index values shall be in accordance with ANSI/IEEE 43.
2. Vibration levels shall be in accordance with manufacturer's published data.
3. Performance tests shall conform to manufacturer's published data and ANSI/NFPA 110.

AUTOMATIC TRANSFER SWITCH

Visual and Mechanical Inspection:

1. Compare equipment nameplate data with Plans and Specifications.
2. Inspect physical and mechanical condition.
3. Confirm correct application of manufacturer's recommended lubricants.
4. Verify that manual transfer warnings are attached and visible.
5. Verify tightness of all control connections.
6. Inspect all bolted electrical connections for high resistance using one of the following methods:
 - 6.1. Use of low-resistance ohmmeter in accordance with NETA ATS, Section 7.22.3.2 (Electrical Tests).
 - 6.2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 10.12.

6.3. Perform thermographic survey in accordance with NETA ATS, Section 9.

7. Perform manual transfer operation.
8. Verify positive mechanical interlocking between normal and alternate sources.

Electrical Tests:

1. Perform a contact-resistance test.
2. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable, in accordance with NETA ATS, Section 7.22.3.1 (Visual and Mechanical Inspection).
3. Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed and across each open pole for one minute. Perform tests in both source positions. Test voltage shall be in accordance with manufacturer's published data or NETA ATS, Table 10.1.
4. Calculate polarization index.
5. Verify settings and operation of control devices.
6. Calibrate and set all relays and timers in accordance with NETA ATS, Section 7.9.
7. Perform automatic transfer tests:
 - 7.1. Simulate loss of normal power.
 - 7.2. Return to normal power.
 - 7.3. Simulate loss of emergency power.
 - 7.4. Simulate all forms of single-phase conditions.
8. Verify correct operation and timing of the following functions:
 - 8.1. Normal source voltage-sensing relays.
 - 8.2. Engine start sequence.
 - 8.3. Time delay upon transfer.
 - 8.4. Alternate source voltage-sensing relays.
 - 8.5. Automatic transfer operation.
 - 8.6. Interlocks and limit switch function.
 - 8.7. Time delay and retransfer upon normal power restoration.
 - 8.8. Engine cool down and shutdown feature.

Test Values:

1. Compare bolted connection resistance to values of similar connections.
2. Bolt-torque levels should be in accordance with NETA ATS, Table 10.12 unless otherwise specified by manufacturer.
3. Minimum insulation-resistance shall be in accordance with manufacturer's published data or NETA ATS, Table 10.1.
4. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar connections by more than 50 percent of the lowest value.

UNINTERRUPTIBLE POWER SUPPLY (UPS):

Visual and Mechanical Inspection:

1. Compare equipment nameplate information with Plans and Specifications.
2. Inspect physical and mechanical condition.
3. Check for correct anchorage, required area clearances, and alignment.
4. Verify that fuse sizes and types correspond to Plans.
5. Test electrical and mechanical interlock systems for correct operation and sequencing.
6. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 6.1. Use of low-resistance ohmmeter in accordance with NETA ATS, Section 7.22.2.2 (Electrical Tests).
 - 6.2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 10.12.

- 6.3. Perform thermographic survey in accordance with NETA ATS, Section 9.
7. Check operation of forced ventilation.
8. Verify that filters are in place and vents are clear.

Electrical Tests:

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable, in accordance with NETA ATS, Section 7.22.2.1 (Visual and Mechanical Inspection).
2. Test static transfer from inverter to bypass and back. Use normal load, if possible.
3. Set free-running frequency of oscillator.
4. Test d-c undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.

Test alarm circuits.

1. Verify sync indicators for static switch and bypass switches.
2. Perform electrical tests for UPS system breakers in accordance with NETA ATS, Section 7.6.1.
3. Perform electrical tests for UPS system automatic transfer switches in accordance with NETA ATS, Section 7.22.3.
4. Perform electrical tests for UPS system batteries in accordance with NETA ATS, Section 7.18.
5. Perform electrical tests for UPS rotating machinery in accordance with NETA ATS, Section 7.15.

Test Values:

1. Compare bolted connection resistance to values of similar connections.
2. Bolt-torque levels should be in accordance with NETA ATS, Table 10.12, unless otherwise specified by manufacturer.
3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar connections by more than 50 percent of the lowest value.

Transient Voltage Surge Suppressors (TVSS):

1. Visual and Mechanical Inspection:
 - 1.1. Adequate clearances between arresters and enclosures.
 - 1.2. Ground connections to ground bus.
2. Electrical Tests (Varistor-Type Arresters):
 - 2.1. Clamping voltage test.
 - 2.2. Rated rms voltage test.
 - 2.3. Rated d-c voltage test.
 - 2.4. Varistor arrester test values in accordance with ANSI C62.33, Sections 4.4 and 4.7.

12-16.09 GROUNDING

PART 1 - GENERAL

DATA TO BE FURNISHED

Action Submittals:

Product Data: For each type of product indicated.

Informational Submittals:

Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Grounding arrangements and connections for separately derived systems.
4. Grounding for sensitive electronic equipment.

Field quality-control reports.

Closeout Submittals:

Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. Include the following:

1. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2. Include recommended testing intervals.

PART 2 - PRODUCTS

Conductors:

Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches by 24 in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

Connectors:

Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts. Pipe connectors shall be clamp type, sized for pipe.

Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

Grounding Electrodes:

Ground Rods: Copper-clad steel, sectional type; 3/4 inch in diameter by 10 feet long.

PART 3 – EXECUTION

Applications:

Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

Grounding Underground Distribution System Components:

Comply with IEEE C2 grounding requirements.

Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

Equipment Grounding:

Install insulated equipment grounding conductors with all feeders and branch circuits.

Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including heaters, dampers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

Installation:

Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building. Install copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel. Bury ground ring not less than 24 inches from building's foundation.

Labeling:

Comply with requirements in Electrical Identification Section as specified herein for instruction signs. The label or its text shall be green.

Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

Field Quality Control:

Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

Perform tests and inspections. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
 - 3.1. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - 3.2. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Plans locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

Grounding system will be considered defective if it does not pass tests and inspections.

Prepare test and inspection reports.

Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1, 3 ohm(s).
5. Manhole Grounds: 10 ohms.

Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

12-16.10 WIRING DEVICES

PART 1 - GENERAL

DATA TO BE FURNISHED

Action Submittals:

Product Data: For each type of product.

Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

Informational Submittals:

Field quality-control reports.

Closeout Submittals:

Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

Manufacturers:

Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in these Special Provisions:

1. Cooper Crouse-Hinds Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Emerson Industrial, Appleton.

Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

General Wiring-Device Requirements:

Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Comply with NFPA 70.

Receptacles:

General Description: Receptacles shall have NEMA designation. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.

Explosion proof receptacles: Provide explosion proof receptacles for area identified as "Hazardous Area" in Plans. Provide explosion-proof outlet of the cast malleable iron type with sealing chamber to house receptacle. Unit shall be of dead front design with spring-loaded cover utilizing receptacle outlet as indicated. Provide watertight self-adjusting matching plug capable of securely locking to outlet with no danger of being accidentally withdrawn. Receptacles shall comply with NEC Class I Division 2. Provide Hubbell UGR series, Appleton "U-Line" series, or Crouse-Hinds "ENR series".

Weather proof receptacles: All exterior receptacles shall have weather proof cover. Provide Leviton Industrial Grade NEMA 5-20R, Hubbell HBL7423WO with weather protective covers or Fastenal BRY.

Toggle Switches:

Comply with NEMA WD 1, UL 20, and FS W-S-896.

Switches, 120/277 V, 20 A:

Products: Subject to compliance with requirements, provide one of the following:

1. Single Pole:
 - 1.1. Cooper; AH1221.
 - 1.2. Hubbell; HBL1221.
 - 1.3. Leviton; 1221-2.

2. Two Pole:
 - 2.1. Cooper; AH1222.
 - 2.2. Hubbell; HBL1222.
 - 2.3. Leviton; 1222-2.

3. Three Way:
 - 3.1. Cooper; AH1223.
 - 3.2. Hubbell; HBL1223.
 - 3.3. Leviton; 1223-2.

Explosion-Proof Switches: Provide explosion-proof switches for areas identified as "Hazardous Area" in the Plans. Provide factory-sealed tumbler switches, 20 amperes, 120-volt a-c. Comply with NEC Class I, Division 2, Groups C. Provide Appleton EDS series, Crouse-Hinds EDS series or Allen-Bradley EX Range.

Wall Plates:

Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

PART 3 – EXECUTION

Installation:

Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - 4.1. Cut back and pigtail, or replace all damaged conductors.
 - 4.2. Straighten conductors that remain and remove corrosion and foreign matter.
 - 4.3. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

Receptacle Orientation: Install ground pin of vertically mounted receptacles down and on horizontally mounted receptacles to the right.

Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

Identification:

Comply with Electrical Identification Section as specified herein.

Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

Field Quality Control:

Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is from 105 to 132 V(AC).
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

Wiring device will be considered defective if it does not pass tests and inspections.

Prepare test and inspection reports.

12-16.11 TRANSFER SWITCHES

PART 1 - GENERAL

DATA TO BE FURNISHED

Action Submittals:

Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

Informational Submittals:

Qualification Data: For manufacturer and testing agency.

Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined per Electrical Work for Electrical Systems as specified herein. Include the following:

1. **Basis for Certification:** Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 1.1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 1.2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. **Dimensioned Outline Drawings of Equipment Unit:** Identify center of gravity and locate and describe mounting and anchorage provisions.
3. **Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.**

Field quality-control test reports.

Closeout Submittals:

Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. "Operation and Maintenance Data," shall include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

PART 2 - PRODUCTS

Manufacturers:

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

Manufacturers: Transfer switches using molded-case switches or circuit breakers subject to compliance with requirements, provide products by one of the following:

1. ASCO Power Technologies
2. Eaton Electrical, Inc.; Cutler-Hammer.
3. GE Zenith

Transfer-Switch Product Requirements:

Transfer Switch:

Transfer switch shall be open type and installed in a vertical section of a motor control center as shown in the Plans. Transfer switch shall have number of poles, amperage, and voltage ratings as shown in the Plans. Transfer switch shall have number of poles, amperage, and voltage ratings as shown in the Plans. Withstand current rating shall not be less than 42,000-ampere rms symmetrical.

Switch shall be listed per UL 1008 as a recognized component for emergency systems and rated for all classes of loads.

Transfer switch shall be electrically operated and mechanically held in each direction by a single operating mechanism momentarily energized from the source to which the load shall be transferred. Accomplish mechanical locking in each direction without the aid of latching solenoids, toggle mechanisms, or gear arrangements. Total operating transfer time shall not exceed one-sixth of a second.

Operation shall be inherently double throw where normal and emergency contacts operate simultaneously with no momentary delay in a midposition. An overload or short circuit shall not cause the switch to go to a neutral position. Do not use main contact structures not originally manufactured for transfer switch service (molded case circuit breakers or contactors). Inspection and replacement of all contacts (stationary and arcing) shall be possible from the front of the switch without any disassembly of operating linkages or power conductors. Provide a handle to permit no-load manual operation.

Accessories:

Provide a solid-state sensing and control logic panel. Include the following operational characteristics:

1. Adjustable (0.5 to 6.0 seconds) time delay on engine starting to override momentary dips in normal source, set at 1 second.
2. Full phase voltage relay supervision of the normal source with at least one close differential relay to detect "brownout" condition, set at 70 percent dropout and 90 percent pickup.
3. Voltage/frequency lockout relay to prevent premature transfer, set at 90 percent voltage and 90 percent frequency.
4. Engine starting control contacts (one normally open and one normally closed).
5. Adjustable (2 to 25 minutes) time delay on retransfer to normal, set at 20 minutes.
6. Unloaded running time delay for generator cool down (adjustable 0.1 to 10 minutes), set at 5 minutes.
7. Transfer to emergency time delay (adjustable 1 to 300 seconds), set at 1 second.

Provide a system test switch (momentary type) on the front of the enclosure.

Manual push button to bypass the time delay on retransfer.

Indicating lights to indicate source to which the load is connected.

Indicating light to indicate presence of normal power source.

Control switches and indicating lights shall comply with Low Voltage Motor Control Section as specified herein.

Auxiliary contacts for remote indication of switch position, one normally open and one normally closed contact for normal and emergency position.

An in-phase monitor shall control transfer/retransfer operation between live sources when the sources are approaching and are sufficiently close to a zero-phase angle difference so as to avoid excessive motor inrush currents. The monitor shall cause in-phase transfer/retransfer to take place over engine-generator frequency ranges of 58 to 62 hertz with a utility source of 60 hertz. Normal transfer/retransfer operation shall automatically occur, without the use of manual overrides, in the event of a complete failure of the load-carrying source.

Transfer switch shall include four pilot contacts (10 amperes at 480-volt a-c) that open 60 seconds (nominal) prior to transfer and reclose three seconds (nominal) after transfer. These contacts will deenergize motor loads during the transfer time of the switch.

Source Quality Control:

Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 – EXECUTION

Installation:

Install transfer switch in motor control center.

Identify components according to Electrical Identification Section as specified herein.

Set field-adjustable intervals and delays, relays, and engine exerciser clock.

Connections:

Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost if necessary to accommodate required wiring.

Ground equipment according to Grounding Section as specified herein.

Connect wiring according to Conductors and Cables Section as specified herein.

Field Testing:

See Electrical Field Testing Section as specified herein.

Field test per manufacturer's recommended standard test procedure.

Field test and calibrate timing and monitoring logic. All adjustments shall be within 5 percent of the previously specified set points.

Field test and calibrate the in-phase monitor. Demonstrate that the switch transfers when source phase differences are within 20 degrees under varying generator speeds.

12-16.12 PANELS

PART 1 - GENERAL

DATA TO BE FURNISHED

Per Instrumentation and Control Systems Section as specified herein.

Dimensioned front view drawings.

Dimensioned internal equipment layout drawings.

Panel assembly drawings shall include sections showing clearances between face and rear mounted equipment with items keyed to the bills of materials.

Nameplate engraving schedule showing engraving by line, character size, and nameplate size.

Enclosure manufacturers' drawings.

Panel seismic calculations.

Panel wiring diagram for each panel. The diagram shall meet the requirements as set forth in the NFPA 79 Electrical standards for industrial machinery.

Calculations of percentage wire fill for wire ways including factory wiring and allowance for field wiring.

Panel load calculations.

UPS hold up time calculations.

PART 2 - PRODUCTS

Materials and Quality:

General:

Panel work shall be designed for seismic requirements per Electrical Work as specified herein.

Cutouts for future equipment shall be blanked off with suitable metal covers.

Nameplates shall identify face-mounted instruments per Electrical Identification Section as specified herein.

Instruments shall be mounted in a manner that allows ease of access to components and ease of removal.

Face-mounted instruments that are more than six inches deep, weigh more than 10 pounds, or exert more than a 4 ft-lb moment force on the face of the panel shall be supported underneath at the rear by a 1-inch x 1/8-inch thick steel angle.

Face-mounted equipment shall be flush or semi-flush with escutcheons.

Floor mounted cabinets without touch screen operator interface panels or panel mounted computers that are less than 60 inches high shall be provided with floor stands to raise the top of the panel to at least 60 inches above the floor or work platform. Wall mounting may be used in lieu of a floor stand if panel weighs less than 100 pounds and wall space is available.

Panels with touch screen operator interface or panel mounted computers shall be configured and installed so that center of screen is 60" AFF.

Fabrication of NEMA Type 4X Cabinets:

NEMA 250, Type 4X requirements

Fabricated from 14 gauge (minimum thickness) Type 316L stainless steel (or fiberglass when specifically specified) and provided with an interior frame or otherwise formed to provide a rigid structure.

Where face-mounted instruments are specified mount on an interior sub-panel.

Doors:

1. Vault-type latch and three-point latch hardware
2. Latch shall accept a 3/8-inch shackle padlock.
3. Unless shown otherwise, door width shall not exceed 36 inches.

For cabinets located outdoors, equip with rain and sun shields

Fabrication of NEMA 7D Cabinets: NEMA 250, Type 7 suitable for Class 1, Division 1, Group D classified area and assembled and installed to maintain this rating.

Heating and Ventilating:

Cooling shall be provided to maintain the internal panel temperature below 104 °F (40 °C) when all equipment is operating at its maximum heat load and the ambient temperature is 86 °F (30 °C). Filtered forced air ventilation shall be provided for NEMA 12 cabinets and either closed glycol loop heat exchange system or a mechanical refrigeration system for NEMA 4X and NEMA 7 enclosures.

Fans shall be equipped with UL-approved washable filters and provide at least 240 cfm. Noise level at three feet from exterior wall and 30 degrees off axis shall not exceed 60 dB.

Outdoor or below grade cabinets shall not be insulated and shall be provided with thermostatically controlled space heaters.

Heater wattage shall to maintain the air temperature inside the cabinet above the dew point or 50 °F (10 °C), whichever is higher, at all times.

If space heater surface temperature exceeds 122 °F (50 °C), an expanded metal guard shall be provided.

When a strip type heater is used, the heater shall be a 240 V(AC) heater and connected to 120 V(AC) and sized to produce the required heat at 120 V(AC).

Thermostat Acceptable Manufacturer:

1. Honeywell T631B1013
2. Penn Controls A28AA-4
3. Dayton 55-115F

Nameplates:

Machine engraved laminated white phenolic nameplates with black lettering shall be provided for panel mounted equipment.

Nameplate engraving shall be as specified and shall carry the instrument tag number in 3/32-inch minimum size lettering on the bottom line, or engraved as shown on the Plans.

Nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel screws.

Wording may be changed if changes are made prior to commencement of engraving.

Machine-printed laminated adhesive labels shall identify tag number of instruments and equipment inside panels.

Attach nameplates and labels to panel surfaces, not to instruments.

Machine embossed, adhesive backed nameplates shall identify the tag number of equipment inside cabinets.

Interconnection Wiring and Electrical Devices:

Interconnection Wiring:

Power, control, and signal wiring inside panels:

1. Conductor insulation shall be rated for 600 volts and 90 °C in dry locations.
2. All conductors shall be stranded copper.
3. Power and control conductors in panels shall have insulation type MTW, minimum 14 AWG.
4. Wiring for instrumentation analog signals shall be minimum 18 AWG; aluminum foil twisted shielded pairs, Belden type 8760, Encore Wire Type TC, or Okonite Type P-OS. Wiring for instrumentation analog signals shall be run continuously from measuring instrument to control cabinet terminal strips without splices.
5. Conductor size vs. fuse rating for conductors inside panels shall be as follows UNO:
 - 5.1. 18 AWG 1 AMP
 - 5.2. 14 AWG 15 AMPS
 - 5.3. 12 AWG 20 AMPS

Support wiring independent of terminations by slotted flame retardant plastic wiring channels

Wiring channels shall comply with UL94, Type V. Wiring channel fill shall not exceed 40 percent.

Wire Naming and Tagging:

Wiring shall be tagged at terminations with machine printed plastic sleeves.

Wire numbers shall consist of three parts, or as shown on the Plans.

Unless shown otherwise, the prefix of the wire number shall be the instrument loop number.

If an instrument loop number is not available, the lowest mechanical equipment number of all final drives in the circuit shall be used.

Following the prefix shall be a code letter. The third part of the wire number shall be a number that identifies wires in a circuit that are electrically identical.

Label each control and instrumentation wire as defined on the Plans.

Color Coding:

Color coding of wires within control panels shall follow UL 508A.

Power and control wiring shall be carried in covered wiring channels separate from low voltage analog signal circuits.

All control wiring in control panels or other enclosures that is powered from an external source and is not disconnected by the control panel disconnect shall be terminated at a disconnecting terminal block (with energization indicator light upon entering the enclosure.) The color of the wire shall then be changed to yellow to identify it as being powered from an external source. Provide identification nameplate on exterior of enclosure to indicate sources of external power.

Terminal Blocks and Accessories:

1. UL listed
2. DIN rail mounted. Compliant with IEC 60947-7-1
3. Compression clamp type terminal rated for 600 volts and 30 Amperes
4. 22 AWG to 12 AWG copper wire size range
5. Mark using marker carrier and preprinted marker bars for the terminal numbers
6. Acceptable manufacturers:
 - 6.1. Entelec Series: Typical Entelec catalog numbers are the following:
 - 6.1.1 Terminal Block: Type MS 4/6
 - 6.1.2 Switch Block: Type M 4/6.SNT
 - 6.1.3 Fuse Block: Types M 4/8.SFL, M 4/8.SFD, M 4/8.SFD1
 - 6.2. Phoenix Contact Series UK IEC Terminal Blocks
 - 6.3. Allen-Bradley Series 1492 IEC Terminal Blocks
7. Field connections shall be to separate terminal blocks. Terminal blocks for field terminations shall be in a separate part of the panel close to where the field cables enter the panel.
8. External circuits shall be fused. Fuses shall include blown fuse indicator lamps.
9. Comply with UL 508A requirements in construction.

Panel Grounding:

Each panel shall be provided with two copper ground bars. One bar shall be bonded to the panel frame or sheet metal and to the station ground system. The second (signal) ground bar shall be mounted on insulated stand-offs and shall be bonded to the frame ground bar at one point only.

Signal circuits, signal cable shields, and low-voltage DC power supply commons shall be bonded to the signal ground bar.

Surge protectors and separately derived AC power supplies shall be bonded to the frame ground bar.

Fuses:

Circuits shall be fused. Fuses shall be 1/4 x 1-1/4 inch. Fuses on 120 V(AC) circuits shall be ceramic tube type with 25,000 amperes interrupting capacity at 125 volts and neon blown fuse indicator lamps. Fuses for 24 V(DC) circuits shall be fast acting glass tube type rated 1/8 or 1/10 A for 4 to 20 mA loops and 1/2 amp for the power supply to individual instruments. Fuse holders for 120 V(AC) shall be drawout type and molded from melamine plastic.

Panel Light, Switch, And Convenience Outlet:

Provide a light with a door actuated switch in control panels that contain a PLC rack, relays, or other equipment that would require troubleshooting or operator access for normal operation. Provide a duplex outlet, 120 V(AC) 15 A, in all panels that require a computer or other maintenance tools that may need a power source. These shall be on a separate dedicated circuit.

Panel Disconnect Switch:

All control panels shall be provided with a main power disconnect switch. Label panels with multiple power sources and identify power sources.

PART 3 – EXECUTION

General:

Wired as shown on the wiring diagrams.

Control cabinets: Mount on channel iron sills as specified. Sills shall be leveled so panel structures will not be distorted. Panels shall be shimmed to precise alignment so doors operate without binding. Sealant shall be provided under panels not located in dry control or electrical equipment rooms. Mount field panels and cabinets per Instrumentation and Control Systems Section as specified herein. Floor-mounted cabinets except in dry control rooms or electrical equipment rooms shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified. Mount record drawings for wiring, connection and interconnection diagrams behind a piece of Plexiglas on the inside of one (or more) door(s).

Terminals and terminal blocks shall be sprayed with a silicone resin, similar to Dow Corning R-4-3117 conformal coating, after all terminations have been completed.

Coating:

Except for stainless steel and fiberglass panels, all panels and cabinets shall be painted inside and out. Exterior finish shall be an enamel meeting ANSI 61 gray. Interior panel finish shall be an enamel meeting Federal Standard 595: 27880 white.

Treat cutouts to prevent corrosion.

Except for stainless steel enclosures, the metal surfaces of panels, cabinets, and consoles, shall be prepared, primed, and finish coated.

Except for stainless steel enclosures, the metal edges of cutouts for instruments, switches, lights, etc., in panels, cabinets, and consoles shall be prepared, primed, and finish coated.

12-16.13 PANELBOARDS

PART 1 - GENERAL

DATA TO BE FURNISHED

Show ratings and characteristics including voltage ratings, busing arrangement, continuous current ratings, fault current withstand ratings, neutral bus rating, enclosure type, ratings and arrangement of overcurrent protective devices, and mounting provisions.

Submit outline and dimensional drawings and conduit entry restrictions.

PART 2 - PRODUCTS

General:

Panelboards shall comply with NEMA PB 1 (panelboards) and UL 67 (electric panelboards) requirements.

Provide dead-front, safety-type panelboards with ratings as scheduled. Panelboards shall be circuit-breaker type and shall be fully rated for short-circuit capacity indicated in the Plans. Panelboards shall be UL listed and labeled and manufactured by General Electric, Cutler-Hammer, Square D, or Siemens.

Cabinets:

Where shown as part of a motor control center, panelboard shall be mounted in the motor control center by the motor control center manufacturer.

Provide space for controls, such as contactors, in a separate compartment with hinged doors within respective panelboards. Where limited by the height of the panels, locate controls in a separate cabinet adjacent to the respective panelboard.

Breakers:

Breakers shall be molded-case type and shall comply with NEMA AB3 requirements. Provide quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide trip ratings as indicated in the panelboard schedules.

Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multiple circuit breakers shall be of the common-trip type having a single operating handle.

Provide HACR-type breakers where indicated in the Plan or when protection of HVAC equipment is required.

Breaker Connections:

Circuit breaker current-carrying connections to the bus shall be bolted type factory assembled.

Bus Bars:

Bus bars shall be tin-plated copper. Provide a copper ground bus bar installed on the panelboard frame, bonded to the box, and containing a number of terminal screws equal to or greater than the maximum number of branch circuits. For panelboards with neutrals, provide full-size neutral bus bar, unless otherwise noted in the Plans, and suitable lugs to support maximum number of circuits.

Space:

Where "space" is noted in the panelboard schedules in the Plans, provide connectors and mounting brackets for the future insertion of a 20-ampere, single-pole overcurrent device.

Directories:

Provide typed circuit directories on the inside face of the door of each panel. Do not provide handwritten directories.

Nameplates:

Provide nameplates as specified in the Electrical Identification Section as specified herein. Designate the identifying nomenclature, voltage, and phase of the panel as shown in the Plans; for example, "PANEL LA, 277/480-volt, 3-phase, 4-wire, 225-ampere bus."

PART 3 – EXECUTION**Accessibility:**

Install panelboards so that the top of the highest circuit breaker is not more than 6 feet 6 inches above the floor or working platform.

Tests:

Operate each circuit breaker and verify that all phases of each load are disconnected.

12-16.14 DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

DATA TO BE FURNISHED

Submit ratings and characteristics including voltage, phases, connections, enclosure type and dimensions, and conduit entry restrictions.

PART 2 - PRODUCTS

General:

Provide general-purpose, single-phase and three-phase, individually mounted dry-type transformers of the two-winding, self-cooled type. Kva size, voltage, and phase of the transformers are indicated in the Plans.

Within motor control center or electric cabinets, provide core and coil, dry-type transformers.

Transformers shall have copper windings and shall be UL listed and labeled where listing applies.

Transformers shall be rated for continuous operation in a 40°C maximum ambient temperature.

Dry-Type Transformers (10 kVA and Below):

Construct transformers in accordance with ANSI C89.2, NEMA ST-20, and UL listed under the requirements of UL 506.

Transformers 5 kVA and larger shall have two 5 percent FCBN taps on the primary side.

Transformers rated 2 kVA and below shall have 80°C rise, 150°C insulation system. Transformers rated 3 kVA through 10 kVA shall have 115°C rise, 185°C insulation system.

Encapsulate core and coil in an insulating resin of the class equal to the temperature rise and embed in a resin and filler system to attenuate the sound level.

Transformer shall be totally enclosed, nonventilated, suitable for indoor or outdoor installation.

Transformers shall be Sorgel Electric Division, Square D Company "Quiet Quality"; General Electric Company "QB," "ML," or "QMS"; Cutler-Hammer Type Westinghouse "EP" or "EPT".

Dry-Type Transformers (Core and Coil Type):

Transformers shall be constructed in accordance with ANSI C89.1, NEMA ST 1-4 and shall be UL listed.

Transformer shall have 115 °C rise, 185 °C insulation system.

Dry-Type Transformers (15 kVA and Above):

Transformer shall be in accordance with ANSI C89.2 NEMA TR-27, NEMA ST-20, and UL listed under the requirements of UL 506.

Transformers shall have two 2-1/2 percent FCAN and FCBN taps on the primary side.

Transformers shall have 115 °C rise, 150 °C insulation system.

Transformers shall be energy-efficient type complying with NEMA TP-1.

Sound levels shall be within the requirements of ANSI C89.1-2.7.2.

Transformers shall be ventilated type.

Basic impulse level (BIL) shall be 10 kV for transformers less than 300 kVA and 30 kV for transformers 300 kVA and larger.

Transformers shall be Sorgel Electric Division, Square D Company "Quiet Quality," General Electric Company "QL," Cutler-Hammer Type Westinghouse "DS-3" or "DT-3".

Factory Tests:

Perform factory tests in accordance with the latest revisions of ANSI C57.12.91 for dry-type transformers.

PART 3 – EXECUTION

General:

Where shown as part of a motor control, install transformer within a section center of the motor control center.

Set taps under load conditions for correct voltage.

Make conduit connections to transformers with liquid-tight flexible conduit utilizing neoprene gaskets and isolated grounding bushings at the transformer enclosures, to achieve complete metal-to-metal sound and vibration isolation. Install flexible jumpers for grounding continuity from enclosure to conduits.

Tests:

Transformers shall have insulation resistance tests made on the windings prior to being connected. The measurements shall be from primary and secondary windings to ground and between primary and secondary windings. The minimum value shall be 10 megohms.

Constant Voltage Transformer Tests:

Verify that output voltage remains within specified tolerance when the taps of the transformer feeding the constant voltage transformer are changed from maximum to minimum tap settings (not to exceed ± 15 percent nominal voltage).

Verify load regulation is within specified limits by connecting resistive load to the transformer output.

12-16.15 LIGHTING

PART 1 - GENERAL

Scope: This work shall consist of furnishing, installing and connecting all lighting equipment in accordance with the details shown on the plans and these special provisions.

DATA TO BE FURNISHED

Manufacturer's descriptive information, photometric curves, catalog cuts, and installation instructions shall be submitted for approval. Any other data as requested by the Engineer shall also be submitted for approval.

PART 2 - PRODUCTS

General:

Furnish lighting fixtures of the type indicated in the Plans, complete with lamps, sockets, wiring, and mounting hardware.

The use of a manufacturer's name and model or catalog number in the Plans is for the purpose of establishing the standard of quality, photometrics, and general appearance desired only.

Lamps:

Fluorescent: 32-watt - F032, T-8, 4,100K, 75 CRI, 2,850 lumen minimum output lamps; 60-watt - F96, lite white, slimline, 6,000 lumen minimum output lamps.

Compact Fluorescent (CFL): Lamp shall be integral, low mercury content, warm-white, Energy Star-qualified type.

Incandescent: Standard filaments, Halogen PAR, or linear quartz as applicable, rough service type, 125 volts, of the type and wattage shown in the Plans.

High-Pressure Sodium: Suitable for burning position as required for the light fixture, conforming to ANSI C78.388. Average rated life shall be 24,000 hours minimum, mean lumens shall be 90 percent of initial lumens minimum, color temperature shall not be less than 2100K, re-strike time after momentary interruption shall not be more than one minute, and warm-up time to full brightness shall be within four minutes.

Metal Halide: Pulse-start type suitable for burning position as required for the light fixture, conforming to ANSI C78.388. Average rated life in the vertical burning position shall be 12,000 hours minimum for 250-watt and smaller lamps and 25,000 hours minimum for 400-watt and larger lamps. Mean lumens shall be 75 percent of initial lumens minimum, color temperatures shall be 3600K minimum. Re-strike time after momentary interruption shall not be more than four minutes, and warm-up time to full brightness shall be within two minutes.

Instant Re-Strike High-Pressure Sodium Lamps: Similar to high-pressure sodium lamps but with less than 1-second re-strike time and warm-up time to full brightness within 90 seconds.

Manufacturers: General Electric, Osram Sylvania, or Philips.

Ballasts:

Fluorescent: Ballasts:

1. Provide solid-state electronic ballasts compatible with the lamps provided. Provide ballasts with 97 percent minimum power factor, less than 10 percent THD, instant start, multivolt type, having less than 1.7 current crest factor, with a minimum operating frequency of 20 kHz, Class A sound rating, IEEE 587A (ANSI C62.41) transient protection, FCC Part 18C, Class A EMI filtering, and UL listed.
2. Provide single-lamp dimming ballasts for fixtures controlled by dimmers. Verify type with dimming system provided.

High-Intensity Discharge:

1. Ballasts shall be single lamp, volts and watts as indicated. At any lamp voltage, from nominal through life, lamp wattage regulation spread at that lamp voltage shall not exceed 5 percent for ± 10 percent line voltage variation. Ballasts shall have a minimum power factor of 90 percent and shall be suitable for low-temperature operation.
2. Indoor ballasts shall have all components, including capacitor and starter where applicable, enclosed in a fluorescent style ballast can. Ballast shall be encased and potted and shall be sound rated.
3. Outdoor ballasts shall be weatherproof.

Manufacturers: Advance, General Electric, or Osram Sylvania.

Steel Poles:

Fabricate pole shaft from square extruded 6063-T6 aluminum alloy. Pole shaft shall consist of square steel tubing possessing a minimum yield strength of 46,000 psi per ASTM A500, Grade B.

Design poles, including handholes and luminaires, for a minimum yield safety factor of 1.5 when subjected to a sustained wind velocity of 100 mph and wind gusts of 130 mph. In addition, limit the deflection to 5 percent of pole length under these conditions.

Equip with handhole of sufficient size to permit the pulling and splicing of wires and grounding of the pole. Provide a grounding lug accessible through the handhole to accept a 1/2-inch-diameter copper conductor. Equip handhole with a cover.

Poles shall be fabricated to withstand seismic requirements per Electrical Work as specified herein.

PART 3 – EXECUTION

Installation:

Install lighting fixtures as close as possible to the locations shown in the Plans, making adjustments only for the purpose of avoiding interferences.

Install lighting fixtures plumb and level, with fixture surfaces parallel and perpendicular to walls and other major structures.

Install continuous rows of fixtures straight and true and equip with joining straps, couplings, and nipples as recommended by the manufacturer.

Support fluorescent lighting fixtures at two points minimum from structural elements that are capable of carrying the total weight. Mount fixtures rigidly with no rocking action. Where fixtures are mounted in or on a suspended grid-type ceiling, support fixtures at two points in addition to support from the ceiling grid.

Remove ballasts that are judged by the Engineer and the City of Burbank's representative to be excessively noisy and replace at no cost.

Provide pendant stem-mounted fixtures with swivel hangers. Stem shall be one piece without coupling and shall be finished the same color as the canopy and the fixture, unless otherwise noted.

Set fixture poles on anchor bolts and secure with double nuts on each bolt. Dry-pack fixture base, after fixture has been leveled and plumbed.

12-16.16 STANDBY GENERATOR

PART 1 - GENERAL

Scope: This work shall consist of furnishing and installing a standby generator in accordance with the details shown on the plans and these special provisions.

Delete diesel fuel tank if LPG fuel is used. Delete protective housing if engine-generator is installed indoor.

The standby generator shall include engine, generator, automatic transfer switch, circuit breakers, starting batteries, engine-generator control panel, battery charger, protective housing, top-mounted exhaust silencer, base mounted diesel fuel tank, drip pan, warning sign, battery hydrometer with storage container, battery filler, distilled water, anchoring devices, vibration isolators, and such other miscellaneous accessories, not mentioned, which are required for the complete installation and proper operation of the standby generator.

The standby generator assembly shall be factory assembled and mounted on a steel base with vibration isolators.

Quality Control:

Referenced Standards:

1. National Electric Code (NEC)
2. National Electrical Manufacturer's Association (NEMA).
3. Underwriter's Laboratories, Inc. (UL).

Load Test: Before delivery of engine to jobsite, provide engine load test by independent testing agency or manufacturer for 5 continuous hours at 100 percent rated torque.

DATA TO BE FURNISHED

Verify dimensions, coordination, and applicability of equipment furnished.

Contractor shall prepare on behalf of the City permit applications for "Authority to Construct" and "Permit to Operate" for the South Coast Air Quality Management District (SCAQMD). The permit applications shall include all necessary documentation required by SCAQMD including, but not limited to, shop drawings, source test requirements, etc. The Contractor shall submit these applications to the City within 90 days from the date of the Notice to Proceed. The City will then submit the permit applications to the SCAQMD within 5 working days from when received from the Contractor. If the application is deemed incomplete or not acceptable by the SCAQMD, the Contractor shall be responsible for responding to any comments or requests for information from SCAQMD and for preparing any and all revised permit applications for resubmittal to SCAQMD. Obtaining approved permits from SCAQMD shall be the sole responsibility of the Contractor. Any changes to equipment and/or emission requirements that occur after the initial submittal to SCAQMD shall be made at the Contractor's sole expense.

Full detail for performing of engine testing required by "quality control" above. Upon completion of engine testing prepare and submit final results along with all new data.

Full design of exhaust system with full drawings showing major elements, piping supports, and auxiliary items.

Generator fault current at full rpm and main circuit breaker trip curves and fault interrupting rating.

Full detail of bolt patterns for pad-mounting requirements.

Full design of engine generator enclosure including drawings and details.

Manufacturer's Field Representative: Submit manufacturer's field representative's qualification at least two weeks prior to start-up. Submit written report to Engineer at conclusion of all site visits prior to leaving jobsite. Report to include copies of all pertinent operating and test data obtained during visit, and description of all work performed. Submit final start-up report within two weeks after completing start-up.

Training: Submit a lesson plan in accordance with this Section.

Warranty:

The emergency generator system shall be warranted for five years from the date of final acceptance.

PART 2 - PRODUCTS

Acceptable Manufacturers:

Subject to compliance with the Contract Documents, the following manufacturers are acceptable: Cummins, Caterpillar, or Kohler.

Service and replacement parts: Service centers housing service personnel and spare parts shall be located within a 100-mile radius of the project sites.

Performance and Operating Instructions:

Operating Conditions: Provide complete generator sets controls and accessories rated for the following conditions: Elevation: 100 ft above MSL; ambient air temperature: 125 °F (maximum), 20 °F (minimum), 0-95 percent humidity.

Performance: Establish net rating of generator set under operating conditions specified, when equipped and fully loaded with all necessary operating accessories, such as radiator fan. Substantiate ratings with manufacturer's standard published curves and data. Provide engine generators meeting the following minimum requirements:

1. The generators shall be sized for the loads shown on single line diagram
2. Maximum voltage drop shall be 12 percent from initial voltage output conditions.
3. Minimum ratings:
 - 3.1. Power Factor: 0.8 PF.
 - 3.2. Frequency: 60 Hz.
 - 3.3. Voltage and phase: 480 Volt/3 phase.
 - 3.4. Engine speed, maximum: 1800 rpm.
 - 3.5. Maximum winding temperature for the alternator at the generator set standby rating shall be 105 °C.

Fuel: Diesel No. 2 diesel, as required by California Air Resources Board

Engine:

Engine Construction: Provide diesel-type engine of heavy-duty construction, full compression ignition diesel, water cooled, multi-cylinder, four stroke, four cycle units. Engines solid-state designed for cold quick start, capable of delivering full load output in 10 seconds. Ensure engines have replaceable cylinder liners of wet sleeve-type and replaceable valve seat inserts. Combustion chambers of open type. Cross tie bolt main bearing caps to crankcase for rigidity. Connecting rods of forged steel, angle split line for precise cap alignments. Crankshaft of forged steel. Two cycle engines not allowed. Filter for recycling crankshaft vent fumes back to engine.

Lubrication: Provide pressure-type lubrication system with gear-type oil pump and full flow filters fitted to engines. Locate filter for convenient servicing. Equip filters with spring loaded bypass to ensure oil circulation if filters are clogged.

Air-Cleaner: Provide one or more dry-type replaceable element air cleaners suitable for high dust load operation. Equip each air cleaner with service indicator.

Governor: Provide a fully enclosed electronic governor for each engine generator. Frequency at any constant load shall not deviate more than ± 0.5 percent of rated frequency. The governors to provide adjustable frequency regulation of 0 to 7 percent from no load to full rated load. Provide initial setting of 3 percent regulation.

Engine Cooling: Equip the engine with a radiator and engine drive blower fan of a type and capacity recommended by the engine manufacturer for specified ambient conditions and with an engine driven,

centrifugal type water circulating pump and thermostatic valve to maintain the engine at recommended temperature level. The cooling system to include one or more coolant filters.

Emissions: Air Emissions: The IC engines shall meet the Best Available Control Technology (BACT) and Toxics Review (T-BACT) for emergency IC engines, as determined by the SCAQMD. It has been determined that the following emissions currently comply with the BACT and TBACT standards:

1. Pollutant
2. Nox + VOC (NMHC) 3.0 g/bhp-hr
3. Carbon Monoxide (CO) 2.6 g/bhp-hr
4. Particulate Matter (PM) 0.15 g/bhp-hr

Notwithstanding the above emission requirements, the CONTRACTOR shall be solely responsible for providing a system that complies with BACT standards at the time of equipment purchase. At a minimum, the engines shall be a minimum of Tier 3 Certified. Submit certificate or "Source Test Report" for each engine demonstrating compliance with the more stringent requirements of either the emissions limits specified above or the BACT standards at the time of equipment purchase with the draft permit applications. Provide particulate matter filter if required to meet requirement of SCAQMD.

Generators:

Construction: Provide brushless, revolving field type with permanent magnet, generators each coupled directly to engine flywheel through a flexible driving disc for positive alignment. Bolt generator housing directly to engine flywheel housing. Provide a single or double ball-bearing support for the rotor in the generator housing. Dynamically balance rotor for up to 25 percent overspeed. Provide single/double bearing, rotating field, synchronous-type generators built to NEMA standards. Provide Class F insulation on the stator and rotor, and protect with 100 percent epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and abrasion deterioration. Equip field with full amortisseur winding. Perform generator field excitation with static permanent magnet-type rotating exciter mounted on the generator rotor shaft. Provide volts-per-hertz type voltage regulators of solid-state construction matching characteristics of each unit. Provide regulators incorporating cross-current compensation and reactive drop compensation. Mount inside generator control cabinet. Furnish voltage adjusting rheostats to provide ± 5 percent voltage adjustment. Provide readily accessible voltage droop, voltage level and voltage gain controls with each regulator. Provide shock-resistant mounting of regulators. UL 2200 listed with label.

Performance: Ensure voltage regulation from no load to rated load remains within a band of ± 2 percent of rated voltage. Steady state voltage stability to remain within a 0.5 percent band of rated voltage. Ensure measured voltage dip does not exceed 20 percent of rated voltage for any sudden addition of load up to and including 90 percent of rated load. Assure voltage recovery to the steady state band in not more than 4.5 seconds. The frequency regulation from no load to rated load shall be in accordance with specified engine governor performance. For any sudden addition of load up to 90 percent of rated load, the frequency shall recover to the steady state frequency band within 7.0 seconds.

Cooling System:

Provide radiator cooling system with sufficient capacity for cooling generator set at full rated load and operating conditions specified. Equip engine with engine-driven centrifugal-type water circulating pumps and thermostatic valve to maintain coolant temperature below 200 °F. Maximum air flow: 94,000 cfm. Verify radiator fan has sufficient static pressure for system shown and specified. Provide fan with external static pressure (external to radiator and load bank, if applicable) capacity minimum: 0.75-inch WC.

Coolant: Fill cooling system with 50 percent ethylene glycol and water solution. Assure radiator, engine block and related items protected to 20 °F.

Jacket Water Heaters: Furnish engine mounted thermal circulation type water heater at engine generator set to maintain engine jacket water at 120 °F at minimum ambient temperature specified. Include integral thermostatic control to maintain desired temperature. Rate heater for 208 V(AC), 1 PH, 60 Hz.

Exhaust System:

Exhaust Silencer: Provide a Maxim model M-51 Critical Silencer and related hardware to include side inlet, standard 125 to 150 pounds flange connections, companion-flanges, cleanouts, Type E support arrangement, and Type 316 stainless steel bellows type flexible exhaust connectors at least 24 inches long. Ensure silencer and related hardware are properly sized and installed according to the manufacturer's recommendation to achieve 37 dB attenuation at 400 (H2) octane center band. The silencer shall be mounted on the roof of the enclosure. Furnish and install exhaust pipe constructed of schedule 40 steel pipe with standard 125 to 150 pounds flange connections. Exhaust pipe size shall be sufficient to ensure that measured exhaust backpressure does not exceed 80 percent at maximum recommended back pressure. Silencer shall be manufactured using Type 304 stainless steel.

Exhaust system insulation: Stainless steel flexible insulation blankets with insulation valve such that surface temperature does not exceed 150 °F. Apply to all exhaust components. Install insulation so that it does not interfere with the functioning of the flexible exhaust fitting.

Starting Systems:

Starting Motors: Provide 24 V(DC) starting system with solenoid operated positive engagement drive.

Batteries: Furnish lead acid batteries with engine generator with sufficient capacity to crank engine for three 15-second cranking periods with a 15-second rest period between cranks without recharging. Provide battery rack appropriately sized for the batteries furnished, painted with alkaline-resistant paint. Provide constant voltage, current limiting, full wave rectifier type battery chargers using silicon controlled rectifiers as the power controlling elements. Provide float and equalize charge rates. Rate charger for 120 V(AC), 1 PH, 60 Hz with output current rating to recharge the battery from a 70 percent discharged condition to 95 percent charged condition in 12 hours. Provide malfunction alarm contacts for actuation of alarm in the event of malfunction in the battery charging system. Provide DC voltmeter and ammeter. Charger is to shut down when battery is fully charged. Provide cables, clamps and all other necessary connections. Size main cables to exhibit total circuit resistant of 0.005 ohm or less. Enclose batteries and charger within generator enclosure.

Sub-Base Diesel Storage Tank:

Double wall sub-base day tank mounted underneath engine generator unit.

Tank capacity shall be rated at full load continuous run for 24 hours period.

Construction: Sides and ends: 7 gauge steel channel. Bottom: 10 gauge steel. Top and interior baffles: 12 gauge steel. Steel gussets on both sides of mounting holes.

Tank shall have double walled construction for spill containment.

Tank shall be constructed to support the entire weight of the engine-generator set.

Inner Tank Fittings: 1-1/2-inches NPT level gauge; 2-inches fill connection with cap and 1 gallon spill containment at fill fitting accessible from outside enclosure; 1/2-inch NPT fuel return, vent, and overflow; 1/2-inch NPT fuel supply dip tube; 3/8-inch NPT drain; 4-inches fitting for inserting commercial dip tube; and 2-inches fitting with dip tube for fuel transfer.

Outer Tank Fittings: 3/8-inch NPT emergency drain; 1-inch NPT vent; and leak detector probe.

Provide tank with electrical stub up area.

Dimensions of double-walled tank shall match the exact skid dimensions of the engine-generator set and enclosure.

Location of all tank connections shall be coordinated with engine-generator manufacturer to provide a complete fuel delivery system.

Rust proofing, epoxy coated interior of interior tank, interior of exterior tank and bottom of exterior tank.
Rust inhibiting primer on exterior of interior tank.

Leak Detector: Leakage sensors switch; signal wiring to generator control panel; and red indicated light for leak detector:

1. Leak detector alarm.
2. Isolated remote alarm contact for leak.

Low level warning with contacts for remote alarm. Set to alarm at 25 percent of capacity. Critical low level shutoff with contacts for remote alarm.

Controls:

Control Panel: Control of the generators shall be coordinated with the ATS. The function of the control and instruments is expected to be performed by a microprocessor-based system. Local generator control panel PLC shall communicate over an Ethernet network with the PLC in the Central SCADA system. The function of the control and instruments is expected to be performed by a microprocessor-based system. Local generator control panel shall provide signals to and from ATS and local PLC, as shown on Electrical and Instrumentation Drawings.

Generator Instruments and Controls: The function of the control and instruments is expected to be performed by a microprocessor-based system. Generator mounted NEMA 1 type, illuminated vibration isolated instrument and control panel(s). AC voltmeter and phase selector switch. AC ammeter and phase selector switch. Emergency stop pushbutton located on outside of generator enclosure. Frequency meter. Kilowatt load meter. Run-off-auto engine, start-stop control switch. Emergency stop. Run time meter. Governor control rheostat. Voltage level adjustment rheostat. Cool down time delay from 0 to 15 minutes adjustable. Cycle cranking control. Minimum red shut down indicating lights as follows:

1. Overcrank.
2. Overspeed.
3. Low lubricating oil pressure.
4. High engine water temperature.

Minimum amber alarm indicator lights as follows: Control switch not in auto position; low engine water temperature (less than 70 °F); low fuel in day tank; day tank leak; battery charger malfunctioning; and low battery voltage.

Minimum amber prealarm indicator lights as follows: High engine water temperature; and low lubricating oil pressure.

Common dry contact and audible alarm to indicate when one or more alarm or prealarm conditions exist. Isolated contacts for Generator Running, Generator Fail, Low Battery, Ready, engine not in automatic, Low Fuel, Fuel Leak, Overcrank, over-speed, low oil pressure, and common fault. Shall accept a call signal from ATS.

Accessories:

Provide I/O to indicate the following alarms at the Generator Annunciator panel to be furnished in the Generator Control Cubicle.

No.	FUNCTION	MODE	COLOR
1.	Low Oil Pressure	Pre-alarm	Amber
2.	Low Oil Pressure	Shutdown	Red
3.	High Water Temperature	Pre-alarm	Amber
4.	High Water Temperature	Shutdown	Red
5.	Overcrank	Shutdown	Red
6.	Overspeed	Shutdown	Red
7.	Engine not in Auto	Status	Amber
8.	Low Water Temperature	Pre-alarm	Amber
9.	Protective Relay Trip	Shutdown	Red
10.	Control Voltage Fail	Shutdown	Red
11.	Emergency Stop	Shutdown	Red
12.	Battery Charger Alarm	Pre-alarm	Amber
13.	Day Tank High Fuel Level	Alarm	Amber
14.	Day Tank Low Fuel Level	Alarm	Amber
15.	Day Tank Rupture	Alarm	Amber
16.	Fail to Synchronize	Status	Red
17.	Engine Not Available	Status	Red (Flashing)
18.	Engine Running	Status	Green
19.	Breaker Failure	Shutdown	Red
20.	Low Water Level	Status	Amber
21.	Voltage regulator Shutdown	Shutdown	Red
22.	Overcurrent	Shutdown	Red
23.	Voltage Regulator Alarm	Pre-alarm	Amber
24.	Ground Fault Alarm	Status	Amber
25.	Engine Diagnostic Fault	Status	Amber
26.	Engine Fault Relay Shutdown	Shutdown	Red

Fuel System: Fuel pump: Built-in gear-type, engine-driven fuel transfer pump. Equip fuel system with replaceable fuel filter elements arranged for easy removal without breaking any fuel line connections or disturbing fuel pumps or any other part of engine. Locate all fuel filters in an accessible housing, ahead of injection pumps to thoroughly filter fuel before it reaches the pump. Use no screens or filters requiring cleaning or replacement of injection pumps or valve assemblies.

Drains: 1-inch oil and 1/2-inch coolant drains, with ball valves inside enclosure. Extend drain lines and valve to outside of engine skid. Fume disposal tube extended to enclosure exterior under radiator opening.

Provide solid-state main circuit breaker at the generator.

Provide 120/208 V(AC), 3 phase distribution panel in the generator enclosure to serve battery charger, engine jacket water heater, lights, receptacle, 100 A maximum.

Provide grounding resistors mounted on roof of enclosure.

Wiring: All auxiliary loads shall be prewired to common connection point: 120 V battery charger; and 208 V engine jacket water heater. Battery rack and cables for battery set. Generator housing shall be effectively grounded with braided copper ground conductors.

Generator set weather protective enclosure:

Sheet steel with side servicing panels, air intake louvers and rear control panel access door. Side servicing panels shall have two locking points; all panels and doors are key lockable. Pitched roof with silencing exhaust muffler mounted outside the enclosure. Completely install enclosure on generator set mounting base.

Construction:

1. Aluminum frame and exterior panels.
2. Structurally stable in 100 mph wind.
3. Support roof load of 40 psf.
4. Fiberglass or mineral wool insulation to provide minimum R11 insulation in side walls and roof for thermal transmission, sound attenuation material can be in addition to or include the thermal insulation.
5. Enclosure shall be approved for installation in local seismic zone.

Exterior shall be mill prepainted in color selected by the Engineer and the the City of Burbank. Resist intake of blown sand or rain through intake air assembly. Space for routine maintenance and service shall be provided on all four sides of generator. Anchor bolts for casting into concrete base for attaching enclosure to pad. Provision for exit of exhaust stack in roof, flashed and sealed to prevent entry of moisture:

1. Support for critical silencer on roof.

Minimum of two fluorescent lighting fixtures and switches on each side of enclosure. Provide light over control panel. Coordinate the enclosure with the engine generator furnished to assure physical clearances, sound attenuation, airflow and pressure drop through the system. Enclosure and generator to be delivered with all connections, conduits, and wiring complete.

Cover all accessible moving parts with OSHA approved guards.

Spare Parts: The Work includes the following spare parts for each engine-generator unit:

Quantity	Description
1	Lube Oil Filter Element Double Length
1	Lube Oil Filter Cover O-Ring
1	Water Pump Belt Set
1	Aux. Water Pump Belt Set
2	Air Cleaner Element
1	Each size and type of relay
1	Each size and type of lamp in the control panels
2	Complete replacements, engine oil filters
2	Complete replacements, air inlet filters
1	Complete set special maintenance tools

Spare parts shall be crated, packaged, and stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the boxes.

Operating Sequence:

Normal Power Fails: After adjustable time delay generator receives start command. If generator switch is in auto the generator crank cycle commences. If generator fails to start by end of crank cycle the overcrank alarm is initiated.

Restoration of Normal Power: When utility power is restored, retransfer signal is generated and the system is transferred to utility power source after a setpoint amount of time. After preset cool down period generator stops.

If generator switch is turned to run position the generator will initiate the start cycle, but will not transfer on line.

If generator switch is turned to off position the generator will not operate.

If short trip is made, the generators will immediately shut down.

Source Quality Control:

Factory test: Inform Engineer at least thirty (30) days prior to factory testing of engines, and then again fourteen (14) days prior to testing. Performance test: Perform continuous 6 HR factory test of engine-generator set at 100 percent rated torque; and results certified by a registered Engineer.

PART 3 – EXECUTION

Mounting and Enclosure:

Base: Mount engine, generator and radiator on a common structural steel subbase capable of maintaining unit alignment suitable for mounting unit on two 60 LB rails. Equip with neoprene spring-type vibration isolators between subbase and 60 LB rails. Vibration isolators to be equipped with seismic restraints suitable for Zone 4. Provide mounting hardware for mounting generator set on sub-base fuel tank and enclosure. Seismic anchors to be designed by a California Registered Civil or Structural Engineer.

Field Quality Control:

Service: Prequalified service personnel must be available on a 24-hour a day basis. The personnel must be completely trained and experienced in operation and maintenance of the items supplied so as to return the equipment to service in the shortest possible time. The manufacturer shall have an adequate parts and service facility. The equipment supplier shall act as an advisor in assisting the Contractor regarding the unloading and move-in operations; and ship the specified equipment in a manner that will allow the Contractor to use the equipment he has on site to efficiently unload the equipment. Supplier is responsible to coordinate handling and delivery of the shipment with the Contractor.

Field Testing: Manufacturers to inspect equipment covered by these Specifications. Manufacturers to supervise any adjustments and installation checks. Conduct initial start up of equipment and perform operational checks at jobsite. Operate generator set for at least 3 consecutive hours at 100 percent load. If full rated load is not available at the jobsite, furnish load banks as required, including temporary electrical connections, to make up the difference.

Manufacturer's Field Service:

Qualified field personnel to assist in start-up and operator training. Representative(s) shall be available within two weeks of request of services and shall be on site for a period of not less than three working days for each generator set furnished and shall include a minimum of one trip: To inspect completed installation; to supervise initial startup, adjustments, and testing; and to instruct the City of Burbank's personnel in proper operation and maintenance. Clear, detailed recommendations on equipment shipping, storage, and installation, as well as contact with qualified technical representative to assist in answering questions concerning the above.

Manufacturer's field representatives are to furnish a written report confirming the equipment:

1. Has been properly installed and lubricated.
2. Is in accurate alignment.
3. Has been operated satisfactorily under full-load conditions.
4. Personnel trained in all operations.
5. Electrical system is completely corrected and properly functioning.

System shall be tested by simulating a loss of power, and making sure that the generators start and carry the load. Manufacturer shall be present during the test and assist in conducting the test.

Training:

Training Session:

Type of Classroom Sessions:	Number of Sections	Hours per Session
Operations:	1	2
Maintenance:	1	2
Field Sessions:		
Operations	1	2
Maintenance	1	4

Manufacturer shall submit a lesson plan to include operator training and maintenance training at least two weeks prior to the training sessions. Training shall include both classroom and field "hands-on" training. Both types of training shall provide full coverage of all techniques for the operators to fully understand the generator operation, and for the maintenance personnel to fully understand the requirements for preventive and corrective maintenance. Acceptable operation and maintenance manuals must be onsite and available when training sessions are implemented.

Operation and Maintenance Manuals: Training of personnel in the Operation and Maintenance Manual shall be provided.

SECTION 13 RAILROAD RELATIONS AND INSURANCE REQUIREMENTS

SECTION 13-1. GENERAL REQUIREMENTS

13-1.01 DESCRIPTION

The Empire Avenue and Buena Vista Grade Separations project includes construction work within the right-of-way of the Southern California Regional Rail Authority (SCRRA). This section describes coordination with SCRRA when work by the Contractor will be performed upon, over, under, or adjacent to SCRRA right-of-way or its work may impact current or future SCRRA operations and is not meant to override any contract requirements for work outside of SCRRA right-of-way.

The Contractor must familiarize itself with the proper manner of protecting the tracks, signals, fiber optic cables, pipe lines, other Property, and tenants or licensees upon, adjacent to, across (under, and/or over), and along SCRRA and Member Agency Property during the construction and/or maintenance activities on or adjacent to Railway Property. The Contractor must coordinate with SCRRA while performing the work described in the Contract, the Drawings, and the Specifications, and shall afford the same cooperation with SCRRA as it does with the State. All submittals and work shall be completed in compliance with this Section, SCRRA guidelines and other operating rules and engineering requirements as issued from time to time by SCRRA.

Modifications to the railroad signal system to accommodate Positive Train Control will be performed concurrently with this project. The Contractor shall provide access to SCRRA personnel and contractors when requested. Except during the cut-over of new signal and control locations, or existing signal and control locations modified by this contract, the Contractor will not be required to provide signal support for SCRRA work that is connected exclusively to the Positive Train Control project.

13-1.02 DEFINITIONS

Abbreviations and terms are to be interpreted as provided in Section 1 of the Standard Specifications, except as provided below, or when the context otherwise requires.

13-1.03 SCRRA PROJECT REPRESENTATIVE

The SCRRA Director of Engineering & Construction, acting either directly or through properly authorized agents, the agents acting within the scope of the particular duties delegated to them.

The SCRRA Project Representative for this project is:

Mr. Andrew Althorp, P.E.
Senior Engineer
Southern California Regional Rail Authority
279 East Arrow Highway
San Dimas, California 91773
Phone: (909) 394-3520

The Contractor must notify SCRRA Project Representative, not less than thirty (30) calendar days before commencing any work on SCRRA right-of-way. Contractor's notification to SCRRA shall be in writing and must refer to SCRRA File S0001269.

All notices and submittals to SCRRA Project Representative are to be made through the State's Resident Engineer or other designated representative of the State, unless otherwise permitted by mutual agreement between the State, SCRRA, and the Contractor.

13-1.04 SCRRA

Southern California Regional Rail Authority (SCRRA) is a five-county joint powers authority, created pursuant to California Public Utilities Code Section 130255 and California Government Code Sections 6500 et seq., to build and operate the "METROLINK" commuter train system. The five-county member agencies are:

1. Los Angeles County Metropolitan Transportation Authority ("MTA");
2. Ventura County Transportation Commission;
3. Orange County Transportation Authority;
4. San Bernardino Associated Governments;
5. Riverside County Transportation Commission.

SCRRA builds, operates and maintains a commuter rail system in the five-county area on rail rights-of-way owned by the member agencies.

13-1.05 PROPERTY

Property as defined in this Section to mean the real property, or personal property, or both of SCRRA or a Member Agency.

13-1.06 SCRRA CONTRACTOR

SCRRA Contractor is an individual, firm, third party, partnership or corporation, or combination thereof, private, municipal or public, including joint ventures, retained by SCRRA to provide construction or maintenance services which may impact SCRRA Property and who is referred to throughout this document by singular number and masculine gender.

13-1.07 PUBLIC AGENCY

Public Agency is defined to mean (i) the federal government and any agencies, departments or subdivisions thereof, and (ii) the State of California or any other State, and any Public Agency, city, city and Public Agency, district, public authority, Public Agency, joint powers, municipal corporation, or any other political subdivision or public corporation therein.

13-1.08 SCRRA FORM 37

SCRRA Form 37 is the "Rules and Requirements for Construction on Railway Property." SCRRA Form 37 is superseded by this Section and any reference in any SCRRA document to Form 37 must be read as referring to this Section 13.

13-1.09 FOULING A TRACK

Placement of an individual or a piece of equipment in such a proximity to a track that the individual or equipment could be struck by a moving train or on track equipment, or in any case is within eight (8) feet of the field side of the nearest running rail.

13-1.10 SITE SPECIFIC WORK PLAN (SSWP)

The details of each construction activity affecting SCRRRA railroad operations, facilities, or right-of-way of SCRRRA, or the operations or facilities of other railroads using the right-of-way, must be described in a Site Specific Work Plan (SSWP) prepared by the Contractor and submitted for review by SCRRRA. Written approval of the SSWP must be obtained from SCRRRA before such construction activity is undertaken.

A written program, plan, and schedule prepared and submitted by the Contractor and approved by SCRRRA that accurately describes and illustrates the manner in which work within the Right-of-Way (ROW) will be accomplished, the impacts on any elements of the ROW and the manner in which Work will be accomplished within the ROW allotted Work Windows.

SECTION 13-2. GENERAL REQUIREMENTS FOR WORK NEAR RAILROAD

13-2.01 GENERAL REQUIREMENTS FOR THE CONTRACTOR

All railroad tracks within and adjacent to the Project site are to be assumed active and rail traffic over these tracks must be maintained throughout the Project. Rail traffic may include both through trains and switching moves to local customers. SCRRRA and other railroad traffic and operations can occur continuously throughout the day and night on these tracks and may not be interrupted except as approved by SCRRRA. The Contractor shall coordinate and schedule the work so that construction activities do not interfere with rail operations.

The Contractor, and its sub-contractors of any tier (collectively referred to as the Contractor), must coordinate its work with SCRRRA during construction of the Project when any of the following conditions are present:

1. Where work is performed on the right-of-way of SCRRRA;
2. When the work is over or under or adjacent to the tracks of SCRRRA;
3. When excavations are performed within 30-feet of the centerline of the nearest track;
4. When the work has the potential to foul (obstruct) any track or reduce any clearance below the allowable minimum.

The Contractor may not move, relocate, remove, obstruct, or otherwise interfere with any railroad tracks, signals, cables, signs, flags, or other railroad facilities, or any service or connection to any railroad facility. All work on active SCRRRA tracks, signals, communication equipment, and other active railroad facilities must be performed by SCRRRA. Connections and tie-ins of new or temporary track, signal, communication, and other equipment into active systems must be performed by SCRRRA.

The Contractor's ability to enter the SCRRRA right-of-way is subject to the absolute right of SCRRRA to cause the Contractor's work on the SCRRRA right-of-way to cease if, in the sole opinion of SCRRRA, the Contractor's activities create a hazard to the SCRRRA right-of-way, or SCRRRA employees, or SCRRRA operations, or any combination thereof.

SCRRRA Form 6 - Temporary Right-of-Entry Agreement and this Section are intended to be complimentary. The Contractor shall comply with all requirements stipulated in the Temporary Right-of-Entry Agreement, and shall maintain all insurance in full force during the time that its work is performed on or adjacent to the SCRRRA right-of-way. Furnishing Railroad Protective Insurance in the amounts listed in SCRRRA Form 6 - Temporary Right-of-Entry Agreement is a requirement of working on or adjacent to the SCRRRA right-of-way.

The Contractor shall inform itself of the expected train movements over the tracks in the vicinity of the work prior to developing its plans for any portion of the work. The Contractor must plan, schedule and conduct all work activities so as not to interfere with the movement of any trains.

The Contractor shall provide a detailed construction schedule to SCRRRA for review and approval prior to commencement of work within or adjacent to the right-of-way. The Contractor shall use activity codes to identify specific activities that involve work within or adjacent to the SCRRRA right-of-way. Activities that involve working within reduced clearances must also be identified by a unique activity code. This schedule shall be updated for all critical events as necessary but not less than monthly so that site visits may be scheduled at the appropriate times. A copy of each schedule update shall be furnished to SCRRRA. The Contractor shall also furnish SCRRRA, at the beginning of each week, with a look-ahead schedule projecting the Contractor's activities for three weeks in advance of the week in which the look-ahead schedule is issued.

The Contractor shall perform no work on the SCRRRA right-of-way until all its employees, including sub-contractors of any tier, have attended and passed the safety orientation class as described in SCRRRA Form 6 – Temporary Right-of-Entry Agreement.

13-2.02 SUBMITTALS

Whenever work is performed within the vicinity of the SCRRA right-of-way, or when work may affect the operation or safety of trains, the method of performing the work shall first be submitted to the SCRRA Representative for approval. Construction submittals requiring SCRRA approval, and Requests For Information (RFI) requiring a reply from SCRRA, must be forwarded to the Engineers who in turn will forward to the SCRRA Representative. Where required by SCRRA rules, standards, guidelines, and other requirements, the Contractor shall submit plans, calculations and other documents prepared under the direction of a Registered Professional Engineer licensed to practice in California.

As soon as possible, but no later than fifteen (15) working days after contract approval with any portion of the work, the Contractor shall submit for SCRRA's review and approval, a document control plan that describes and illustrates the process (including roles, responsibilities, and contact information) by which the firms and individuals responsible for submitting, reviewing, and approving all submittals from the Contractor to the State, will manage the flow of submittals and information. The document control plan must also include a master list of submittals. A preliminary list of submittal is included in Exhibit A at the end of section 13. The Contractor shall also submit, not later than fifteen (15) working days after the contract approval, a testing and inspection plan that identifies the tests and inspections required, the point during construction at which each test or inspection is to be performed, and the entity responsible for performing each test or inspection on both temporary and permanent work.

The details of each construction activity affecting the operations, facilities, or right-of-way of SCRRA, or the operations or facilities of other railroads using the right-of-way, must be described in a Site Specific Work Plan (SSWP) prepared by the Contractor and submitted for review by SCRRA. Requirements for the SSWP are more generally described in SCRRA's SSWP. Written approval must be obtained from SCRRA before such construction is undertaken.

No work shall take place within the SCRRA right-of-way until both the document control and inspection plan have been reviewed and approved by SCRRA. If a change occurs in the process, involvement of firm, or individuals named in the document control and inspection plan, the Contractor shall immediately revise the document control and inspection plan and submit the changes for approval.

SCRRA shall be allowed 20 working days for review of all submittals. Upon written approval by the State, the Contractor or Contractors may make the submittals directly to SCRRA Representative and the State simultaneously. However, SCRRA will not approve any submittal for which the approval of the State is required until the State has first reviewed and approved the Contractor's submittal.

The SCRRA's review and approval of the State's or the Contractor's plans in no way relieves the State and Contractor from their responsibilities, obligations or liabilities under the Agreement between the State and the Contractor, or SCRRA Form 6 - Temporary Right-of-Entry Agreement. SCRRA's review and approval will be given with the understanding that SCRRA makes no representations or warranty as to the validity, accuracy, legal compliance or completeness of the designs prepared by the State or the Contractor, and that any reliance by the State or the Contractor with respect to such designs is at the risk of the State and the Contractor.

SECTION 13-3. CONTRACTOR SAFETY REQUIREMENTS

13-3.01 SCRRA EMPLOYEE-IN-CHARGE (EIC)

Work in the proximity of railway track(s) is potentially hazardous where movement of trains and equipment can occur at any time and in any direction. All work performed by the Contractor within or adjacent to the right-of-way of SCRRA must be in compliance with this section and the requirements of SCRRA Form 6 - Temporary Right-of-Entry Agreement.

The SCRRA Employee-in-Charge (EIC) is responsible for on-track safety anytime that work is underway on or adjacent to the track. Services of an EIC will be provided by SCRRA using railroad personnel trained and qualified under the rules of the Federal Railroad Administration (FRA) and qualified to work on the SCRRA Subdivision on which they will be providing services. All persons acting as an EIC will be furnished through SCRRA under agreement with the State. Personnel of the Contractor may not provide an EIC or perform flagging or other protective services for railroad operations. No work may begin until the EIC is present at the work site and proper protection has been provided.

The EIC will provide job briefings and safety protection to assure the contractor a safe work environment and the safe passage of trains. The EIC will conduct job briefings at the start of every work shift and every change of conditions affecting roadway worker safety during a work shift. The EIC has the authority to temporarily or permanently halt work or to temporarily or permanently remove employees of the Contractor from the right-of-way in order to assure the work is conducted safely. The Contractors' employees must comply immediately with all instructions of the EIC involving work within or affecting the right-of-way of SCRRA.

13-3.02 RIGHT TO CHALLENGE SUFFICIENCY ON-TRACK SAFETY

The employees of the Contractor may, during the job briefing process, may request clarification of the protection against trains being provided by the EIC. If an employee of the Contractor does not believe that the protection against trains is sufficient, the employee may at any time, in good faith, challenge the form of protection established by the EIC and must remain clear of all tracks until the challenge is resolved. Federal regulations and SCRRRA rules require that the EIC, Contractor supervisor and the SCRRRA supervisor must resolve the challenge before work can begin. A Good Faith Challenge Form must be completed by the parties involved.

If the Contractor disagrees with any instructions from the EIC, the contractor and contractor employees must immediately clear the tracks to a safe location. After employees are clear of tracks, the contractor may contact the EIC's supervisor to resolve any disagreement over the instruction provided.

13-3.03 WORK REQUIRING PROTECTION OF TRACK AND OPERATIONS

The Contractor must request and arrange for an EIC, inspector, or other protective services from SCRRRA for the following conditions:

1. When the Contractor's work activities are within the right-of-way of SCRRRA.
2. When the Contractor's work activities are located over or under a track or tracks.
3. When cranes, pile drivers, drill rigs, concrete pumps, or similar equipment positioned outside of the right-of-way could foul the track in the event of tip-over or other catastrophic occurrence.
4. When in the opinion of the SCRRRA it is necessary to safeguard the employees, trains, engines and facilities of SCRRRA.
5. When any excavation is performed below the elevation of the track sub-grade, or track or other railroad facilities may be subject to movement or settlement, within the zone of railroad influence.
6. When work in any way interferes with the safe operation of trains at timetable speeds.
7. When any hazard is presented to railway track, communications, signal, electrical, or other facilities either due to persons, material, equipment or blasting in the vicinity.
8. When clearing, grubbing, grading, or blasting is in proximity to the right-of-way which, in the opinion of SCRRRA or representative of an SCRRRA member agency, may endanger the right-of-way or operations.
9. When street construction and maintenance activities, located within the right-of-way or in the vicinity of the highway-rail grade crossing, requiring temporary work area traffic control, which may affect or create unsafe conditions for employees, public, trains and vehicles.

The services of an EIC are generally provided by one employee. However, additional personnel may be required to protect the facilities and operations of SCRRRA, if deemed necessary by the SCRRRA representative or other authorized SCRRRA employee. The maximum shift duration for one EIC is 10 hours. Under "Form B" protection, the 10 hours includes 8 hours of the Contractor work and 2 hours to determine the limits of the "Form B", install, and remove "Form B" flags. The Contractor shall not be allowed to work within the Operating Envelope during the 2-hour flag installation and removal. The minimum shift duration for flagging services is 4 hours. If the Contractor desires to perform activities requiring an EIC that are longer than 10 hours' duration, then the Contractor shall coordinate with SCRRRA to schedule multiple EICs for the Work. SCRRRA will provide any needed EIC's under an agreement with the State at no cost to the Contractor.

The Contractor shall call the phone number provided with the executed copy of SCRRRA Form 6 - Temporary Right-of-Entry Agreement, a minimum of fifteen (15) working days in advance of the date that services of an EIC will be required. An EIC will not be scheduled until the Contractor has executed the SCRRRA Form 6 - Temporary Right-of-Entry Agreement, and the Contractor has attended the required safety training.

13-3.04 CONTRACTOR GENERAL SAFETY REQUIREMENTS

Safety takes precedence over deadlines, production schedules, and all other considerations. When uncertainty arises, take the safest course. Remember that accidents are often the result of carelessness, unsafe practices, lack of attention, and complacency.

The following rules must be followed at all times:

1. Using, possessing, or working under the influence of alcohol or drugs is not permitted anywhere on railroad property. This includes prescription drugs that cause drowsiness or otherwise impair a person's ability to perform an assigned task. SCRRRA may require employees of the Contractor to submit urine or other toxicological samples to be used for drug and alcohol testing after an accident or incident occurring within the railroad right-of-way.

2. Any employees, agents or invitees of Contractor or its sub-contractors under suspicion of being under the influence of drugs or alcohol, or in the possession of same, will be removed from the SCRRRA right-of-way and subsequently released to the custody of a representative of the Contractor's management. An employee removed for violation of the drug or alcohol policy will not be permitted future access to the right-of-way.
3. SCRRRA may require employees of the Contractor to submit urine samples for drug and alcohol testing after an accident or incident. Acceptance of this provision is a condition precedent to entering upon the SCRRRA Property.
4. The use or possession of unauthorized radio equipment is prohibited. The use of personal radios (including iPod, MP3 players, and similar devices), and cell phone ear pieces while working is prohibited.
5. The use of cellular phones within 25-feet from the nearest rail is prohibited.
6. Horseplay, physical altercations, running or jumping is prohibited.
7. Firearms or other deadly weapons, including knives are prohibited.
8. Work on public streets, roadway crossings, and highway bridges must conform to the California Vehicle Code and the standards given in the California Manual of Uniform Traffic Control Devices, and must be performed with due regard for the convenience and safety of the public.
9. Only authorized employees are allowed on engines, cars, cabooses, track cars or other railroad equipment.
10. Contractor employees must exercise care to prevent injury to themselves or others.
11. Employees must be alert and attentive at all times when performing their work.
12. Any defective tools, machinery and equipment are prohibited from use on SCRRRA property and, if found, must be removed immediately.
13. When on or near the tracks, the following precautions must be taken:
14. Keep clear of all tracks unless the EIC has provided a job briefing and identified the On-Track Safety protection in effect. No work may begin until the EIC is present at work site and a job briefing has been conducted.
15. Always look both ways before crossing tracks. Always step over the rails when crossing the tracks. Never walk, stand, or sit on the rails. The rail surface can be extremely slippery.
16. Always face the direction from which the train or on-track equipment is approaching.
17. Avoid track switches. The switch points are controlled from a remote location, can move unexpectedly, and exert enough force to crush ballast rock. Stand 150 feet from track switches when trains are approaching. Stay away from any other railroad device with which you are not familiar.
18. Always walk single file when crossing the tracks in a group.
19. Never stand between adjacent tracks in multiple track territory when a train is passing.
20. Always cross at least 20 feet away from the end of equipment: i.e. engines, railroad cars, or on-track equipment
21. Do not pass between standing locomotives, railroad cars or on-track equipment when there is less than 50 feet between the equipment.
22. Never cross tracks by going underneath, over or through cars, engines or on-track equipment.
23. Work is not allowed within 50 feet of the track centerline while trains are passing the work site. Always stand as far back as possible to prevent injury from flying debris or loose rigging.
24. Always visually inspect all passing trains. If you detect a dangerous condition, inform your EIC or watchman immediately. The EIC or watchman will notify the train crew.
25. Always stop equipment while a train is passing through your working limits. No movement will be allowed toward an approaching train that would cause the engineer to believe the track might be fouled.
26. Trains travel faster than they appear. It may be difficult to hear an approaching train. Trains may operate with cab car or freight car forward in the direction of travel.
27. Employees must not rely on past experience to determine train schedule. Train schedules are unpredictable and are subject to changes delays.

13-3.05 PERSONAL PROTECTIVE EQUIPMENT

All persons working on, over, or under the SCRRRA right-of-way must be equipped with personal protective equipment meeting applicable OSHA and American National Standards Institute (ANSI) specifications. Personal protective equipment must be appropriate for the task performed. Employees, subcontractors, suppliers, agents or invitees of Contractor shall wear the following minimum equipment while on the right-of-way:

1. Safety glasses with side shields conforming to ANSI Z87.1 - Occupational and Educational Personal Eye and Face Protection Devices.
2. Protective Helmets (Hard Hats) conforming to ANSI Z89.1 - Requirements for Protective Headwear for Industrial Workers, Type I or II, Class G or E.

3. Safety shoes with hardened toes conforming to ANSI Z41.1 – Personal Protection - Protective Footwear. Shoes must lace above the ankle and have a defined heel.
4. High visibility ORANGE or green fluorescent retro-reflective work wear. (Green and Red shirts, vests, or other outerwear are not permitted within the SCRRA right-of-way because of the use of the same colors as signals to trains).
5. SCRRA railroad safety training card in possession.

Hearing protection, face and eye shields, fall protection, gloves, and respirators must be worn as required by State and Federal regulations.

13-3.06 MAINTENANCE OF WORK AREA

The Contractor shall not pile or place any materials, articles, or equipment, nor park any machinery or equipment within the SCRRA Right-of-Way, or closer than 25'-0" to the center line of the nearest track, or in a manner that blocks access to SCRRA facilities and equipment. Soil, aggregates, or other similar loose materials must be covered to prevent migration of the material toward the track. Dust or blowing soil or debris must be controlled in accordance with South Coast Air Quality Management District Rule No. 402 and Rule No. 403.

Materials, machinery or equipment must not be stored or left within 250 feet of any highway railroad at-grade crossings, or where storage of the same will interfere with the sight distances of motorists approaching the crossing. For construction on the SCRRA right-of-way the Contractor must establish a storage area with concurrence of the SCRRA prior to beginning work, or as part of a Site Specific Work Plan.

Machines or vehicles must not be left unattended with the engine running. Parked machines and equipment must be turned off and must be in gear with brakes set. If equipped with blade, pan or bucket, the blade, pan or bucket must be lowered to the ground. All machinery and equipment permitted to be left unattended on SCRRA right-of-way must be left inoperable and secured against movement. Vehicles must not be parked over vegetation that might be ignited by the heat from the vehicle's exhaust system.

The Contractor shall not create and leave any conditions at the work site that would interfere with water drainage. Any work performed over water must meet all federal, State and local regulations.

13-3.07 PRECAUTIONS WHEN WORKING NEAR ELECTRICAL CONDUCTORS

All wires and cables must be considered to carry electric current at high voltage and to be dangerous unless informed to the contrary by proper authority. When using temporary power cords, cords must never be placed over the rails, nor may any metal object be placed across the rails.

For all power lines the minimum clearance between the lines and any part of the equipment or load must meet the State, Federal and OSHA construction safety standards and requirements. If capacity of the line is not known, a minimum clearance of 45 feet must be maintained. A person must be designated to observe clearance of the equipment and give a timely warning for all operations where it is difficult for an operator to maintain the desired clearance by visual means. When the height of overhead wire lines cannot be determined from the available records, the actual height must be determined by field survey.

13-3.08 SAFETY TRAINING AND COMMUNICATION

All personnel working on, over, or adjacent to the SCRRA right-of-way must attend a railroad safety training class and pass a closed-book examination covering the information presented in the class. Persons not regularly employed on the project, or at the project site only intermittently, are not exempted from this requirement.

Successful completion of the class and attaining a passing grade on the examination will permit a person to work on the Property of SCRRA for a period of one year at which time each person working on the Property of SCRRA must again take the class and attain a passing grade on the examination.

Before beginning any task on the right-of-way of SCRRA, a thorough job safety briefing must be conducted with all personnel involved with the task. The briefing must include the Contractor's job hazard analysis, its plan for conducting the work, and the procedures the Contractor will use to prevent its employees, sub-contractors, suppliers, agents or invitees from moving any equipment adjacent to or across any SCRRA tracks without the appropriate protection for the Contractor and the railroad operations. Additional job safety briefings must be conducted anytime that the job tasks, or conditions affecting the job tasks, are changed or revised.

When Contractor employees are required to work on the SCRRA right-of-way after normal working hours or on weekends, the Engineer and SCRRA Representatives must be notified. A minimum of two Contractor employees must be present at all times. If work is within or near the SCRRA right-of-way an EIC will be required, and a representative of the State must also be present on the project site.

The Contractor shall develop and provide an emergency action plan indicating the location of the site, contact names and phone numbers, directions for access to the site, instructions for emergency response, and location of the

nearest hospitals. The plan must also cover the Contractor's means of preventing fires arising from the Contractor's operations, and the Contractor's methods of fire suppression. The plan must also include the local direct phone numbers and locations of the nearest fire and police departments. Phone numbers for utility and SCRRRA emergency response must be obtained from the SCRRRA representative prior to the start of any work and must be posted at the job site.

13-3.09 EMERGENCY RESPONSE AND ACCIDENT REPORTING

Prior to starting work, the Contractor must provide the EIC with the emergency phone numbers for the project. At a minimum, phone numbers must be provided for paramedics, fire, police, utility response, SCRRRA Representative, Contractor Superintendent, Metrolink Operation Center (MOC), and the Metrolink Signal emergency number. A map and directions to the site must be immediately available for the use of the EIC.

In emergency situations the following apply:

1. Immediately report to the EIC any accidents, personal injuries, defects in tracks, bridges, signals utilities or communication facilities or any unusual condition that may affect the safe operation of the railroad.
2. When a person is injured, stop work and ensure everything possible is done for the injured person. Also take the following immediate action: Notify the fire, police, or paramedics as appropriate, and notify the Metrolink Operations Center; provide an individual or individuals to guide emergency response personnel to the site; and make sure that all access ways are cleared for emergency vehicle access.
3. If equipment was involved in the incident, it must not be moved until examined to ensure the equipment was in proper working condition, unless movement is necessary to prevent further injury or risk to persons or property.
4. In case of personal injury, loss of life, or damage to property, the EIC must immediately document the names, addresses and occupation of all persons involved, including all persons at the scene regardless of whether these persons give a Statement about the incident. This information should be included in the incident reports. The Contractor's cooperation with, and assistance to, the EIC is a requirement of accessing the SCRRRA right-of-way.
5. If an incident causes personal injury or death, all tools, machinery and other equipment involved, including premises where such accident occurred must be promptly inspected by the EIC. Tools, equipment and machinery must be secured until the EIC, Safety Officer, or other competent person has completed an inspection. A report of such inspection, stating the conditions found and names of persons making the inspection must be promptly forwarded to SCRRRA and the supervising officer of person making the inspection.

Information concerning incidents or personal injuries occurring to persons who are not employees, must not be given to anyone except authorized representatives of the SCRRRA or an officer of the law.

All damage to the right-of-way, facilities, or Property of SCRRRA, or any accident or incident within SCRRRA right-of-way, or any hazard noticed on passing trains must be reported immediately to the railroad EIC, if an EIC is present, or in the absence of a railroad EIC, to SCRRRA's Metrolink Operations Center (MOC). The phone number for the MOC is (888) 446-9715 or (909) 593-0661. Any vehicle or machine which comes in contact with the track, signal equipment, structure or other railroad installation or facility, regardless of the force of the impact, may result in the derailment of a train and must be reported immediately to the SCRRRA representative and to the EIC, if an EIC is present, or in the absence of a railroad EIC, to MOC.

SECTION 13-4. SHOOFLY CUTOVER COORDINATION

13-4.01 TRACKWORK

The Contractor shall furnish all material necessary for the construction of the full length of the shoofly, including the material needed for that portion of the shoofly between the 13-foot clear points and the connection to the main track, and construct the shoofly between the 13-foot clear points at each end of the shoofly. SCRRRA will construct that portion of the shoofly between the 13-foot clear point and the connection to the main track, make the final connection, raise, line and surface the portion between the 13-foot clear point and the connection to the main track, and de-stress the rail in the portion constructed by SCRRRA portion.

The limits of responsibility are:

Begin Station	End Station	Length	Performed By
Shoofly Sta 606+42.00	Shoofly Sta 613+53.48	711.48 ft	SCRRA
Shoofly Sta 707+44.06	Shoofly Sta 715+22.98	778.92 ft	SCRRA
Valley Sub Main Track 1 Sta 606+42.00	Valley Sub Main Track 1 Sta 612+26.03	584.03 ft	SCRRA
Valley Sub Main Track 1 Sta 709+07.35	Valley Sub Main Track 1 Sta 715+25.00	617.65 ft	SCRRA

The Contractor shall furnish all material and construct the shoofly track between the 13-foot clear point and the connection to the main track at each end of the shoofly. The Contractor shall also construct the subgrade for the entire shoofly including the sub-ballast and the initial ballast layer for the portions constructed by SCRRA, and furnish materials. The Contractor shall also furnish all material necessary for the construction of the shoofly track from the 13-foot clear point to the point of connection to the main track.

SCRRA will construct the final connection between the 13-foot clear point and the existing main track and make the final connection.

13-4.02 SIGNAL WORK

The railroad signal design drawings illustrate the signal system in the final configuration for the operation of trains on the shoofly, and for the operation of trains on the completed main track. They do not include the design of any intermediate phases or staged construction to accommodate the work of the Contractor. The Contractor shall be responsible for the design of any temporary work necessary to support phased or staged construction. The Contractor shall submit all designs for temporary signal construction to SCRRA for approval not less than 60 working days prior to the proposed start of the work. The Contractor shall maintain the signal system operational at all times during construction except during the planned cut-over and integration of the new or temporary control points, wayside signals, and grade crossing warning devices into the signal system.

The Contractor shall construct the signal system as shown on the design drawings and be responsible for the cutovers of the at-grade crossing warning devices during intermediate stages, with the exception of the final cut-over. The Contractor shall be responsible for pre-testing and "point check" all new signal and grade crossing systems in preparation for putting equipment into service and for final cutover by SCRRA forces prior to SCRRA's testing and acceptance. The Contractor shall be responsible to communicate and work with SCRRA cut-over designee during this process. The Contractor shall be responsible to provide documentation of their pre-test and "point check" work (process). SCRRA will make the final cut-over to integrate the new control points, intermediate signals, and grade crossing warning devices into the SCRRA system.

The Contractor shall furnish all materials, articles, and equipment necessary to provide fully functional control points, wayside signals, grade crossing active warning devices and ancillary facilities as shown on the drawings or required by SCRRA standards, except the State-Furnished Materials shown in the section "State-Furnished Materials" of these special provisions. The State furnishes you railroad signal equipments at SCRRA Free On Board (F.O.B.) Contractor's trucks at 186 University Parkway, Pomona, California 91768.

13-4.03 TESTING

The Contractor shall conduct operational tests of the signal system at each control point, intermediate signal, grade crossing, and other equipment or facility to verify and insure that each location or system is in compliance with the Federal Railroad Administration Rules and Regulations Governing Railroad Signal and Train Control Systems, as well as all applicable SCRRA standards and policies. The Contractor shall conduct tests of the equipment after installation in the field but prior to the start of the final cut-over. Shop and bench tests, when required by the Specifications, may not be offered as a substitute for field testing.

The Contractor shall submit its plan for the operation tests to SCRRA for review and approval 30 working days prior to the proposed start of any work on the signal system. The Contractor shall divide its plan into four parts corresponding to the following divisions:

1. Operational tests performed as an integral part of the construction of all new control points, intermediate signals, grade crossing warning systems, (or other equipment or facility) in the project.
2. Operational tests performed at the start of the cut-over of existing control points, intermediate signals, grade crossing warning systems (or other equipment or facilities) where modifications were performed.

3. Operational tests performed at the start of the cut-over of new control points, intermediate signals, and grade crossing warning systems (or other equipment or facilities).
4. Operational tests (end to end) of the system performed prior to opening the track to train to verify that each of the individual locations contained within the project is operating as designed, and in accordance with SCRRA operating rules, and federal regulations.

During the operational testing of the individual locations, all signals at the location must be observed at the same time. During the system check, after all individual locations have been operationally tested, it is permissible to view only the signals for only the routes being tested. Although the Contractor is not responsible to perform the final cut-over testing, it must be present with a minimum of one person at each location where testing is being done, plus a qualified signal engineer. The Contractor shall be able to troubleshoot make changes to equipment and appliances at locations and otherwise assist as needed during testing.

A new control point, intermediate signal, or grade crossing will be considered operationally tested when all equipment at the location has been installed, all appliances controlled by the location have been installed, all inputs to and outputs from the location have been tested and verified, and all applicable tests performed. Equipments must be pre-tested before the location is actually placed in service. The Contractor shall provide a track code generating test unit equivalent to the Alstom Generakode Test Unit, or a Harmon TIS-4 Track Input Simulator BB to generate and receive the track codes as part of the operational tests prior to the cut-over. All tests must be performed in the presence of SCRRA or designated SCRRA representative who will be on-site during the testing.

SCRRA will perform the final end-to-end testing of the system prior to opening the track to train movements under signal control. The Contractor shall perform other required operational tests with the presence of SCRRA representatives.

SECTION 13-5. TRACK OCCUPANCY AND WORK WINDOWS

13-5.01 DESCRIPTION OF LOCATION AND TRAFFIC

The Contractor shall obtain permission in writing from SCRRA for movement of equipment on track or across tracks at locations other than public highway crossings.

The Contractor shall include milestone schedule for delivery of long lead items allowing for six (6) months between order and delivery of the items.

The mainline tracks, within the limits of Project site, are under direct control of SCRRA dispatcher. No track shall be fouled without authorization and in the presence of an SCRRA EIC. For all work with the potential to foul the track, the Contractor shall allow sufficient time in his work schedule for the EIC to clear trains. Approximately 15 minutes is required for the EIC to clear each train, during which time the Contractor shall not foul the track or perform work that has the potential to foul the track.

13-5.02 COORDINATION WITH RAIL TRAFFIC

The Contractor's operations are subordinate to the operation of trains on the SCRRA right-of-way, whether passenger or freight. All work upon the SCRRA right-of-way shall be done at such times and in such a manner as to not interfere with or endanger the SCRRA Operations. SCRRA will strive to cooperate with the Contractor such that the work may be handled and performed in an efficient manner. However, the Contractor will have no claim whatsoever for any type of damages or for extra or additional compensation in the event its work is delayed by rail operations.

All forecasts of train traffic and schedules are approximate. The public time table or schedule shall be used for planning purposes only and shall not be used for scheduling actual work in the vicinity of the railroad tracks in the absence of a railroad EIC. SCRRA, UPRR, BNSF, and Amtrak may run additional trains as needed to perform their respective obligations. The operation of extra and special trains will be at sole discretion of SCRRA. The Contractor's work may be halted or delayed whenever necessary to accommodate train service.

Persons acting as an EIC are generally dispatched to projects in the order requested. An EIC may not be available at all times without advance notice. The Contractor is encouraged to schedule the services of an EIC or inspector a minimum of 15 working days in advance of any planned operation to avoid delay. Any work to be performed by the Contractor, which requires services of an EIC or inspector, shall be deferred until an EIC or inspector is available at the job site.

13-5.03 TRACK WORK WINDOWS AND TRACK ACCESS

All work on, over, or adjacent to the tracks must be coordinated with SCRRA, and the Contractor's work is subject to the SCRRA operating rules for work on main tracks and other than main tracks:

1. **Work Window:** A period of time with specific beginning and ending time and durations for which the track, signals, bridges and other Operating System elements within the Operating Envelope are temporarily removed from service or modified in some other manner and train and other operations suspended or modified to allow construction or maintenance work to occur. Written authority from SCRRA and an approved Site Specific Work Plan (SSWP) is required before the Contractor is granted a Work Window. The Contractor's Work Window shall have specific geographic limits, which are defined in the approved SSWP. Modifications or suspension of train and on-track equipment movements resulting from a Work Window involves written changes to the Railroad's Rules of Train and On-Track Equipment Operations.
2. **Exclusive Track Window:** An approved Work Window in which no train movements (accept the Contractor or SCRRA work trains or equipment under control of the EIC, in accordance with an approved SSWP) will operate on any track within the window limits. The Contractor may dismantle, remove, reconstruct, or otherwise obstruct tracks within the limits of such a window. This Work may be protected by track out of service, track and time limits, or by "Form B" Track Bulletin.
3. **Limited Track Window:** An approved Work Window for some, but not all tracks, within a general Work area (e.g. one track remains for operation of trains, other tracks are available for the Contractor's Work). Movement of trains over the track(s) of a Limited Track Window is under the control of the EIC who will not authorize train movement unless and until the Contractor personnel and equipment are clear of the operating track. The Contractor may remove, construct, or obstruct only the track designated by the SSWP and must arrange the Work so that trains can operate without delay on the remaining track(s) in the Work area. This Work may be protected by track out of service, track and time, or by "Form B" Track Bulletin at the discretion of SCRRA.
4. **"Form B" Work Window:** An approved Work Window in which passenger, freight and all other trains and on-track equipment movements can be prohibited from entering the defined limits of a segment of track. The "Form B" Work Window does not allow the Contractor to remove from service or modify the tracks, signals, bridges, stations or other elements of the Operating System in a manner, which will delay or in any way affect the safe operation of the trains. The "Form B" Work Window allows the Contractor the ability to enter the Operating Envelope and perform construction activities subject to the conditions above. An Employee-in-Charge/Flagman from the SCRRA will exercise strict control over the Contractor's construction activities in conjunction with Roadway Worker Protection requirements, to assure that the Contractor's activities do not delay or impact train service.

13-5.04 REQUESTING WORK WINDOWS

The Contractor shall make requests in writing to the SCRRA Representative for Track Work Windows not less than fifteen (15) working days in advance of the desired Work Windows. An advance notice of Sixty (60) days is required when requesting an Exclusive Track Window.

Requests for Work Windows must include an approved site specific work plan (SSWP) for the work to be performed during the window.

SSWPs shall include a detailed schedule of events, indicating the expected hourly progress of each activity that has duration of one hour or longer. The schedule shall include a time at which each activity planned under the SSWP and the requested Work Window will be completed, and the total duration of all the construction activities shall be less than the approved Work Window. Failure of the Contractor to complete the scheduled activities by the planned time or to put in place an approved contingency plan may adversely affect the operations of scheduled trains. The SSWP shall include the information specified below:

1. All activities necessary to perform construction activities within the Operating Envelope, including use of stations, sidings, and proposed storage areas.
2. A description of any proposed changes in the Operating System between start and finish of the work, including any requested Work Windows.
3. A schedule of the work, showing each activity and where and how it affects normal operation of the Operating System. This schedule shall integrate and allow for the necessary work of the Signal and Communication forces. Each activity in the plan shall include all labor, materials, and equipment required to complete the activity within the SCRRA allotted time period. The Contractor shall identify on the schedule all SCRRA furnished labor, equipment and materials.
4. The Contractor shall have SCRRA approved Contingency plans for putting the Operating System back in operation in case of an emergency, or in case the Contractor fails to perform and complete the work on time. The contingency plans shall address the various stages of activities necessary to restore the System.
5. List all of the approved proposed work plans to be performed under the SSWP, and provide the name(s) and number(s) of the Contractor's supervisor(s) in charge of the SSWP tasks.

The SSWPs must be of sufficient detail, clarity, and organization to permit easy review and approval by the SCRRA before the proposed work is performed. The SSWP shall be submitted to SCRRA as follows:

1. At least 14 calendar days prior to start of the work within the Operating Envelope for work other than signal or third-party activity.
2. At least 30 calendar days prior to the start of work for work involving signal or third-party installation.

SCRRA may request explanations and changes to the SSWP to conform the SSWP to the requirements of SCRRA. If the SSWP is not acceptable, the Contractor shall revise the SSWP to make it acceptable. The Contractor shall be responsible for submitting a revised SSWP that can be reviewed and approved by the SCRRA at least seven days in advance of any work that affects the Operating System.

The Contractor shall be informed if the SSWP is acceptable not less than seven calendar days prior to the scheduled start of work within the Operating Envelope. Once the plan is accepted, the Contractor shall assemble the resources necessary to perform the work represented by the SSWP, so that necessary resources are available one day before the work is to be accomplished, thereby demonstrating to SCRRA the readiness of the Contractor to perform the Work. At this time, SCRRA will make a final decision as to whether or not the Work is to proceed as planned or be canceled.

13-5.05 EXTRAORDINARY WORK

Should a condition arise from, or in connection with, the Contractor's work on the Project which requires immediate and extraordinary actions to be taken to protect operations and facilities of SCRRA, or facilities of others occupying the right-of-way, the Contractor shall undertake such actions. If, in the judgment of the SCRRA or the State, such actions are insufficient, SCRRA may undertake any action that it deems necessary. In any event, such actions shall be at the Contractor's expense and without cost to SCRRA. SCRRA, the State, or a or Public Agency shall have the right to order the Contractor to temporarily cease operations in the event of an emergency or if, in the opinion of SCRRA, the Contractor's operations may interfere or endanger train operations.

13-5.06 RULES AND HOURS OF OPERATION

This Section outlines requirements and provisions for rules and hours of operation for the Contractor execution of the Work under this Contract. The Contractor shall cooperate with the SCRRA in all matters requiring coordination for execution of the Railroad Work including eliminating or minimizing to the greatest extent possible interference and delays to all scheduled passenger and freight trains movements. Information regarding train movements is available to the Contractor, upon request. A sample activity report of train movements for one week may be obtained from the SCRRA.

The Contractor shall keep the SCRRA fully informed regarding any planned night or weekend Work for all Contract Work that has the potential to foul the tracks.

Any damage caused by the Contractor to rails, ties, structures, embankment, third-party property, signal and communications equipment, or any other facilities shall be repaired at the Contractor's expense to a condition equal to or better than the condition prior to the Contractor entry, and as accepted by the SCRRA. At the sole discretion of the SCRRA, SCRRA may direct that repairs be performed by other Contractors. The charges for such repairs shall be deducted from the Contractor's payment due under this Contract.

The Contractor shall consider the safety of the Work, train operations personnel, and property on and adjacent to the Worksite when determining amount, location, movement, and use of materials and equipment on Worksite. The Contractor shall not load worksite with excessive amounts of material, equipment, or other items that have the potential to interfere with the Work or with train operations. The Contractor shall relocate stored products, equipment, and materials that interfere with train operations, public and private utilities, or visibility at railroad crossings. Materials and equipment shall not be so piled, stored, or parked when not in use.

As necessary, the Contractor will preserve and relocate railroad signs (mileposts, speed limits, "no trespassing" signs, station signs, crossing whistle signs, etc.) during the full period of construction. Signs shall be maintained during construction or restored upon completion of the Work. The Contractor shall protect at-grade crossing warning signs.

13-5.07 PROJECT SPECIFIC WORK WINDOWS

The time limits for all types of Work Windows include the time for the Contractor to restore and test the signal and communication system before the operation of trains; therefore, the full duration of the Work Window is not available for the use of the Contractor. The SSWP shall designate both the time at which the Contractor shall make the track ready (in full compliance with the FRA Track Safety Standards and with the SCRRA's Track Maintenance

and Engineering Instructions) for the passage of trains, and the remaining time within the Work Window that will be required for the signal and communications system restoration.

The Contractor shall personally inspect the track within the Work Window prior to the restoration of train service; confirm with the Authority that the track is in full compliance with the above standards and establish the speed at which trains will operate upon restoration of the service.

Work windows applies to this project as follows:

1. Form B available 4:00 AM to 10:00 PM, Monday morning through Sunday night.
2. Absolute Window – Track Out of Service may be available Sunday night through Saturday morning, 10:00 PM to 4:00 AM the following morning.

ADDITIONAL ABSOLUTE WINDOW – TRACK OUT OF SERVICE

A limited number of longer track work windows will be available during the contract duration. These windows will follow the Absolute Window – Track Out of Service rules.

Three (3) 54 hour Absolute Windows will be available from 10:00 PM Friday night to 3:58 AM Monday morning. These Absolute Windows are reserved for the cut-overs of track to the shoofly and back to main track.

Work Window Rules and Requirements

A 65-day advance notification is required to set up Absolute Windows. If the scheduled work during the Absolute Window cannot begin, the Contractor shall provide a 65-day advance notice to schedule another Window.

In the event that the scheduled work during the Absolute Window cannot be completed, the Contractor shall provide an additional 65-day advance notification to schedule another Absolute Window.

No Absolute Window will be allowed during the Metrolink "Holiday Train" weekend. This event is tentative scheduled between the Thanksgiving holiday and the Christmas holiday. The Contractor shall coordinate with Metrolink when this event will be scheduled.

All required signal and track testing by the Contractor and SCRRRA shall be completed by the end of the Absolute Window.

Additional Requirements and Notes that pertain to work windows:

1. Metrolink commuter service begins at 3:58 AM each weekday. It ends at 10:57 PM each weekday. SCRRRA weekend commuter services begin at 6:40 AM on Saturday and Sunday and ends at 9:45 PM on Saturday and Sunday.
2. The start time for Track Work Windows is an "average" start time dependent on location and train on-time performance, and may vary by 30 minutes either direction.
3. Either a Form B or an Absolute Window – Track Out of Service will be required for all work activities on any track within the rail ROW.
4. Scheduling of Work Windows, SCRRRA EICs and watchmen, and signal support forces during track construction will be strictly controlled by SCRRRA and documented in the Contractor's Site Special Work Plan and three-week look-ahead schedule. Work Window activities not coordinated in the weekly construction meetings and documented in the look-ahead schedules will not be supported by authorization of Work Windows.
5. The Contractor is strongly encouraged to work additional shifts as required to finish the Work within the contract time. There shall be no additional payment for night work, weekend work and overtime required for working around live track.

Daily Train Traffic volumes that apply to this project:

Type of Train	2012	2013
Metrolink	30	30
Freight	8	8
Total Trains	38	38

The table of trains shown above represents the expected number of scheduled trains on a normal day through the project area and is subject to change. On certain days, the number of scheduled trains may vary, particularly on weekends and holidays. Certain number of these trains may operate ahead of schedule and any of the trains may operate behind schedule, depending on operating conditions on a given day. Passenger and freight train schedules are re-issued as necessary through the year, and such re-scheduling is to be expected during the duration of the project.

Freight trains may or may not be scheduled, and vary by the day of the week. However, operating times of freight trains are more varied than the those of passenger trains due to the length of their trips, the number and weight of the cars they are carrying, and the nature of the business en-route. Maintenance of way trains, extra trains, or other movements are made up and operated according to the needs of the railroad. These may also be operated on an emergency basis without prior notice, if conditions require.

Extra trains, not shown on passenger schedules or freight schedules may be operated for special events, for freight traffic purposes, for railroad maintenance activities, or in support of this or other projects. The actual operating conditions, the number of trains to be operated and the on-time status of trains on any given day may cause changes in the available Work Window shown in this section.

Under emergency conditions adversely affecting SCRRA, it may be necessary to alter or cancel previously scheduled work windows with little or no advance notice. SCRRA will make every attempt to minimize the occurrence of such events.

The Contractor shall not perform any fieldwork during three annual designated holidays. Fieldwork shall not include receipt or delivery of materials or equipment or work performed in field offices. The designated holidays are Labor Day, Thanksgiving Day and Christmas Day. During these periods, SCRRA will not have the resources (labor and equipment) or construction management personnel to issue track bulletins or to support, inspect, or oversee the Contractor's Work.

SECTION 13-6 CONSTRUCTION

13-6.01 DEMOLITION AND REMOVAL

Where structures over or adjacent to the tracks are to be demolished, the tracks must be protected from damage during the demolition. Equipment used in demolition operations may not be operated on or over unprotected track. Blasting will not be permitted to demolish a structure over or within railroad right-of-way.

The Contractor may employ either of the following methods:

1. During demolition of a bridge deck or overhead structure, a protection shield must be erected over the track to catch falling debris. The protection shield shall be supported from girders or beams and shall not be lower than the allowed temporary clearance from the top of rail. The deck must be removed by cutting into sections and lifting out. All cranes, hoists, winches, and hardware used in connection with the demolition are to include a factor of safety of 150% in addition to the safe working load of the equipment or hardware. Large pieces of deck or other portions of the structure must be handled individually and must not be allowed to fall on protection shield or onto the ground.
2. When an overhead protection shield cannot be installed due to limited clearance or type of superstructure, the track may be protected by timber mats placed over the track structure, subject to approval by SCRRA. Mats must be designed to support all anticipated live and dead loads within the allowable stress range of the lumber used in the mats, however, individual timbers construction of timber mats must not be less than 8" x 8" in cross section dimension. The length of the mat must be sufficient to span the track and ballast section without need to support the mat from the rails. Timber mats shall be made in sections such that they may be lifted in and out as a unit quickly. Mats must not rest on ties or rails. Geofabric or canvas must be placed over the track structure to keep the ballast clean. The mats and ballast protection must cover the full extent of the work zone but not less than 25-ft beyond the existing limits of the overhead bridge or structure.

The Contractor shall submit detailed SSWP and plans of the protection shield or the timber mats to the SCRRA Representative for approval prior to the start of demolition. The plans shall also indicate the location and capacity of the proposed cranes and estimated lifting loads. The design of all load-bearing structures or supports and lifting plans shall be prepared by a registered Professional Engineer and shall bear the seal and signature of the engineer in responsible charge of the design.

The Contractor shall provide timely communication to the SCRRA Representative when scheduling the demolition-related work so that the SCRRA Project Representative or his or her designee may be present during the entire demolition procedure.

The Contractor is responsible for protecting the track and other railroad facilities from damage or degradation resulting from demolition activities. At any time during demolition activities, the SCRRA Representative may require revisions to the previously approved procedures to address weather, site conditions or other contingencies that may create a potential hazard to rail operations or SCRRA facilities. Such revisions may require immediate interruption or termination of ongoing activities until such time that protection satisfactory to the SCRRA Project Representative.

13-6.02 EXCAVATION AND BACKFILL

Earthwork for railroad work and railroad structures must conform to Section 19 of the Standard Specifications except as required in this Section 13.

All excavations must be conducted in compliance with applicable law and regulations and, regardless of depth, must be shored when within the zone of influence from the railroad loading, or when necessary to protect structures, facilities, or personnel. Shoring for excavations must comply with the SCRRA "Excavation Support Guidelines." Any excavations, holes or trenches on the SCRRA right-of-way must be covered, guarded and protected when work is not actively prosecuted. When leaving work site areas at night and over weekends, the areas must be secured and left in a condition that will ensure that SCRRA employees and other personnel who may be working or passing through the area are protected from all hazards. All excavations must be backfilled as quickly as practicable.

The Contractor shall submit a plan showing the limits of all excavations within the Right-of-Way of SCRRA, and the method of support when support is required. The Contractor shall not make any excavations on the SCRRA right-of-way, or within the zone of railroad load influence as defined in Figure 2-1 of the SCRRA "Excavation Support Guidelines", until the Contractor's excavation plan, and its plans and calculations for the support of the excavation are approved in writing by SCRRA.

The Contractor shall cease all work and notify SCRRA immediately before continuing excavation in the area if obstructions are encountered which do not appear on drawings. If the obstruction is a utility and the owner of the utility can be identified, then the Contractor shall also notify the utility owner immediately. The Contractor shall not perform any work if there is any doubt about the location of underground cables or lines of any kind until the exact location of the underground facilities has been determined. There will be no exceptions to these requirements.

The Contractor shall perform excavation and grading so that the finished surfaces are in uniform planes with no abrupt breaks in surface and having positive drainage on the right-of-way away from the track structure, and to approved catchment areas.

13-6.03 SHORING AND SUPPORT OF EXCAVATION

Shoring, cribbing and sheeting designed to support excavations or embankments shall be designed to support all lateral forces caused by the earth, vehicular traffic, construction equipment, temporary and permanent structures, and other surcharge loads in the vicinity of the excavation. Support or shoring located on the SCRRA right-of-way, or within the zone of influence from railroad loading, shall conform to the SCRRA Excavation Support Guidelines. Designs for all temporary structures supporting tracks, or excavations adjacent to the tracks and within the zone of influence from railroad loading, shall include railway surcharge loading imposed by a Cooper E-80 live load. Any excavation adjacent to track must be covered and provide a uniform path and include with standard handrails when work is not actively underway.

The Contractor shall submit a detailed SSWP drawings and supporting calculations for any temporary support of excavation for SCRRA review and approval. For the installation of temporary or permanent shoring systems, including soldier piles and lagging, or interlocked steel sheeting on or adjacent to SCRRA's right-of-way, lateral deflection of the shoring system plus top of rail monitoring is required. The frequency of monitoring must comply with the SCRRA "Excavation Support Guidelines." The monitoring program must identify the survey locations, the distance between the location points, and frequency of monitoring before, during, and after construction. The Contractor shall submit the monitoring program for the track, roadbed, and shoring for review and approval prior to starting work.

The monitoring survey data must be collected at the approved frequency and immediately furnished to the SCRRA Representative for review. If SCRRA determines that any movement has occurred in the track or supporting structure, SCRRA will notify the Contractor and the Contractor shall immediately take all necessary steps to correct the movement or settlement. SCRRA, at its sole discretion, shall have the right to immediately require the Contractors' operations to be ceased, or to have the excavated area immediately backfilled, or to perform additional investigations to determine what corrective action is required, or any combination thereof. SCRRA may modify the survey locations and monitoring frequency as it deems necessary during the project. Any corrective action required by SCRRA or performed by SCRRA, including the monitoring of corrective action of the Contractor, will be at the cost and expense of the Contractor.

13-6.04 DRILLING AND PILE DRIVING

The Contractor shall take special precaution and care, in connection with drilling or driving piles or sheets adjacent to tracks, to provide adequate lateral support for the tracks and the loads which they carry, without disturbance of track alignment and surface, and to avoid obstructing track clearances with working equipment, tools or other material. The Contractor shall submit detailed SSWP and plans of the Drilling and Pile Driving Operations to the SCRRA Representative for approval prior to the start of drilling and pile driving.

Pile driving must be carried out so that it does not interfere or endanger train operations. An EIC must be present whenever pile driving or drilling is underway in the vicinity of the SCRRA track. Equipment must be positioned so that no part of machine swings over the track or infringes within 25-ft of the nearest rail without first obtaining permission from SCRRA and SCRRA has established an appropriate work window.

Piles must be secured independently of the hammer or vibrator at all times while driving until sufficiently anchored in the soil such that the pile will stand without external support during the completion of the driving. Reinforcing steel cages or other internal structural supports in concrete structures must be designed to withstand all loads imposed in handling and setting. A crane must remain attached to the reinforcing steel cage until the reinforcing steel cage is guyed or braced to prevent movement unless it can be demonstrated that the cage or support will resist all loads which may be imposed without collapse or failing.

Large diameter holes and shafts within the zone of influence from railroad loads must be cased to prevent caving and loss of support adjacent to the tracks. If caving occurs, the hole must immediately be filled until additional casing can be advanced in the hole before drilling is continued.

13-6.05 BORING AND JACKING

The face of all jacking and receiving pits shall be located an outside of the SCRRA right-of-way, or a minimum of 25 feet from the center line of the nearest track, measured at right angle to the track, whichever is greater unless otherwise approved by SCRRA. The use of trench boxes may be permitted for jacking and receiving pits, however, trench boxes, shields, and hydraulic shores are not acceptable inside the zone of influence from railroad loading. Design of the temporary supports for the jacking and receiving pits must be conform to the requirements of the SCRRA "Excavation Support Guidelines."

Boring and jacking of casings and other conduits must conform to the requirements of SCRRA Engineering Standard ES5001 and ES5002. For any conduit that is bored or jacked under the track, the Contractor shall guarantee the work against settlement for two years after the completion of the work, and shall furnish a performance bond against failure or settlement of the soil around the jacked pipe or casing in the amount shown in the following table:

Casing Diameter	Bond Amount	Casing Diameter	Bond Amount
<12"	\$45,000	80"	\$315,000
24"	\$90,000	96"	\$360,000
36"	\$135,000	108"	\$405,000
48"	\$180,000	120"	\$450,000
60"	\$225,000	132"	\$495,000
72"	\$270,000	144"	\$540,000

The Contractor shall submit detailed SSWP and plans for jacking and boring operations, including the design of temporary supports for the jacking and receiving pits, to the SCRRA Representative for approval prior to the start of any work.

13-6.06 TEMPORARY STRUCTURES

Formwork, falsework, guying, bracing, and other temporary structures must be designed to resist all imposed construction live and dead loads including wind and seismic loads. Railroad track, structures, equipment, or other railroad facilities may not be used to secure or brace temporary or permanent structures during construction.

Designs for falsework above any tracks shall conform to the SCRRA Grade Separation Guidelines and the Caltrans Falsework Manual. Falsework over or adjacent to railroad tracks shall meet the requirements in the Caltrans Falsework Manual for falsework over traffic (traffic openings). The additional provisions stipulated the "Guidelines for Design of Falsework for Structures Over Railroad in Connection with Highway Grade Separation Construction," issued by the Southern Pacific Lines (Falsework Memo No. 7) shall be included in all designs of falsework over SCRRA tracks. Collision posts are required.

The Contractor shall submit a detailed SSWP and procedure for erecting and removal of the falsework spans over railroad tracks. Equipment used for the erection, or removal of structures over railroad facilities, shall have a minimum lifting capacity of one hundred-sixty seven percent (167%) of the lift weight (operational capacity limited to sixty percent (60%) of the tipping load or the boom structural load). The procedure shall indicate the capacity of cranes, location of cranes with respect to the tracks and estimated lifting loads. The erection procedure must be

prepared by a California Registered Professional Engineer and shall bear his or her seal and signature. The procedure must be approved by SCRRA.

The Contractor shall furnish, to the SCRRA Representative, four sets of working drawings and a copies of the Contractor's plans illustrating and describing the details of construction affecting SCRRA Property and tracks. The working drawing must include the proposed method of installation and removal of falsework, shoring or cribbing. The Contractor shall also furnish two sets of structural calculations of any falsework, shoring or cribbing. A registered professional engineer licensed to practice in the State of California shall seal and sign all drawings and calculations. The Contractor shall not begin work until SCRRA has reviewed and approved the plans.

13-6.07 HOISTING OPERATIONS

The Contractor shall submit a detailed SSWP and procedure for any crane, mast, or boom operations, on, over, or adjacent to the SCRRA right-of-way to the SCRRA Representative for approval prior to the start of hoisting operations. The Contractor shall submit four (4) copies of the detailed procedure for erection of the proposed structures over or adjacent to SCRRA's tracks or right-of-way. This procedure shall include a plan showing the locations of cranes, horizontally and vertically, operating radii, with staging locations shown, including beam placement on ground or truck unloading staging plan. Plan should also include the location of all tracks, other railroad facilities; wires, poles, adjacent structures, or buried utilities that could be affected, showing that the proposed lifts are clear of these obstructions. No crane or equipment may be set on the SCRRA rails or track structure.

The following additional information must be included in the submittal as applicable:

1. All as-built bridge seats and top of rail elevations shall be furnished to SCRRA Representative for review and verification at least 30 days in advance of construction or erection of the bridge span, to ensure that minimum vertical clearances as approved in the plans will be achieved.
2. Computations must be made for the weight of the materials, articles or equipment being lifted and must be submitted for review and approval by SCRRA. Computations shall be made from plans of the structural members being erected and those plans or sections thereof shall also be included in the submittal; the weight shall include the weight of concrete or other materials including lifting rigging.
3. Crane rating sheets showing cranes to be adequate for 167% of the actual weight of the pick. A complete set of crane charts, including crane, counterweight, maximum boom angle, and boom nomenclature is to be submitted. Safety factors that are included by the manufacturer in the crane charts are not to be considered when determining the 167% additional capacity.
4. A data sheet shall be prepared listing the type, size and arrangements of slings, shackles, or other connecting equipment. Include copies of a catalog or information sheets for specialized equipment. All specific components proposed for use shall be clearly identified and highlighted in the submitted documents. The safe working load capacity of the connecting equipment shall be 167% above the calculated weight of the pick.
5. A complete written procedure is to be included that describes the sequence of events, indicating the order of lifts and any repositioning or reconnecting of the crane or cranes.
6. A time schedule for each of the various stages must be shown as well as a schedule for the entire lifting procedure. The proposed time frames for all critical sub tasks (e.g., performing aerial splices, installing temporary bracing, etc.) shall be furnished so that the potential impact to SCRRA operations may be assessed and eliminated or minimized.
7. The names and experience of the key Contractor personnel involved in the operation shall be included in the Contractor's means and methods submission.
8. Design and supporting calculations prepared by the Professional Engineer for items including the temporary support of components or intermediate stages shall be submitted for review. A guardrail or collision post will be required to be installed in a track where a temporary bent is located within fifteen (15) feet from the centerline of that track.
9. The proposed erection procedure must be approved by the SCRRA Representative prior to undertaking work on the project.

The Contractor shall provide timely communication to the SCRRA Representative when scheduling the erection-related work so that the SCRRA Representative may be present during the entire erection procedure.

At any time during construction activities, the SCRRA Representative may require revisions to the previously approved procedures to address weather, site conditions or other circumstances that may create a potential hazard to rail operations or SCRRA facilities. Such revisions may require immediate interruption or termination of ongoing activities until such time the issue is resolved to the satisfaction of the SCRRA Representative. SCRRA shall not be responsible for any additional costs or time claims associated with such revisions.

13-6.08 CLEARANCES

The Contractor shall not pile or store any materials, machinery or equipment closer than 25'-0" to the center line of the nearest SCRRA track, and only then with the permission of SCRRA. Materials, machinery or equipment must not be stored or left within 250 feet of any highway railroad at-grade crossings, where storage of the same will interfere with the sight distances of motorists approaching the crossing. Prior to the start of work, the Contractor shall establish a storage area with concurrence of the SCRRA representative.

Unless shown otherwise on the Contract Drawings and approved by SCRRA, the Contractor shall abide by the following temporary clearances during construction. The Contractor shall not place forms, materials, spoils, or other temporary construction, including bracing or work platforms, within the clear area defined below unless approved in writing by SCRRA:

- 15' -0" Horizontally at right angles from centerline of nearest track
- 22' -6" Vertically above the top of the highest rail

For all power lines the minimum clearance between the lines and the top of the rail must be as shown below:

- 27'-0" Vertically above top of rail for electric wires carrying less than 750 volts
- 28'-0" Vertically above top of rail for electric wires carrying 750 volts to 15,000 volts
- 30'-0" Vertically above top of rail for electric wires carrying 15,000 volts to 20,000 volts
- 34'-0" Vertically above top of rail for electric wires carrying more than 20,000 volts

At no time may the Contractor reduce the minimum clearances required by the California Public Utilities Commission (CPUC) General Order 26-D, or block or restrict the visibility of any signal or railroad warning device. Any infringement within the clearances established by General Order 26-D due to the Contractor's operations must be submitted to SCRRA and the operating railroads, and must not be undertaken until approved in writing by SCRRA, and until SCRRA has obtained any necessary authorization from the CPUC for the infringement. No extra compensation will be allowed in the event the Contractor's work is delayed pending approval by SCRRA, the operating railroads, or the CPUC as applicable.

In the case of impaired vertical clearance above top of rail, SCRRA will have the option of installing tell-tales or other protective devices SCRRA deems necessary for protection of SCRRA operations. The cost of tell-tales or protective devices will be borne by the Contractor.

Reduced temporary construction clearances, which are less than construction clearances defined above, will require special review and approval by SCRRA and, if less than the statutory minimum, the CPUC. Any proposed variance on the specified minimum clearances due to the Contractor's operations shall be submitted to the SCRRA Representative and the State at least thirty (30) working days in advance of the work. No work shall be undertaken until the variance is approved in writing by the SCRRA Representative.

Parallel to the outer side of each exterior track of multiple operated tracks and on each side of single operated track, an unobstructed continuous space suitable for trainman's use in walking along trains, extending in width not less than twelve feet (12') perpendicular from centerline of track, must be maintained. Any temporary impediments to walkways and track drainage encroachments or obstructions allowed during working hours must be covered, guarded and/or protected as soon as practicable. Walkways with railings shall be constructed by the Contractor over open excavation areas when in close proximity of track, and railings shall not be closer than 9' -0" perpendicular from the center line of tangent track or 10' - 0" horizontal from curved track.

13-6.09 TEMPORARY VEHICULAR TRAFFIC CONTROL

The Contractor's operations which control traffic across or around SCRRA facilities shall be coordinated with and approved by both SCRRA and State, and shall be in compliance with Section 21400 et seq. of the California Vehicle Code and the California Manual of Uniform Traffic Control Devices (California MUTCD). Traffic control in the vicinity of highway - railroad grade crossings shall conform to the Section 6G-19 of the California MUTCD and SCRRA Standard ES4301. The Contractor shall perform no work at, or in the vicinity of a highway-railroad grade crossing without the presence of a railroad EIC, notwithstanding that the work of the Contractor may not be physically located on the SCRRA Right-of-Way.

SCRRA will not permit temporary at-grade crossings unless absolutely necessary and there is no practicable alternative route available to the Contractor to access the project site. Temporary crossings, if permitted, must conform to SCRRA Standard ES4302. All work at temporary crossings that lies between the rails and within 8.5 feet of the center line of the track on each side must be performed by SCRRA at the cost and expense of the Contractor.

The Contractor shall comply with all traffic control signs and other devices within SCRRA facilities, and must observe a maximum speed limit of 20 mph within the SCRRA Right-of-Way. Disregard for posted traffic control signs and devices, or excessive speed within the SCRRA Right-of-Way may lead to revocation of access for the offending individual.

13-6.10 WORK TO RAILROAD STANDARDS

Construction of railroad tracks, signals, communication systems, fiber optic systems, and civil work associated with any railroad work must be in conformance with SCRRA Standards. SCRRA has the right to inspect the construction, review test records, and witness any quality tests performed. If SCRRA finds any work that wasn't constructed to its standards, the Contractor shall remove the non-conforming work and correct the deficiencies at its expense. SCRRA will have sole authority to determine final acceptance of railroad work.

SECTION 13-7 UTILITIES

13-7.01 PROTECTION OF UNDERGROUND FACILITIES

Signal, communication, fiber-optic, petroleum, natural gas, electric power and other utilities are present in the SCRRA right-of-way. Delays and disruptions to service may cause business interruptions involving loss of revenue and profits, danger to train operations, and release of potentially hazardous or flammable compounds. The Contractor shall take special precautions and care in connection with excavating, shoring, and other subsurface construction to avoid damage to subsurface facilities.

Before excavating, the Contractor shall determine whether any underground pipe lines, electric wires, or cables, including fiber optic cable systems, are present and located within the Project work area by calling the Southern California Underground Service Alert at 811. SCRRA is not a member of Underground Service Alert and SCRRA signal and communication lines must be located by contacting the SCRRA Signal Department at (909) 859-4100 or (909) 859-4112 at least 72 hours prior to commencing work. Calls to SCRRA for cable marking must be made during normal business hours.

All underground and overhead wires must be considered HIGH VOLTAGE and dangerous until verified with the company having ownership of the line. It is the Contractor's responsibility to notify any other companies that have underground utilities in the area and arrange for the location of all underground utilities before excavating. Individual owners of utilities may require that an inspector employed by the utility owner be present during any excavation near the utility.

In case of emergencies involving SCRRA signal or communication facilities, the Contractor shall call (888) 446-9721. The signal and communication emergency phone line is staffed 24 hours a day, 7 days a week. If a telecommunications system is buried anywhere on or near SCRRA right-of-way, the Contractor will coordinate with SCRRA and the telecommunication company to arrange for relocation or other protection of the system prior to beginning any work on or near SCRRA right-of-way. Notice must be given to the freight railroads and fiber optic companies not less than 72 hours prior to work by calling to permit them to arrange for the location or protection of any lines under their control.

It is the responsibility of the Contractor to make arrangements directly with utility companies involving the protection, encasement, reinforcement, relocation, replacement, removing or abandonment in place of non-railroad facilities affected by the Project. SCRRA has no obligation to supply additional SCRRA right-of-way for non-railroad facilities affected by this Project, nor does SCRRA have any obligation to permit non railroad facilities to be abandoned in place or relocated on SCRRA's right-of-way. Any facility or utility that crosses SCRRA right-of-way must be covered under an agreement or license obtained through SCRRA including, without limitation, any relocation of an existing facility or utility.

SCRRA will, if required, rearrange its communications and signal lines, grade crossing warning devices, train signals, tracks and facilities that are in use and maintained by SCRRA forces in connection with its operation. This work by the SCRRA will be done by its own forces or by the Contractors under a continuing contract and is not a part of the work under the Contract for the construction of the Project. The Contractor shall allow sufficient time in its schedule to permit SCRRA to issue the necessary task orders to the Contractors order material, and perform any necessary work.

SECTION 13-8 HAZARDOUS AND CONTAMINATED MATERIALS

13-8.01 DISCHARGE

Discharge, release or spill on the SCRRA right-of-way of any hazardous substances, oil, petroleum, constituents, pollutants, contaminants, or any hazardous waste is prohibited and the Contractor shall immediately notify the SCRRA Representative of any discharge, release or spills in excess of a reportable quantity. The

Contractor shall not allow SCRRRA Property to become a treatment, storage or transfer facility as those terms are defined in the Resource Conservation and Recovery Act or any State analogue.

13-8.02 NOTIFICATION, CONTROL AND DISPOSAL

If the Contractor discovers any hazardous waste, hazardous substance, petroleum or other deleterious material, including any non-containerized commodity or material, on or adjacent to the SCRRRA right-of-way, in or near any surface water, swamp, wetlands or waterways adjacent to the right-of-way, while performing any work on this Project, the Contractor shall immediately: (a) notify the Engineer and the SCRRRA Representative, of such discovery; (b) take safeguards necessary to protect its employees, sub-contractors, agents and third parties; and (c) exercise due care with respect to the release, including the taking of any appropriate measure to minimize the impact of such release.

SECTION 13-9 INSPECTION AND OBSERVATION

13-9.01 SITE INSPECTIONS BY SCRRRA AND OTHERS

In addition to the office reviews of construction submittals, site observations will be performed by SCRRRA or its designee at significant points during construction as determined by SCRRRA. Site visits to observe the progress of the work may be performed at any time throughout the construction process as deemed necessary by SCRRRA.

Federal or State representatives may also conduct inspections and tests to verify compliance with laws and regulations. SCRRRA maintains an Efficiency Testing program to verify the effectiveness of the Contractor's compliance with 49 CFR 214 – Railroad Workplace Safety regulations and SCRRRA third party work rules.

13-9.02 SCRRRA EFFICIENCY TESTS

The Contractor shall cooperate with SCRRRA, Federal, and State representatives at all times. Disregard for, or failure to comply with, the requirements of 49 CFR 214 – Railroad Workplace Safety regulations, or SCRRRA third-party safety requirements may result in the removal of an offending individual from the SCRRRA Right-of-Way. Egregious or repeated disregard for any safety rule or requirement may result in the termination of the Contractor's Right-of-Entry Agreement. SCRRRA representatives may make inspections and conduct tests to judge the effectiveness of the safety training, and compliance with SCRRRA requirements. These observations and tests are collectively known as Efficiency Tests.

13-9.03 SCOPE OF INSPECTIONS AND OBSERVATIONS

SCRRRA will inspect railroad track, signals, communication systems, and other railroad facilities for compliance with SCRRRA standards, guidelines, rules, and agreements, and will generally be limited to the work of the Contractor within or near the SCRRRA right-of-way.

The inspection of the railroad work by SCRRRA shall not relieve the Contractor of any of its obligations to fulfill the requirements of the Contract, and defective work shall be made good, and unsuitable materials may be rejected, notwithstanding that such work and materials have been previously overlooked by SCRRRA and accepted or estimated for payment by the State. If the work, or any part thereof, shall be found defective at any time before the final acceptance of the whole work, the Contractor shall immediately make good such defect without compensation but in a manner that is in conformance with the Contract.

However, in the event that SCRRRA finds that a defect necessitating the repair or removal of completed work is due to the use of materials furnished by SCRRRA which were when incorporated in the work, or have since become, unsatisfactory or unsuitable from causes for which the Contractor is not responsible, then SCRRRA will furnish satisfactory material to the Contractor to replace that previously furnished by SCRRRA.

If any material furnished and brought to the jobsite by the Contractor for use in the work, or selected for the same by him, is condemned by the Engineer as unsuitable or not in conformity with the specifications, the Contractor shall forthwith remove and discard such material to a satisfactory distance from the vicinity of work.

Notwithstanding any inspection or site visit by SCRRRA, responsibility for compliance with a Contract between the Contractor and the State, local codes and ordinances, SCRRRA standards and guidelines, and for the inspection of temporary and permanent work and other work site inspections, resides with the State and the Contractor. SCRRRA by its inspections and comments makes no representations and offers no warranty as to the completeness, accuracy, degree of conformance to codes, compliance with the Contract or local codes or ordinances.

SECTION 13-10 CLEARING OF RIGHT-OF-WAY

13-10.01 CLEARING OF RIGHT-OF-WAY

The Contractor shall, upon completion of the work, promptly remove all of the Contractor's tools, implements and other materials whether brought upon the right-of-way by the Contractor or any sub-contractor, employee, supplier, or agent of the Contractor. The Contractor shall also restore the right-of-way of SCRRA, and make arrangements with SCRRA to restore the tracks, wire lines, signals, and other facilities of SCRRA. The Contractor shall leave the premises in a clean and presentable State equal to or better than existed at the start of the project work. All areas must be graded to drain away from the tracks, all fences or other barriers that have been damaged during the work, or removed to facilitate the work, must be replaced with new fencing of an equivalent character. Where the project improvements intersect the natural flow of the runoff, the Contractor shall provide facilities for the proper collection, conveyance, and disposal of water reaching the interfering improvement.

SECTION 13-11 PAYMENT

13-11.01 PAYMENT

Payment for work specified in Section 13 is included in the payment for the bid items involved unless:

1. Bid item for the work is shown in the verified Bid Item List
2. Work is specified as paid for as extra work

EXHIBIT A

CONTRACTOR SUBMITTAL CHECKLIST

DESCRIPTION
Temporary Right-of-Entry Agreement
Insurance Certificates
Construction Schedule
Weekly Look-Ahead Schedule
Document Control Plan
Testing and Inspection Plan
Site Specific Work Plans
Demolition and Removal Plans
Excavation and Backfill Plans
Shoring and Support Excavation Plans
Shoring and Support Excavations Removal Plans
Track Monitoring Plan
Drilling and Pile Driving Plans
Boring and Jacking Plans
Boring and Jacking Track Monitoring Plan
Temporary Structures Plans
Falsework Design Plans
Falsework Erection Plan
Falsework Removal Plan
Hoisting Plans
Clearances
Temporary Traffic Control Plans

SECTION 14-1. RAILROAD TRACK CONSTRUCTION

14-1.00 ABBREVIATIONS AND GLOSSARY

The following abbreviations and glossary apply to these special provisions.

ABBREVIATIONS

&	And
#	Number
ADM	Add Drop Multiplexer
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AIS	Alarm Insertion Signal
AISI	American Iron and Steel Institute
AMI	Alternate Mark Inversion (a data transmission protocol)
APD	Avalanche Photo Diode
APL	Average Picture Level
APS	Automatic Protection Switching
AVC	Automatic Vehicle Classification system
AWG	American Wire Gauge
AWM	Appliance Wiring Material
B8ZS	Bit eight Zero Suppression (data transmission protocol)
BER	Bit Error Rate
BERTS	Bit Error Rate Test Set
BITS	Building Integrated Timing Supply
BNC	Bayonet Navy Connector
bps	Bits per second
BPV	Bipolar Violation
CCD	Charged-Coupled Device
CCK	Camera Control Keypad
CCR	Camera Control Receiver
CCT	Camera Control Transmitter
CCTV	Closed Circuit Television
CFR	Code of Federal Regulations
CIDH	Cast-In-Drilled-Hole
CMIP	Common Management Information Protocol
CMISE	Common Management Information Service Element
CMP	Configuration Management Plan
CMS	Changeable Message Sign
CODEC	Coder-Decoder
COMM	Communication
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CTRL	Controller
CTS	Clear to Send
DACCS	Digital Access Cross Connect System
D4	4 th version of the D-signal format for time division multiplexers
dB	Decibel
dBm	Decibel referred to milliwatts
dBm	Decibel above reference noise
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DCS	Digital Cross-connect System
DEMARC	Demarcation
DEMUX	Demultiplexer
DS-1	Digital Signal Level 1. Digital transmission rate of 1.544 megabits per second.

DS-3	Digital Signal Level 3. Digital transmission rate of 44.736 megabits per second.
DTE	Data Terminal Equipment
DWP	Department of Water and Power (Los Angeles)
EIA	Electronics Industries Alliance
EMT	Electrical Metallic Tubing
ESF	Extended Superframe Format
FCC	Federal Communications Commission
FDF	Fiber Distribution Frame
FDU	Fiber Distribution Unit
FRP	Fiberglass Reinforced Plastic
FSK	Frequency-Shift Keying
FXS	Foreign eXchange Subscriber
GUI	Graphical user interface
HVAC	Heating, Ventilation and Air Conditioning
Hz	Hertz
IRE	IRE is a SMPTE standard video reference level
ITU	International Telecommunications Union
JKFD	Jackfield
LA	Los Angeles
M13	Multiplexer, 28 DS-1 circuits to 1 DS-3 circuit
MHz	Megahertz
MUX	Multiplexer
NEMA	National Electrical Manufacturers Association
NHD	North Hollywood
nm	nanometer
NMS	Network Management System
NRZ	Non-Return to Zero
NTSC	National Television Standards Committee
OC	Optical Channel
OD	Outside Diameter
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
OTDR	Optical Time Domain Reflectometer
OW	Order Wire (multiple voice circuit)
P	Pair
P22	Pair 22 American wire gauge
PACBELL	Pacific Bell telephone company
p-p	Peak to peak
PC	Personal computer
PCMS	Pasadena City Municipal Services or Portable Changeable Message Sign
PDA	Power Distribution Assembly
PIN	Positive-Intrinsic-Negative
PR	Pair
PRBS	Pseudo-Random Bit Sequence
QRSS	Quasi-Random Signal Source
RUS	United States Rural Utilities Service
RETMA	Radio Electronics Television Manufacturers Association (former name of EIA)
RF	Radio Frequency
RG	Regulatory Guide
RMS	Ramp Metering System
rms	Root-Mean-Square
RTS	Request To Send
Rx	Receive
SF	Superframe Format (D4)
SM	Singlemode
SMFO	Singlemode Fiber Optic

SONET	Synchronous Optical Network
SSOVP	Solid-State Over Voltage Protector
SSPC	Steel Structures Painting Council
ST	Type of connector
TDM	Time Division Multiplexer
THHN	Heat resistant thermoplastic with nylon jacket conductor
THWN	Moisture and heat resistant thermoplastic with nylon jacket conductor
TIA	Telecommunications Industry Association
TL-1	Transaction Language 1
TLP	Transmission Level Point
TOSNET	Traffic Operational System Network
TMC	Traffic Management Center
TSG	Traffic Signal Generator
TSI	Time Slot Interchange
Tx	Transmit
UNC	Unified National Coarse
UNIX	Specific operating system found in real time applications
UV	Ultraviolet
V	Volt
V(ac)	Volt, alternating current
V(dc)	Volt, direct current
VID	Video Identification and date/time Display
VSK	Video Switch Keypad
VSM	Video Switch Matrix
VT-1.5	Virtual Tributary – Level 1.5 (1.728 Mb/s)
VT	Virtual Tributary
W	Watt
WFM	Waveform Monitor
WTO	Wire Transit Only
X.11, X.25	Specific protocol standards generated by the International Telecommunications Union (formerly CCITT)
XHHW	Moisture and heat resistant cross-linked synthetic polymer conductor

GLOSSARY

Breakout: Cable "breakout" is produced by removing jackets just beyond the last tie-wrap point, exposing 0.9 m to 1.8 m of cable buffers, Aramid strength yarn and central fiberglass strength members and cutting Aramid yarn, central strength members and buffer tubes to expose individual glass fibers for splicing or connection to the appropriate device.

Cable Storage Cabinet: A cabinet for holding excess cable slack, allowing flexibility in equipment location and allowing cable pulling for re-splicing.

Channel: An information path between a discrete input and a discrete output. One single input to a multiplexer or output from a demultiplexer.

Closed Circuit Television Assembly: Camera, lens, environmental enclosure, and necessary connectors and cables.

Connector: A mechanical device providing the means for attaching to and decoupling from a transmitter, receiver or another fiber (such as on a patch panel).

Connectorized: A fiber with a connector affixed to it.

Connector Module Housing (CMH): A patch panel used in the FDF to terminate singlemode fibers with most common connector types. It may include a jumper storage shelf and a hinged door.

Couplers: Devices normally located within FDF's mounted in panels, that mate 2 fiber optic connectors to facilitate the transition of optical light signals from one connector into another. They may also be used unmounted, to join 3 simplex fiber runs. Couplers may also be referred to as adapters, feed-through and barrels.

Fiber Distribution Frame (FDF): A rack mounted system usually installed in the TMC that consists of a standard equipment rack, fiber routing guides, horizontal jumper troughs, fiber distribution units (FDU), connector module housings (CMH) and splice module housings (SMH).

FDF's serves as the "home" for passive fiber optic components from cable breakout, for connection by jumpers, to the electronics.

Fiber Distribution Unit (FDU): An enclosure containing a Connector Module Housing (CMH) and a Splice Module Housing enclosure.

Field Cabinet: A roadside cabinet housing controllers or communications equipment.

Intermediate Distribution Frame Room (IDF room): The room or area inside a hub or hut containing the FDF and other distribution hardware.

Jumper: A short fiber optic cable with connectors installed on both ends, typically used for connection within an FDF.

Light Source: A portable piece of fiber optic test equipment used to perform end-to-end attenuation testing in conjunction with a power meter containing a stabilized light source operating at the designed wavelength of the system under test.

Link: A passive section of the system, the ends of which are to be connected to active components. A link may include splices and couplers. For example, a video link may be from a F/O transmitter to a video Multiplexer (MUX).

Main Distribution Frame Room (MDF room): The room inside the TMC which contains the FDF and other distribution hardware.

Mux/Demux: Multiplexer/Demultiplexer.

Optical Time Domain Reflectometer (OTDR): Fiber optic test equipment used to measure total amount of power loss between 2 points and the corresponding distance. It provides a visual and printed display of the relative location of system components such as fiber sections, splices and connectors and as losses attributable to each component or defect in fiber.

Patchcord: A short jumper.

Pigtail: A short length of fiber optic cable with a connector installed on one end.

Power Meter: A portable fiber optic test equipment used to perform end-to-end attenuation testing in conjunction with a light source, containing a detector that is sensitive to light at the designed wavelength of the system under test. Its display indicates the amount of power injected by the light source that arrives at the receiving end of the link.

Segment: A section of F/O cable not connected to an active device which may or may not have splices per the design.

Splice Closure: An environmentally sealed container used to organize and protect splice trays, normally installed in a splice vault that allows splitting or routing of fiber cables from multiple locations.

Splice Module Housing (SMH): A housing for storage of splice trays, pigtails and short cable lengths.

Splice Tray: A container used to organize and protect spliced fibers.

Splice Vault: A vault used to house splice closures.

T-1 Line: A dedicated phone connection supporting data rates of 1.544Mbits per second.

14-1.01 FIELD WELDING RAIL

GENERAL

Summary

This section consists of the Contractor performing field welding of Continuous Welded Rail (CWR) strings using the flash butt welding process or approved thermite-welding method.

The Contractor must make assessment as to the number of welds, including the method of welding for each weld, to be performed under this contract.

The work of this section consists of welding rails for use in track construction, in accordance with AREMA Manual, Chapter 4, Rail, and AREMA portfolio, except as modified in these special specifications.

Submittals

Procedure: Submit proposed materials, methods and procedures to be used for mobile flash butt field welding of CWR, including:

1. Manufacturer's trade name and technical data for the welding process, including welding machine performance standards:
 - 1.1. Method of welding high strength rail if different from requirements for standard rail.
 - 1.2. Methods of transporting material and mobile equipment to the site and duration of welding operations.
 - 1.3. Method used for cutting and cleaning to parent metal of the rail ends.

- 1.4. Minimum and maximum spacing between rail ends.
 - 1.5. Method used for maintaining the rails in alignment during welding.
 - 1.6. Method used for grinding and contouring rail removing weld upset following the welding process.
 - 1.7. Manufacturer's trade name and technical data for the welding process.
 - 1.8. Method used for cutting and cleaning of the rail ends.
 - 1.9. Minimum and maximum spacing between rail ends.
 - 1.10. Method used for maintaining the rails in alignment during welding.
 - 1.11. Method used for preheating the rail ends including time and temperature.
 - 1.12. Tapping procedure including the minimum time required to cool the weld under the mold insulation.
 - 1.13. Method used, including a description of special tools and equipment for removing the gates and risers and finishing the weld to the final contour.
2. Procedure: Submit rail end hardening procedure.
 3. Testing: Submit testing company qualified in use of the Ultrasonic testing method in accordance with ASTM E164
 4. Field Weld Record: Submit as specified herein.

Quality Control and Assurance

Provide qualified personnel for supervision and performance of work.

Perform certification testing of welds to ensure that work is performed in accordance with the contract documents, and within the tolerances provided herein.

MATERIALS

For electric flash butt welding, materials, equipment and process shall be as provided by Holland L.P. or other approved equivalent.

For thermite welding, Materials and equipment shall be as manufactured by "Boutet," "Orgotherm," "Elektro-Thermite," or other approved equivalent for standard or high strength (alloy or heat treated) rail, as appropriate.

CONSTRUCTION

Electric flash butt welding, methods and procedures shall comply with the AREMA Manual, Volume 1, Chapter 4, Section 2.3, Specification for the Quality Assurance of Electric-Flash Butt Welding of Rail.

Thermite welding, methods and procedures shall comply with the AREMA Manual, Volume 1, Chapter 4, Section 2.5 Specification for the Quality Assurance of Thermite Welding Rail, with the welding kit manufacturer's recommendations, and as specified herein.

Rail ends for thermite welding shall be prepared in accordance with the recommendations of the welding kit manufacturer.

For thermite welding, the rail ends shall be preheated prior to welding to a sufficient temperature and for sufficient time to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

The completed weld shall be finished by mechanically controlled grinding to conform to the same requirements specified for shop welding.

1. Thermite welds shall not be made at the following locations:
 - 1.1. Within 5 inches of the edge of any bolt hole in the rail.
 - 1.2. Within 2 inches of a Cadweld or copper bond wire (If this type of bond exists, remove any presence of copper by grinding. The rail ends must be inspected and cleaned after grinding is complete).
 - 1.3. Closer than 2 feet from an existing plant weld.
 - 1.4. Closer than 6 feet to an existing thermite weld.
 - 1.5. On both ends of a rail plug simultaneously unless the rail is 15 feet or longer on tangent track and 24 feet long or longer on curved track.
2. Follow Manufacturer recommendations for compromise welds.
3. Follow recommendations of rail manufacturer for welding high strength (alloy or heat-treated) rails.
4. Thermite welds shall be located in cribs between ties. The edge of the weld must be no closer than 3 inches from the edge of the nearest tie.
5. Electric Flash Butt welds with the base of the rail smoothly ground may be located anywhere.

Field Welding Record And Rail Markings

6. Field welding record shall be continuously maintained and furnished to the Engineer within 7 working days of completing the weld. The record shall include the following minimum details, noting that a different recording and marking procedure will be required for free end welds or for destress welds used to close up openings in rail:
 - 6.1. Date and time of welds.
 - 6.2. Location by station, specifying track and rail.
 - 6.3. Contractor foreman initials.
 - 6.4. Weather, air and rail temperature for destress welds (welds made to close up rail).
 - 6.5. Track condition, anchorage and rail stress for destress welds, or the word "FREE" for free end welds.
7. Rail shall be permanently marked on the web of rail in legible characters at least 1-1/2 inches high at each field weld with the above information in accordance with Section 3.1.19, Marking Thermite Welds of the SCRRA Track Maintenance and Engineering Instructions. If an existing destress weld is located within 400 feet of a new destress weld, lines shall be marked through the old weld's marking and an arrow marked indicating the direction towards the new destressed weld.
8. A straight edge 36 inches in length, applied to finished welded joint area shall be used to check for the following maximum variations (measurements shall be taken with a 6 inch steel taper gauge):
 - 8.1. Rail Head:
 - 8.2. Vertical Offset: 0.020 inch.
 - 8.3. Horizontal Offset: 0.040 inch.
 - 8.4. Vertical Crown: 0.030 - 0.045 inch.
 - 8.5. Horizontal Kink: 0.020 inch.
 - 8.6. Rail Base:
 - 8.7. Horizontal Offset: 0.060 inch.
 - 8.8. Offset Bending: 0.010 inch per inch.

Sharp edges and burrs shall be removed, including chimneys from thermite welds. Top of base of rail shall be ground smooth at chimney locations.

Weld joints shall be smooth on top and sides of head and straight in line. No over grinding is permitted. Web of rail at thermite welds shall not be ground. Mold residue shall be removed from the weld area and properly discarded.

Finishing of welds shall be sufficient to allow testing using the Ultrasonic test method as described below. Welds rejected because of insufficient or unsatisfactory finishing of welds shall be refinished, repaired, or replaced at the Contractor's expense until the weld meets the testing criteria.

Rail welds must be tested by the Contractor through the use of an SCRRA approved testing agency using the Ultrasonic testing method in accordance with ASTM E164.

Each completed weld shall have full penetration and complete fusion and be entirely free of cracks. Total area of internal defects such as porosity and slag inclusions shall not exceed 0.060 square inch and the largest single porosity or slag defect permitted shall not exceed 1/8 inch diameter.

Other causes for rejection of welds shall be Welded joints not meeting these Specifications and tolerances will be replaced at no cost to the SCRRA or the State. The defective weld shall be cut out, and a new section of rail shall be inserted, welded into place as described in this Section, and retested.

A short section of rail shall be cut in the CWR, when required by the Engineer, for the following reasons:

1. To repair defective rails.
2. To repair defective welds.
3. To destress rail.
4. To make a connection between rail strings or adjust rail to meet a specific point (for example to connect CWR to stock rail or frog).

The short section of rail to be cut in shall be at least 19 feet-6 inches long on tangents and curves less than 2 degrees; and 30 feet long on curves 2 degrees or greater and rail to be cut in shall be of the same weight, size, section, and class of rail being replaced or joined.

Before cutting out rail in CWR and inadvertently losing thermal control, prevent remaining CWR from further movement by applying full box anchors for at least 200 feet each way from the proposed cut. After cutting CWR, a

rail expander/puller or other means shall be used to prevent rail movement until a weld or temporary joint is installed.

The ends of the short rail section and the CWR shall be saw cut.

Follow manufacturer's recommended procedures specified for completing field welding by thermite process.

Repair of rail due to damage by the Contractor shall be at Contractor's expense.

When repairing a defective rail or weld, the new rail shall be the same length as rail being replaced, or as required to achieve thermal adjustment.

When performing field welding, rail temperature adjustments shall be made in accordance with the railroad special provision for trackwork, using either heating of rail or mechanical rail pullers. The first weld of a replacement plug may be at ambient temperature, but the second (destress weld or rail closure weld) shall be installed in accordance with the railroad special provision for trackwork.

MEASUREMENT AND PAYMENT

The contract price paid per track foot for running rail includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in field welding rail, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.02 BALLAST

GENERAL

Summary

This section specifies the material requirements for ballast to be furnished by the Contractor and placed or stockpiled in accordance with the contract documents or required by the Engineer.

This section also includes furnishing all labor, material and equipment necessary and incidental to furnishing walkway rock as required by the Engineer.

Submittals

Submit the Compliance Report prior to ordering material: Submit certified results of the tests required to demonstrate conformance with these specifications prior to any material being shipped.

Quality Control and Assurance

Testing shall be performed by the Contractor's independent certified testing laboratory approved by the Engineer.

The Contractor must provide laboratory certification that ballast material meets the Specifications of this Section.

If the Contractor observes ballast material not suitable for work, or not in compliance with this part, the Engineer must be notified within 3 hours of discovery of condition.

The product delivered shall be from the same source from which samples were tested and found to conform to the Specification and shall be of the same type and quality of that which was tested.

Testing shall be performed by the Contractor's independent certified testing laboratory approved by the Engineer.

The Contractor must provide laboratory certification that ballast material meets the specifications of this Section.

Blending, stockpiling, and other production and handling operations must be managed by the Contractor.

Stockpiling operations shall minimize breakage or excessive fall in stockpiling operations.

The movement of wheeled or tracked machines over stockpiled or installed materials shall be limited.

MATERIALS

Material Grading Requirements

Ballast gradation shall conform to SCRRA ES 2007-02 and AREMA Volume 1, Chapter 1, Section 2.4.4, Table 1-2-2, Standard No. 4A ballast unless otherwise noted.

Gradation test shall be determined in accordance to ASTM C136, utilizing square opening sieves conforming to ASTM E11.

The percentage passing each sieve shall fall within the following limits:

SIEVE SIZE	SIEVE OPENING	PERCENT PASSING BY WEIGHT
2 1/2 INCH	2.50 INCH	100
2 INCH	2.0 INCH	90-100
1 1/2 INCH	1.50 INCH	60-90
1 INCH	1.0 INCH	10-35
3/4 INCH	0.75 INCH	0-10
1/2 INCH	0.50 INCH	-
3/8 INCH	0.375 INCH	0-3
No. 4	0.187 INCH	-

The percent passing each sieve shall fall within the following limits:

Table Title

SIEVE SIZE	SIEVE OPENING	PERCENT PASSING BY WEIGHT
2 1/2 INCH	2.50 INCH	100
2 INCH	2.0 INCH	100
1 1/2 INCH	1.50 INCH	100
1 INCH	1.0 INCH	90-100
3/4 INCH	0.75 INCH	40-75
1/2 INCH	0.50 INCH	15-35
3/8 INCH	0.375 INCH	0-15
No. 4	0.187 INCH	0-5

Ballast shall consist of crushed stone comprised of angular fragments resulting from crushing by mechanical means, the following types of rocks quarried from undisturbed, consolidated deposits:

1. Granite and similar, phanero-crystalline igneous rock, extrusive igneous rock, or massive metamorphic quartzite or similar rock.
2. Furnish prepared ballast that is hard, strong, angular, durable particles of crushed rock containing no carbonates of slag and free from injurious amounts of deleterious substances and conforming to the following requirements of these Specifications:

2.1. Material qualities shall be as follows:

PROPERTY	MINIMUM	MAXIMUM	TEST METHOD
Percent material passing No. 200	--	1.0 percent	ASTM C 136 ASTM C 117
Bulk specific Gravity – Rock	2.60	--	ASTM C 127
Absorption - Rock	--	1.0 percent	ASTM C 127
Clay lumps and friable particles	--	0.5 percent	ASTM C 142
Degradation	--	As Noted for Material Type	ASTM C 535 or ASTM C 131 (Note 1)
Granite	--	35 percent	
Traprock	--	25 percent	
Quartzite	--	30 percent	
Soundness – (Sodium Sulfate) – 5 cycles	--	2.5 percent	ASTM C 88

PROPERTY	MINIMUM	MAXIMUM	TEST METHOD
Flat or elongated particles (length is equal to or greater than three times the average thickness)	--	5 percent	ASTM D 4791
Durability Test – Procedure A	65	--	ASTM D 3744
Magnesium Carbonate	--	0	ASTM D 3042
Sand Equivalent	50	—	California 217

Note 1: Materials having gradations containing particles on the 1 inch sieve shall be tested by ASTM C 535. Materials having gradations with 100% passing the 1 inch sieve shall be tested by ASTM C131. Use ASTM C 535 for Ballast Standard Type 4A and ASTM C131 for Ballast Standard Type 5.

- 2.2. Particles of the ballast shall have been broken by the crusher and must have at least two fractured surfaces.

Contractor's testing laboratory shall take and perform gradation and other tests on representative samples of ballast, of not less than 150 pounds, from each source of ballast:

1. Perform tests to ensure compliance with these specifications.
2. Each shipment of ballast shall be accompanied by a certification as specified.

CONSTRUCTION

Ballast shall be delivered to the project site to specific locations identified in the contract documents, required for completion of the work, or as directed by the Engineer, and installed in accordance with the railroad special provisions for trackwork or track shifting, relocation, and resurfacing.

PAYMENT

The contract price paid per cubic yard for ballast includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in ballast, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.03 SUB-BALLAST AND AGGREGATE BASE

GENERAL

Summary

This section specifies the material requirements for sub-ballast and aggregate base to be furnished and placed to the lines, grades, and dimensions in accordance with the railroad plans, railroad specifications, and directions of the Engineer.

Submittals

Submit the following items prior to ordering materials:

1. Compliance: Supplier's certification that material delivered to the site is in compliance with the Specifications.
2. Samples: As required by the Engineer samples of not less than 150 pounds. Samples shall be furnished by the Contractor or may be obtained independently by the Engineer's representative for testing to determine whether the material delivered to the site is in compliance with the Specifications.
3. Equipment: A list of equipment used for placing and compacting sub-ballast.

CONSTRUCTION

Sub-ballast and aggregate base shall not be spread until the Engineer has approved the subgrade.

Spread and compact sub-ballast and aggregate base in conformance with the requirements of the Standard Specifications Section 26-1.03: Subgrade; Section 26-1.035: Adding Water; Section 26-104: Spreading; Section 26-105: Compacting. Compaction shall be to a minimum of 95 percent relative density of modified proctor ASTM D1557. Maximum lift shall be 6 inches.

The surface of the sub-ballast and aggregate base shall be stable to permit follow-on stages of construction without rutting.

Sub-ballast and aggregate base shall be finished to within 0.05 feet of the lines and grades indicated on the railroad plans.

Sub-ballast and aggregate base shall be maintained during construction free of deformation, rutting, or inclusion of fines and within lines and grades listed above in a condition acceptable to the Engineer until ballast or paving material has been placed and approved at no cost to SCRRA or the State.

MEASUREMENT AND PAYMENT

Full compensation for sub-ballast will be considered as included in the various contract items of work and no additional payment will be made therefor.

14-1.04 CONCRETE RAILROAD TIE

GENERAL

Summary

This Section specifies the material requirements and performance criteria for production and inspection of monoblock, pretensioned, prestressed concrete ties for standard gage track (4 feet-8-1/2 inch) to be furnished in accordance with the specifications and SCRRA Engineering Standards (ES) ES 2402, ES 2403, ES 2406 or ES 2407 as appropriate.

Definitions

The word "**Inspector**": in this Specification shall mean the duly authorized representative of SCRRA.

The word "**manufacturer**": in this Specification shall mean the manufacturer of concrete ties.

The word "**supplier**": in this Specification shall mean a supplier of materials or components for use in the concrete ties.

The word "**source**": in this Specification shall mean a plant where a material or component used in the concrete ties, is produced. For aggregates, the word "source" shall mean the strata or quarry face from which the aggregate is obtained.

The word "**bed**": in this Specification shall mean a prestressing bed with forms placed end to end. Each bed is only one form wide.

The word "**form**": in this Specification shall mean a battery form, one tie long, with 5 to 8 cavities in which ties are cast upside down.

The word "**line**": in this Specification shall mean a series of ties end to end on a prestressing bed. Each line is only one tie wide.

The words "**long line process**": in this Specification shall mean ties being, made on a bed with at least ten forms end to end and on which the prestressing wires are tensioned between fixed abutments, independent of the forms, and prior to placing concrete.

The words "**outside testing laboratory**": in this Specification shall mean a testing laboratory, independent of the manufacturer, which conforms to ASTM E994 and is approved by the Engineer.

Submittals

Compliance: Manufacturer's certification that the materials delivered are in compliance with the specification.

Certification that the proposed concrete tie and shoulder inserts will satisfy test requirements as specified herein.

Certification shall include qualified laboratory test results, calculations and performance reports from a proven fastener design with 5 years of operational service.

Certified test results, as required to demonstrate compliance of materials specified herein shall be submitted to the Engineer. The test results for the following items shall be supplied:

1. Cement.
2. Aggregates.
3. Water.
4. Concrete.

5. Rail Seat Pads.
6. Fasteners.
7. Electrical Properties.
8. Tie Testing.

A complete design analysis of the proposed tie and associated hardware, verifying the tie's capability to pass the test requirements contained in the Specifications and verifying the adequacy of the materials for their intended use.

Design submission shall include:

- A. Structural detail Drawings of the proposed tie and fastening assembly.
- B. The Drawing shall include tie configuration, prestressed strand size and location, and details of the shoulders with their fabrication tolerances.
- C. Structural calculations shall be based upon current industry standards for prestressed concrete design and the American Concrete Institute (ACI) standard requirements applied as follows:
- D. Calculations shall include moment analysis for the tie under no-cracking conditions and shall consider long-term permanent prestress losses.
- E. Concrete batch compositions.
- F. Submission shall include physical and chemical composition of the batch; including, type and source of cement admixtures used, source and gradation of aggregates, source and quality assurance of water, curing, procedure, including concrete strength at prestress transfer, and separation of the tie from the form.
- G. It is the Contractors responsibility to ensure that the concrete composition and quality is suitable for its intended purpose.
- H. Specifications for pretensioning tendons.
- I. Documentation confirming the quality of material used in these elements.

Cure time:

- A. The length of cure time necessary for the tie to reach 7,000 pounds per square inch strength prior to delivery for placement in track.
- B. Submit Shop Drawings prepared by the manufacturer for the standard "Fastclip" concrete ties and the guardrail equipped "Fastclip" concrete ties both with and without neoprene pads, if required.
- C. Submit to the Engineer Shop Drawings prepared by the manufacturer for the forms and for the gages.
- D. Forms and gages shall not be used until the Drawings have been approved by the Engineer.
- E. Before production commences, submit a Quality Control Manual prepared by the manufacturers for approval by the Engineer.

This Manual shall include the following details:

- A. Management organization.
- B. Responsibilities of production and quality control personnel.
- C. Plant Standards.
- D. Checks to be carried out by production personnel.
- E. Inspection and testing to be carried out by quality control personnel.
- F. Procedures for approving sources of materials and for order in materials.
- G. Procedures to insure that only materials complying with these Specifications are used.
- H. Procedures to insure measuring equipment is properly calibrated.
- I. Procedures to insure that ties are not shipped until acceptance load testing is complete and that rejected ties are clearly marked and segregated from good ties.

The Manual shall be revised or amended whenever there are changes in personnel, responsibilities, or other items contained in it.

Submit the Quality Control Program and the Production Program specified under "Quality Assurance and Quality Control" herein.

Submit written reports to the Engineer prepared by the manufacturer documenting strict adherence to the Quality Control Program and the Production Program.

Quality Control and Assurance

The manufacture shall have a minimum of 5 years experience, in a fixed location, of the large-scale manufacture of pretensioned prestressed concrete railroad crossties by the long line process.

The manufacturer's existing plants in the USA shall have been certified under the PCI Plant Certification Program.

If the manufacturer's existing plants are outside the USA, they shall have been certified by the equivalent National Certification Organization for that country.

The manufacturer shall show to the satisfaction of the Engineer that he has, or can obtain, the necessary and proper equipment, tools, facilities and means, and that he has the experience, ability and financial resources to perform the work within the time specified and to the quantity standards required.

Ties shall be manufactured by the long line process with 5 to 8 lines per bed.

If the manufacturer produces the ties in a new plant, that plant shall be certified under the PCI Plant Certification Program within 6 months from the start of production.

The requirements of ACI 301 and PCI MNL 116 shall apply except where other requirements are stated in these Specifications.

Concrete ties shall be shipped in open-top cars or flat bed truck trailers.

Ties shall be securely braced for transportation to prevent any movement that will cause damage.

Ties shall be shipped in a horizontal position and braced with spacer blocks in such a manner that the top surface or cast-in-place hardware does not contact ties loaded above.

Ties shall not be loaded higher than the top of the cars and not more than six layers deep.

Ties must be delivered, unloaded, and neatly stockpiled as necessary on the project site by the Contractor.

When handling ties in the plant, yard or at the delivery site, ties must not be dropped or damaged.

Ties must be stacked on firm level ground, not more than 10 ties high and supported on dunnage at the rail seats only.

MATERIALS

General

The manufacturer shall only use materials from sources approved by the Engineer.

For cement, the source of clinker and the source of the ground cement will be approved by the Engineer.

Tests for cement and aggregate shall be completed in accordance with this Specification before approval of materials is requested from the Engineer.

Adequate time shall be allowed for the Engineer to approve new sources.

Trial concrete mixes shall be cast at least 90 days prior to approval being requested.

For aggregates to be supplied from a new source that has not been previously tested, a minimum period of 224 days shall be required for testing to ASTM C227 prior to approval being requested.

Alternatively, 70 days shall be allowed for the Osmotic Cell Test. SCRRA will accept previous test results on these aggregates from a qualified laboratory performing these tests as required to the standards of the appropriate ASTM which has been supervised, signed and sealed by a California Registered PE or Geologist.

The minimum 28-day-design compressive strength of concrete used for concrete ties shall be 7000 pounds per square inch as determined in accordance with ASTM C39. The test cylinders shall be made and stored as specified in ASTM C31.

Batching and Mixing:

- A. Aggregates and cement shall be measured by weight.
- B. The weight of aggregate shall be based on a saturated surface dry condition corrected for free moisture.
- C. Water shall be measured by weight or volume and admixtures shall be measured by volume.
- D. Each batch of concrete shall be mixed separately in a pan mixer or approved horizontal drum mixer located at the site of the concrete tie manufacturing, process.
- E. No water shall be added to concrete after discharge from the mixer.
- F. The quantity of each material used in each batch of concrete shall be automatically recorded.

Proportioning:

- A. Mix proportions shall be developed using the method in ACI 301, Section 3.9. The cement content shall be not less than 600 pounds per cubic yard.
- B. Temperature: The temperature of freshly mixed concrete shall not exceed 90° F.

Curing:

- A. Immediately after placing and consolidating, the concrete, the exposed surface shall be covered with impermeable sheeting.
- B. Concrete shall not be placed in forms whose temperature is less than 40° F and the concrete temperature shall not be allowed to fall below 50° F between casting, and transfer of prestress.
- C. If heat curing is used, the forms may be preheated to avoid cooling of the concrete after placing but the temperature of concrete shall not rise above 100° F until initial set (ASTM C403) has occurred.
- D. The rate of temperature rise in the concrete shall not exceed 35° F per hour and the maximum concrete temperature shall not exceed 140° F,
- E. Transfer of prestress shall not be carried out at a concrete temperature above 135° F.
- F. The heating method used shall ensure that ties in a bed are at a similar temperature.
- G. During curing, the temperature at the center of the rail seat cross section of one tie in each bed shall be automatically recorded.

Testing Fresh Concrete

The first batch on any bed shall be tested in accordance with this Specification and if this requires no adjustment to the mix, a further test shall be made after approximately 25 cubic yard has been poured.

If the first batch requires adjustment to the mix each subsequent batch shall be tested until no further adjustment is necessary and then a further batch shall be tested after approximately 25 cubic yard has been poured.

Slump

When measured in accordance with ASTM C143, the slump shall not exceed 2" when concrete is placed in the forms.

A minimum of two measurements of slump shall be made, on separate batches of concrete, for each bed cast or each 50 cubic yard concrete whichever is less volume of concrete.

Air Content

Air entrainment of the concrete shall comply with the following table:

PERCENT AIR ENTRAINMENT STAGE	AIR CONTENT
Plastic Concrete	4.5% ±0.7%
Cured Concrete	3.5% ±0.5%

Testing Hardened Concrete

Compressive Strength

When measured on 4 inch x 8 inch cylinders capped in accordance with ASTM C617 and tested in accordance with ASTM C39, the minimum compressive strength shall be:

- A. At transfer of prestress: 4500 pounds per square inch.
- B. At 28 days: 7000 pounds per square inch.
- C. The minimum number of test cylinders per bed shall be:
- D. For transfer strength: 4.
- E. For 28 day strength: 3.
- F. The cylinders shall be made from one batch of concrete and the slump and air content shall be measured on the same batch.
- G. The cylinders shall be cured with the ties until transfer of prestress, so the temperature of the cylinders is with +0°-15° For the temperature of the ties.
- H. After transfer of prestress, the 28-day cylinders shall be cured in accordance with ASTM C192.

Four inch cubes may be used to measure the compressive strength at transfer of prestress. Two cylinders shall be tested for transfer strength.

- A. If either result is less than 4500 pounds per square inch, curing shall be continued for at least a further one (1) hour.
- B. No bed shall be detensioned until at least two cylinders achieve a strength of 4500 pounds per square inch.

- C. If transfer cylinders are tested without conforming to this requirement the bed may be detensioned if at least one cylinder achieves 4500 pounds per square inch.
- D. An additional set of ties from one form shall then be acceptance load tested.
- E. If no transfer cylinders achieve 4500 pounds per square inch, the bed may be detensioned, providing ties are acceptance load tested.

The strength at 28 days shall be satisfactory if the average of three cylinders is not less than 7000 pounds per square inch and no individual result is less than 6500 pounds per square inch.

Durability

One tie shall be selected at the start of production and thereafter every three months, for air void content and durability factor tests by an outside testing laboratory.

The air void content shall be measured in accordance with ASTM C457 on the top, center and bottom of a cross section slice cut from the rail seat of a tie.

The measured air void content shall be not less than 3.0 percent and the air void spacing factor shall not exceed 0.008 inch.

The durability factor shall be measured in accordance with ASTM C666 on a minimum of 4 prisms of concrete taken adjacent to the samples used for the durability tests as required by this Specification.

The durability factor shall not be less than 90 percent.

The frequency of testing, for durability shall be increased at the Engineer's request if there is evidence that ties do not satisfy the requirements of this Specification.

Chloride

The water-soluble chloride content of the concrete shall not exceed 0.06 percent expressed as chloride ion by weight of cement.

This shall be measured by an outside testing laboratory on fresh concrete or on individual materials in the mix when mix proportions are developed in accordance with Paragraph entitled "Proportioning" in the Article "Concrete" of this Specification and thereafter, by tests at three monthly intervals which include materials from all sources in use.

Alkali - Silica Reactivity

The composition of the cement, fine aggregate shall be analyzed and tested in accordance with ASTM C33, ASTM C227, and the "Duggan" Concrete Expansion Test so as to ensure that the resulting combination does not produce a concrete subject to deleterious expansion resulting from an alkali-silica reaction.

These tests must be repeated every 6 months, from each source, unless otherwise defined in this Specification.

Whenever a component or source is changed, new tests must be performed on these components or sources.

CEMENT

Cement shall conform to ASTM C150, and low alkali.

Cement alkali content of Na₂O equivalent (Na₂O + 0.658 K₂O) shall be as low as possible and not greater than 0.6 percent.

The false set penetration, when tested in accordance with ASTM C359, shall be not less than 50 milometer at intermediate times and 40 milometer after remix.

Separate random samples of cement shall be taken each day to represent the cement used on each bed.

Each sample shall be not less than one gallon and shall be clearly identified with the date and bed number.

Each sample shall be kept in air-tight container until the corresponding 28-day cylinder tests have been carried out and results accepted by the Engineer.

Not more than 2 sources of clinker or ground cement shall be used by the manufacturer during any one-month.

Cement from each source shall be clearly identified and stored in separate weather tight silos.

If 2 sources of cement are used on one bed, the tests in this section shall be performed on the first batch of concrete made with each cement and if no adjustment to either mix is required, testing shall continue as single design as required in this section. Strength tests as required in this section shall be conducted on concrete made with each type of cement.

Cement mill certificates shall be provided weekly by each supplier and shall include the results of the following tests on cement delivered during that week.

Substitution of cement are not be permitted unless it pre-qualified through the tests listed in this special provision.

Requirements

Fineness by air permeability (ASTM C204).

False Set (ASTM C359) - Penetration at 3, 5, 8, and 11 minutes and remix.

Setting Time (ASTM C191).

Compressive Strength (ASTM C109) at 1 day, 3 days, and 7 days.

Chemical Analysis (ASTM C114) - INCLUDING SIO, Al_2O_3 , Fe_2O_3 , CaO, MgO, SO_3 , K_2O , Na_2O and calculated alkalis as N_2O equivalent, C_3S , C_2S , C_3S , C_4AF .

Residue on 325-mesh sieve (ASTM C430).

At least once during every three months, a randomly chosen sample of cement from each source used shall be analyzed for alkali content in accordance with ASTM C114 by an outside testing laboratory.

Aggregates

Fine and coarse aggregates shall meet the requirements of the AREMA Specifications for Aggregates, Part 1, Section 1.3, Chapter 8 of the AREMA Manual.

Aggregates shall be natural aggregates complying with ASTM C33 Class 4S. The maximum combined coarse aggregate percentage wear shall not exceed 39 percent.

The manufacturer shall provide evidence that concrete containing aggregate from the proposed source with a cement content and alkali burden similar to the job mix, has a satisfactory service history of at least 5 years. This evidence shall include structures requiring a Class 4S aggregate.

The maximum size of aggregate shall be $\frac{3}{4}$ inch. If the coarse or fine aggregate is supplied in more than one size, each size shall be stored separately.

Washed aggregate shall be allowed to drain, in stockpiles, before use. Aggregates shall be free from ice when used.

In addition to the requirements of ASTM C33, the following tests shall be conducted by an outside testing laboratory:

- A. Petrographic examination to ASTM C295. Examination shall be repeated on aggregate from each new source.
- B. Evaluation of potential alkali reactivity to ASTM C227 or ASTM C1293.

A separate test shall be conducted with each job cement and the results shall conform with ASTM C33 at three and six months.

This shall be repeated every 6 months for each source.

When there is insufficient time for testing, to ASTM C227 or ASTM C1293, potential alkali reactivity may be evaluated by the Osmotic Cell Test* developed by PCA. The flow rate at 30 days shall not exceed 1.5 milometer per day.

Evaluation of potential alkali carbonate reactivity:

Aggregates containing carbonate shall be tested in accordance with ASTM C586.

Water

Water in mixing concrete and washing aggregates shall be potable and free of injurious amounts of oil, acid, alkali, inorganic matter, or other deleterious substances, that may be harmful to concrete or steel as specified in AASHTO T-26.

The mixing water, including that portion of the mixing water contributed in the form of free moisture on the aggregates, shall not contain a chloride ion content greater than 400 ppm.

Admixtures

Chemical admixtures for concrete shall conform to ASTM C494.

Additives containing chlorides shall not be used.

Only liquid admixtures shall be used.

Air-entraining, admixtures shall conform to ASTM C260 and contain neutralized Vinsol resin or other approved natural resins as the active ingredient.

Water reducing admixtures shall only be used with the approval of the Engineer. They shall conform to ASTM C494, Types A, B, D, E.

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water reducing and retarding admixtures, water-reducing and accelerating admixtures, and high range water reducing admixtures, when authorized by the Engineer, shall conform to ASTM C494 or ASTM C1017 in the case of superplasticizers.

Other mineral admixtures shall not be used, except for Class F Flyash as noted below, unless mix and quality control program are specifically approved by the Engineer.

Class F Flyash, if used, shall conform to ASTM C618. The properties shall not exceed the following:

- A. 1.5% available alkalis and 60% loss on ignition.
- B. Mill test certificates shall accompany each lot of Class F Flyash used in tie production in order to ensure consistency.
- C. The combined mix design with admixtures, if used, shall be tested using ASTM C1567 on the proposed job mix to verify alkali-silica reaction (ASR) potential.

Prestressing Tendons

General

Prestressing shall be indented wire strand or stress relieved wire.

The wires shall comply with ASTM A881 or stress relieved wire complying with ASTM A421.

The minimum tensile strength of the wire shall be 225,000 pounds per square inch.

Strands for pretensioning tendons shall conform to ASTM A886.

Tendons shall be thoroughly cleaned of drawing lubricants before shipment.

Tendons from one source only shall be used on each bed.

Tendons shall not be contaminated with mud, oil, grease, or chloride salts.

Loose rust shall be removed during stringing and tendons pitted due to corrosion shall not be used.

Pretensioning

During stringing, tendons shall not become contaminated with form release agent.

Each tendon shall be individually tensioned with the same initial force of between 5 percent and 20 percent of the final force using, a hydraulic jack.

The final force shall then be applied by multiple tensioning with hydraulic jacks.

The force shall be measured by pressure cases located immediately adjacent to each jack and be measured by elongation.

The forces measured by the two methods shall agree to within 5 percent.

Detensioning

Stress transfer shall be performed in a controlled manner with hydraulic jacks.

The forms shall be free to move and the stress in tendons shall be transferred at the same time and the same rate.

No tendon shall be cut until it is completely detensioned.

If any tendons break during, curing, ties shall be load tested in Rail Seat Positive in accordance with Paragraph entitled "Acceptance Load Testing" in Article "Testing of Ties", starting with the ties from the form adjacent to the abutment where the tendon broke and moving towards the other abutment, when a point on the bed is reached at which ties from one form pass the test, the remaining ties shall be accepted without further load testing.

Rail Fastening System Components

Rail fastening system shall be resilient, thread-less and adjustable in three steps without dismantling the fastener. The three steps shall be:

- A. Retracted: Permits installation or removal of rail
- B. Intermediate: Permits longitudinal rail movement
- C. Clamped: Provides full rail clamping force.

Fasteners shall be comprised of as few components as economically and technically feasible for ease of assembly, disassembly, and maintenance. The rail clips, rail seat pads, and insulators shall be furnished by rail clip manufacturer and shall be compatible with concrete tie shoulders.

Configure fasteners so rail clip can be installed or replaced in the field by one person using standard readily available track tools. Clips shall be capable of being installed by commercially available automated equipment.

Configure fasteners so that when the rail clips are retracted, the rail may be lifted vertically until it is completely free of the fastener without disturbing the horizontal or vertical alignment of the fastener.

Fasteners shall have, on both sides of the rail base, a positive means of preventing more than 1/8 IN total lateral movement of the rail base relative to the fastener in case of failure or loosening of one or both rail clips. The positive means shall extend at least 3/8-inch above the base of rail in the installed position.

Fasteners shall be Pandrol "Fastclip" or approved equal. Rail clips, insulators and tie pads shall be pre-assembled on cross tie at manufacturer's plant.

Rail Clips

Rail clips shall not be dependent on elastomeric components in torsion. The clips shall be reusable after removal through repeated applications without any effect on the operating performance of the system.

The minimum vertical hold down force for spring clips shall be 2,500 pounds with total minimum force of 5,000 pounds per rail fastener assembly.

Insulators

An insulator shall be used between the rail clip, shoulder insert and the rail to position rail to the proper gauge, provide electrical insulation, reduce abrasion, and transfer the rail loading to the rail clip and shoulder insert.

The insulator shall be capable of withstanding degradation from oxidation, water, alkali, petroleum oils, synthetic lubricants, and sunlight without having detrimental effect on the performance of the insulator.

Insulator dimensions shall be appropriate to provide standard gauge dimension.

Insulators for different uses (adaptive insulators) shall be of different colors or different appearance for ease in identification.

Rail Seat Pads

Provide rail seat pads compatible with the rail fastening system with a shape which provides positive means of preventing movement of the pad parallel to the rail. Pads must comply with SCRRRA Engineering Standard ES 2363.

Alternate designs of rail seat pads shall be considered, provided they have successful history of performance of at least three years service under comparable service conditions.

Alternate design must be specifically approved by the Engineer.

Submit results of industry standard tests concerning the above properties.

Iron Shoulders

Iron Shoulders shall be Pandrol cast shoulders for "fast clip" or approved equal, sized for 136 pounds, 6 inch base rail dimension, with adaptive insulators, pads, and clips

Ductile iron shoulders shall be obtained by the manufacturer and shall conform to ASTM A536 Grade 60-40-18 or 65-45-12.

They shall be marked with the part number, supplier's identification and pattern number.

At least four Y block specimens shall be cast from each heat, or in continuous casting, from each four-hour period.

Specimens shall be heat treated under the same conditions as the shoulders they represent.

Tension test specimens with a gage length of 2 inch shall be machined from the Y blocks and one tension test shall be made for each heat or each 4-hour pour period.

If the elongation and tension test results do not conform to ASTM A536, a further specimen shall be tested and if this fails the cast shall be reheated or rejected.

The shoulders and test specimens may not be reheated more than once.

After reheating, two test specimens shall be tested.

If either of these fails to conform to ASTM A536, the cast shall be rejected.

The shoulders shall be free from burned-on sand, cracks, cavities, injurious blowholes and other defects.

Fins shall be removed from the vertical faces of the head of each shoulder.

Fins across the top of the head shall not exceed 1/32 inch and below the head, fins shall not exceed 1/16 inch.

At gates, there shall be no cavity in the shoulder more than 1/8 inch below the general surface level.

Go and No Go inspection gages shall be used to check that tolerances conform to the Drawings.

A sampling plan for Acceptable Quality Levels of 1 percent for major dimensions and 4 percent for minor dimensions shall be used.

The manufacturer shall decide which are major and minor dimensions in consultation with the Engineer (through the Contractor).

Iron shoulders shall be free of mud, oil, loose rust and other contamination when cast into ties. They shall be rigidly secured in the forms during casting and shall not move within the concrete when the securing device is released.

Ductile iron shoulders shall conform to the dimensions on the Drawings issued by the fastening clip suppliers.

Guard Rail Inserts

Inserts for guardrail concrete ties shall be as shown on SCRRA Engineering Standards ES 2406 or ES 2407 or approved equal.

Neoprene Pads

Neoprene Pads cast into the bottom of the tie for use on bridge decks in certain applications as indicated in the Contract Documents shall be as shown on SCRRA Engineering Standards ES 2403 or ES 2407.

Tie Dimensions, Configuration and Weight

Dimensions, configuration and weight shall conform to the following:

- A. Alternative designs of concrete ties will be considered if they have the same general profile, and length.
- B. Alternative designs must have a successful history of performance of at least five years service under comparable service conditions.

Alternative design must be approved by the Engineer.

Dimensions

Weight	750 pounds maximum
Base Width	10-3/8" ($\pm 1/4$ ")
Height at rail seat	8" ($+3/16$ " $-1/8$ ")

Cross Ties

Length	8'-3" ($\pm 1/8$ ")
Height at center of tie	6-1/4" ($+3/16$ " $-1/8$ ")
Rail Seat Cant	1 in 40 towards track centerline
Track Gauge	4'-8-1/2"

Flexural Strength

Flexural strength performance and test requirements shall comply with Section 4.4, Chapter 30 of AREMA Manual.

Results per Section 4.9, Chapter 30 of the AREMA Manual shall be provided.

The minimum flexural performance requirements for the concrete ties shall be as follows:

- A. Positive rail seat moment of 280 inch kilo-pound static.
- B. Negative rail seat moment of 146 inch kilo-pound static
- C. Static center positive moment of 110 inch kilo-pound.
- D. Static center negative moment of 162 inch kilo-pound.

Longitudinal and Lateral Rail Restraint

The concrete tie and elastic fastener shall provide longitudinal and lateral rail restraint as specified in Section 4.6 and Section 4.7, Chapter 30 of the AREMA Manual.

Electrical Properties

Each concrete tie, together with its elastic fastening, shall comply with Section 4.8, Chapter 30 of the AREMA Manual.

Tie Testing

Prior to approval of the concrete tie design, tests specified in Section 4.9, Chapter 30 of the AREMA Manual, unless otherwise modified by this Section, shall be performed at testing facility approved by the Engineer and results provided to the Engineer.

Surface Finishes

Every tie shall be visually inspected.

Two ties which, in the opinion of the Engineer, show the required bottom surface finish and two ties which in the opinion of the Inspector show the maximum allowable rail seat defects shall be set aside as comparison standards for acceptance of ties.

The bottom surface of each tie shall have a rough struck, leveled surface.

Projections from and indentations into the general level of the surface shall not exceed 3/16 inch.

The indent pattern shall be approved by the Engineer.

The surface of the rail seat shall have a smooth, formed finish not inferior to the comparison standards.

No forms, seams or warpage in the rail seat will be allowed.

The rail seat flatness shall not exceed a 1/32 inch difference across any part of the rail seat.

When referring to voids and rail seat flatness in the rail seat area, the rail seat will be defined as "inch area between adjacent shoulders and edge of tie to edge of tie" and the area adjacent to the shoulder and 3/8 inch beyond the face of the front face of the shoulder.

Grinding or shaving with a jig is acceptable.

Freehand grinding is not acceptable, unless approved by the Engineer.

Filling of rail seat voids with fillers is not acceptable.

No rubbing, brushing or other treatment shall be used on the rail seat.

Ties require a lateral resistance pattern to be placed on the side of the tie.

The Engineer will review for approval the design, but not provide the design of this pattern.

The tie shall provide a minimum lateral in a single tie push test of 5,000 pounds.

The tested tie must be in track on a major heavy haul railroad with adequate ballast depth.

Proof of the lateral resistance design will be through multiple single tie tests as performed by the AAR.

The tie manufacturer assumes responsibility for maintenance and design of these forms and patterns.

The Engineer will not accept a tie without a proven pattern.

Other formed surfaces shall be smooth and holes shall not exceed 1/4 inch in depth and diameter.

Ties with a limited number of holes up to 3/8 IN DIA but not exceeding 1/4 inch in depth will be accepted providing that holes are filled with a mixture of 3 parts washed sand, 1 part cement and 1 part SBR latex measured by volume or other accepted material.

Holes in tie ends shall not exceed 3/8 inch in diameter and 1/2 inch in depth or 1/4 inch diameter and 1 inch in depth below the general surface level of concrete.

Corner breakage at tie ends shall not exceed 1 inch in depth.

Ties with visible cracks shall be rejected.

Prestressing wire shall not protrude more than 1/8 inch beyond the tie end and shall not have ragged ends, which would be hazardous in handling.

The surfaces where fastening components bear on the iron shoulders shall be 100 percent free from concrete or other foreign materials.

Tie Dimension Inspection

Approved Go and No Go gages shall be used to check the following:

- A. Out to out shoulder spacing.
- B. Adjacent shoulder spacing.
- C. Shoulder height.
- D. Rail seat cant.
- E. Rail seat flatness.
- F. Rail seat wind or warpage.
- G. Wire location.

A "Go and No Go" gage is the basis for acceptance and rejection. No interpretation of a gage is acceptable.

The inspector may gage as often as is required or as the Engineer feels necessary to QC confidence. If a problem is found then it is the responsibility of the Manufacturer to provide inspection as directed by the Engineer (100 percent if necessary) until the extent of the problem has been determined or the rework has been properly confirmed.

When new forms, modified forms or repaired forms are used, the first tie cast in each cavity shall be checked with Go and No Go gages and normal measuring equipment to insure conformity with dimensional tolerances on the tie drawings.

Ties selected for routine acceptance load testing shall be checked as described in this Specification.

Wire pattern shall:

- A. Ensure 3/4 inch minimum concrete cover of prestress tendons.

- B. Be placed accurately to prevent electrical short between embedded fasteners.
- C. Achieve flexural bending strength in Section 2.10.
- D. Wire pattern for ties on both ends shall be visually inspected daily.

Acceptance Load Testing

Acceptance load testing shall be carried out on the day that detensioning is performed. Contractor must provide sufficient notice to the Engineer to allow for SCRRA Inspectors to be present during acceptance load testing.

Production Start-up Testing

From the first bed cast, ties from one form, selected at random, shall be load tested as follows:

- A. Rail seat positive and bond development at one end.
- B. Rail seat negative at the other end.

If the ties meet these test requirements, further beds may be cast.

If any tie fails to meet the test requirements, two further ties shall be taken from the same line and, if either of these ties fails to meet the test requirements, each tie in the line shall be individually tested, excluding the bond development test.

One further bed shall then be cast and the test procedure repeated.

When the test ties meet these requirements an additional four ties shall be randomly selected from the bed already cast and tested as follows:

- A. Two ties tested for Tie Center Negative Moment Test.
- B. Two ties tested for Tie Center Positive Moment Test.

If any tie fails to meet test requirements, two further ties shall be taken from the same line.

If either of the ties fail, then the batch is rejected.

When the test ties meet the production startup testing requirements, further beds may be cast.

Routine Production Testing

After initial production acceptance testing routine acceptance testing shall be carried out on beds cast.

Ties from one form, selected at random from each bed cast, shall be load tested as follows:

- A. Rail Seat Positive at one end.
- B. Every 6th tie selected for test shall additionally be tested as follows:
 - 1. Rail Seat Positive at one end to first crack.
 - 2. Rail Seat Negative at other end to first crack.

If any tie fails to comply with the test requirements, 2 additional ties shall be taken from the same line and tests repeated.

If either of these ties fails the test, each tie in the line shall be tested.

One tie per day shall be selected at random from ties subject to Rail Seat Positive test and additionally tested for bond development.

If the tie fails to conform to the requirements of this test, two further ties from the same line shall be tested.

If either of these fails the test, one tie shall be tested from each bed cast on the same day as the ties, which failed the test.

No ties from beds with test failure shall be shipped until a test program to identify ties with unsatisfactory bond is agreed with the Engineer and the tests completed.

One tie per day shall be selected at random from ties subject to Rail Seat Positive Test and additionally tested for Tie Center Negative Moment.

If the tie fails to conform to the requirements of this test, two further ties from the same line shall be tested. If either of these ties fails, each tie in the line shall be tested.

Rail Seat Positive Test

The tie shall be supported in a hydraulic testing machine with loading points so arranged that the load is applied at right angles to the base of the tie midway between the supporting pads. Test configuration shall be in accordance with Chapter 30 of the AREMA Manual.

A test load of 52 kilo-pound shall be applied at a rate not exceeding 10 kilo-pound per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

A tie will be considered to have failed the test if at the 52 kilo-pound test load, it contains a structural crack when viewed under 5-power magnification. The illumination at the surface shall be not less than 125 FEET candles.

When a tie is to be tested to first crack loading shall continue, after inspection at the 52 kip load until a crack 1 inch in vertical length is observed. The load shall then be recorded.

Rail Seat Negative Test

The tie shall be supported in a hydraulic testing machine, in accordance with the test configuration in AREMA Manual, Chapter 30.

The testing procedure shall be in accordance with Chapter 30 of the AREMA Manual.

A test load of 29 kilo-pound shall be applied at a rate not exceeding 5 kilo-pound per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

Bond Development Test

The tie shall be supported in a hydraulic testing machine, in accordance with the test configuration in AREMA Manual.

Dial gages reading, to 0.001 inch shall be attached to the tie at the end being tested, to measure any movement relative to the tie of the outermost wire in each of the bottom corners of the tie.

A test load of 78 kilo-pound shall be applied at a rate not exceeding, 5 kilo-pound per minute and maintained for a period of five minutes.

The wire movement shall not exceed 0.001 inch.

If during this test, a structural crack more than 3 inch long occurs, the test tie shall be rejected after completion.

Tie Center Negative Moment Test

The tie shall be supported in a hydraulic testing, machine in accordance with the test configuration in the AREMA Manual.

A test load of 12 kilo-pound shall be applied at a rate not to exceed 5 kilo-pound per minute and maintained for at least 3 minutes to permit proper inspection. Both sides of the tie must be inspected.

Tie Center Positive Moment Test

The tie shall be supported in a hydraulic testing machine in accordance with the test configuration in the AREMA Manual.

A test load of 8 kilo-pound shall be applied at a rate not to exceed 5 kilo-pound per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

Electrical Short

Each tie tested in accordance with Paragraph 2.13.C. herein shall be checked for shoulder to shoulder direct electrical shorts under 10 volts DC using an Ohm Meter.

The resistance shall not be less than 100 ohms.

If a tie fails this test, ties from the same line shall be individually tested.

Test Reports

The Contractor must submit a monthly manufacturer's test report to the Engineer. This shall include:

Number of good ties cast.

Number of reject ties cast and reasons for rejection.

Concrete compressive strength test results at transfer and at 28 days.

Average and standard deviation of the 28-day compressive strength results.

Percentage probability of 28-day compressive strength results failing to meet the minimum specified strength and the actual number of failures.

Tie first structural crack loads, rail seat positive and rail seat negative.

Average and standard deviation of the first crack loads.

Percentage probability of the first crack loads failing to meet the minimum specified load and the number of failures.

The 28-day Compressive Strength results shall also be presented as frequency histogram.

The Average 28 Day Strength results, Average first Crack Loads and Percentage probability of failing figures shall also be plotted on graphs showing, the corresponding results for the previous 12 months or since production started, whichever is the shorter period.

The manufacturer shall retain for a period of 10 years test certificates provided by suppliers and outside testing laboratories.

Results of all inspection and testing by the manufacturer shall be retained for 10 years.

The Engineer shall have access, during working hours, to all parts of the manufacturer's plant involved in tie production and to those parts of suppliers plants engaged in producing materials or components for use in the ties.

The Engineer shall access to the results of tests carried out by the manufacturer, suppliers and outside testing laboratories.

Plant Yard and Handling

When handling ties in the plant or yard, they shall not be dropped or damaged.

Ties shall be stacked on firm level ground, not more than 20 ties high and supported on dunnage at the rail seats only.

Identification

Each tie shall be marked with indented or raised letters or numerals to identify the manufacturer, SCRRA designation, form designation and date/month/year of manufacture as detailed on the SCRRA Engineering Standard drawings ES 2402, ES 2403, ES 2406 or ES 2407 as appropriate.

CONSTRUCTION

Testing and inspection shall conform to AREMA Manual, Volume 1, Chapter 30, Part 2, Evaluation Tests for Tie Systems and Para 5, Section 4.9, Testing of Monoblock ties, unless otherwise modified by these Specifications.

Full compensation for evaluation tests shall be considered as included in the contract unit price paid for concrete ties and no additional compensation will be allowed therefore.

Ties may be inspected by the Engineer at suitable and convenient places either at points of shipment or destination.

The Engineer reserves the right to examine any equipment used for any manufacturing process at any stage of tie production.

Material not meeting the requirements of this Specification shall not be used in the work.

Quality Control Program

Contractor must comply with the following Quality Control Program requirements.

A quality control program under which the manufacturer will perform sufficient inspection and tests of items of work, including those by suppliers or subcontractors in order to ensure conformance to applicable standards, Specifications or plans with respect to materials, workmanship, fabrication, and identification.

The control plan shall provide for:

- A. Manufacturer's surveillance (e.g. but not limited to shoulder inserts, wire).
- B. Drawing- control (changes).
- C. Mold Certification.
- D. Document control.
- E. Inspection procedures - in process and final.
- F. Production test requirements.
- G. Segregation and disposition of defective material and products.
- H. Material and process control in plant identifying critical control points.
- I. Production equipment and instrumentation calibration, maintenance, and data recording.
- J. Work procedures and instruction.
- K. Failure reporting analysis and corrective action.
- L. Sample plans and quality levels shall conform to Military Standard 105D, AQL Level H unless otherwise stated or approved.
- M. Raw materials standards and controls.
- N. Records of test and inspections.
- O. Time and temperature control.
- P. Strength testing.
- Q. Storage handling and shipment controls.

- R. Procedures or tests for determining within 24 HOURS that the conditions necessary to achieve the 28-day strength have been met, with a margin of safety.
- S. Quality budget in percentage of contract price.
- T. Assurance that the plant will meet and continue to meet PCI certification.
- U. Quality control organization chart showing QC personnel and their corresponding contact level at SCRRA. QC organization must report independently from Production to Project Manager level or above.

The person responsible for quality control shall be independent of production management and shall report functionally to the manufacturing, company's senior management.

Production Program

Contractor must comply with the following Production Program requirements. A complete production program shall include:

- A. Plant layout.
- B. Form design with tolerances.
- C. Raw material requirements.
- D. Primary and alternate sources.
- E. Material handling.
- F. Material placement with tolerances.
- G. Curing method.
- H. Bond release method.
- I. Method of vibration.
- J. Pretensioning and detensioning method for strand or wire.
- K. Daily production capability.
- L. Finished tie inventory plan.
- M. Plan for handling ties from finished product to assigned rail cars or alternate transportation arrangements.
- N. Flow chart of production process indicating points of control for significant operations.

MEASUREMENT AND PAYMENT

The contract unit price paid for Concrete Ties includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in Concrete Railroad Tie, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.05 WOOD RAILROAD TIE

GENERAL

Summary

This Section specifies the Material requirements and performance criteria for the production and inspection of the wood railroad ties to be furnished and installed in accordance with the Contract Documents.

Work included in this Section encompasses work necessary for the manufacturing, production and handling of wood switch ties, crossties, and grade crossing ties. Requirement for the placement of these wood ties and the measurement and payment provisions are specified in the applicable trackwork sections of these Specifications.

Submittals

Compliance

Manufacturer or Supplier's certification that the materials delivered to the site are in compliance with the Specification.

Tests

Certified test results, as required to demonstrate compliance of materials specified herein must be submitted to the Engineer before any wood ties are used in the Work.

On-Site Storage and Handling

Ties shall be stored to avoid contamination of water and soil by the ties.

Long-term ties storage shall not be located within 250 feet of an open road crossing on residences.

Ties temporarily located within 250 feet of a public road crossings or residences shall be covered by an impervious sheet material to control odor and vapor emitted by the crossties.

Quality Control and Assurance

Testing and inspection of tie manufacture shall be performed by Contractor in conformance with AREMA Manual, RTA and AWWA.

Ties may be inspected by the Engineer, at suitable and convenient times and places including points of manufacture, shipment, or destination.

The Engineer reserves the right to examine any equipment used for any process or method of treatment at any stage of tie production.

Materials not meeting the requirements of this Specification shall not be used in the Work.

The Engineer shall have access to Manufacturers' plant during normal working hours and Project related procurement and production records for inspection during the Contract period of performance.

MATERIALS

Products

The following hardwood species can be used for crossties, and grade crossing ties:

Oaks, Elms, Hickories, Cherries, Walnuts, Oak-Hickory Group: Red Oak, White Oak and Hickories.

Mixed Hardwoods Group: Gums, Ashes, Cherry, Walnuts, Birches, Maples, Beech, Locusts, Sycamore, Elms And Cypress.

The following species are not acceptable:

Douglas Fir, Hem-Fir, Ponderosa Pine, Lodge pole, Pine, Larch, Oak-Hickory Group: Live Oak and Blackjack Oak.

Mixed Hardwoods & Softwoods: Douglas Fir, Hem-Fir, Ponderosa Pine, Lodge Pole, Pine, Larch, Cottonwood, Willow, Basswood, Hackberry And Poplar.

Oak and elm ties shall be of compact wood throughout the top fourth of the tie.

Crossties shall be the full length specified, double end trimmed, and must have full body and full face.

Ties with greater than 1 inch of wane within the 20 inch and 40 inch rail-bearing sections, when measured from the center of the tie, are not acceptable.

Thickness and width tolerance shall be not more than ¼ inch thinner or narrower than the specified size.

Contractor must provide a maximum of 50 percent of the ties from oak species and the remaining 50 percent from mixed hardwoods from list of ties specified in this specification.

Oak ties must be air seasoned Unless otherwise directed by the Engineer and preapproved and specified in writing.

Mixed Hardwoods may be either air seasoned unless otherwise directed by the Engineer and preapproved and specified in writing.

General Tie Requirements

Wooden ties shall be made from sound, straight, live timber and shall be free from defects that may impair their strength or durability, such as bark, splits, shakes, large or numerous holes or knots, pitch seams, pitch rings, slanting grain or other imperfections.

Decay or insect damage in any form is not acceptable.

Ties shall be well sawn on sides and cut square at the end to the full dimensions specified.

Ties shall be straight and opposite faces shall be true and parallel, and with bark entirely removed.

Ties shall be straight.

A tie shall be considered straight when:

- A. Timber Cross Tie: When a straight line from a point on one end to a corresponding point in the other end is no more than 1- ½ inch from surface at all points.
- B. Timber Switch Ties: When straight line from a point on one end to a corresponding point on the other end is no more than 2 inch from the surface at all points.

A tie is not well sawn when its surfaces are cut with score marks more than 1/2 inch deep, or when its surfaces are not even.

The top and bottom of a tie shall be considered parallel, if any difference in the thickness at the sides or ends does not exceed 1/8 inch.

For proper seating of nail plates, tie ends must be flat and will be considered square with a sloped end of up to 1/2 inch, which equals a 1 in 20 cant.

Ties must be marked with saw kerf mark on the sap side, line end of the tie, not to exceed 1/4 inch in depth and 1/4 inch in width.

The kerf mark will indicate heart side down when tie is installed.

If no end plate is installed, the tie must be stamped or branded "SCRRA" and the manufacturer followed by the year of manufacture on the sap side on the end of tie.

The stamp or brand must be applied so the lettering and date are right side up when the tie is properly installed.

Anti-Splitting Devices

Anti-splitting devices are required.

Anti-splitting devices (end plates) shall be multi-nail plates as specified in AREMA Manual, Volume 1, Chapter 30, Part 3.1.6, Specifications for Devices to Control the Splitting of Wood Ties.

Structural type, Grade "C", 18 gauge galvanized steel, ASTM A653 or better with ultimate strength of 55,000 pounds per square inch and yield strength of 40,000 pounds per square inch.

Galvanizing per ASTM A653, G60 coating.

4-5 teeth per square inch.

1/2 inch to 9/16 inch length of tooth.

This application must enable the plate to hold both vertical and horizontal splits.

End plates shall be applied by a mechanical device capable of squeezing any splits; bringing the tie back to its original (cross section) dimensions prior to application.

End plates for 7 inch x 9 inch ties are to measure 6 inch x 7 inch or 6-1/4 inch x 7 inch.

No part of the end plate is to be within 1/4 inch of any side.

Anti-split end plates shall have rounded corners and a smooth perimeter.

Embossed on all end plates will be "SCRRA" and manufacturer followed by the year of manufacture. End plates shall be installed with the letters "SCRRA" upright with the tie oriented with heartwood down.

Dimensions

Crossies shall have a 7 inch x 9 inch cross-section and shall be double end trimmed, unless otherwise ordered.

Length of ties shall be as ordered in each shipping release.

Ties will be ordered as 9 feet or in one foot increments from 9 feet to 24 feet

The length, thickness, and width specified are minimum.

Ties over 1 inch longer, thicker or wider shall be rejected.

Tie dimensions shall not be averaged.

Preservative

The preservative shall consist of a mixture of 50 percent by volume of P-1 creosote oil conforming to AWPA Specifications (AWPA P3 and AWPA P4), and 50 percent by volume of an approved petroleum residuum oil.

The creosote and oil shall be thoroughly mixed in the working tank until the mixture is of uniform composition. (Note: use of treatment with P-2, 7 pounds per cubic foot is an approved equal).

The residuum oil shall be approved asphalt base petroleum residuum oil.

It shall be free from water and any foreign substance that might interfere with its penetrating qualities.

The flash point of the residuum oil shall not be less than 210° Fas determined in the Cleveland Open Cup.

The viscosity of the residuum oil shall be such that a blend of 50 percent residuum oil and 50 percent creosote shall have a viscosity exceeding 50 seconds Saybolt Universal 180° F.

BS&W shall not exceed 1 percent and the creosote oil mixture shall show no sludge formation upon standing. (Note: AWPA P4 is acceptable as an approved equal for residuum oil).

Approvals and Rejections

Ties with any type of decay will be rejected.

Rejection of ties for holes and knots. Holes and knots will be allowed if they occur outside the sections of the tie between 20 inch and 40 inch from its middle.

A large hole is a hole more than 1/2 inch in diameter and 3 inch in depth within the rail bearing area, or more than 1 inch diameter and 3 inches deep outside the sections of the tie between the 20 inch and 40 inch rail bearing area measured from the center of the tie.

"Numerous holes" are any number of holes equaling a large hole in damaging effect. Such holes, whether caused in manufacture or otherwise, will be cause for rejection.

A "large knot" within the rail bearing area is one whose average diameter is more than 1/3 the width of the surface on which it appears. "Numerous knots" are any number, which, in total, equal a large knot in damaging effect. A cluster of knots will be judged as if it were a large knot in damaging effect.

Ties with shake wide or more than 1/3 the width of the tie, and nearer than 1 inch to any surface, will be rejected.

Fire scar will be considered as shake.

Except in woods with interlocking grain, ties with a slant grain in excess of 1 in 15 will be rejected.

Ties with continuous checks whose depth in a fully seasoned or treated tie is greater than 1/4 the tie thickness and longer than 1/2 the length of tie will be rejected.

Do not count the end as a surface.

Any other imperfections that are within the limits of current AREMA and RTA Specifications will be allowed.

A split is a separation of the wood extending from one surface to an opposite or adjacent surface.

A split 1/8 inch wide and 4 inch long in an unseasoned crosstie is acceptable.

A split more than 1/4 inch wide or 9 inch long on the face on which it occurs in a seasoned crosstie will be rejected.

Stump pull will be graded the same as a split in the end of a tie.

A stump pull that goes into the interior of the tie more than 5 inch will be rejected.

Bark seam or pocket is a patch of bark partially or wholly enclosed in the wood.

Bark seams will be allowed outside the rail bearing area provided they are not more than 2 inch below the surface, 1/4 inch wide, and not more than 5 inch long.

Ties with heart-checks that go into the tie plate area will be rejected if the check is more than a cumulative 1/2 inch wide or if the check causes the plate area to be concave/convex.

Holes

Ties having solid holes on any surface within the rail bearing areas greater than 1/2 inch diameter and greater than 3 inch deep will be rejected.

Ties having solid holes on any surface outside the rail bearing areas greater than 1 inch in diameter or greater than 3 inch deep will be rejected.

Stump pull will be graded the same as a split in the end of a tie.

A stump that goes into the interior of the tie more than 5 inch will be rejected.

Numerous holes are defined as having any number equaling a large hole in damaging effect. Such holes may be caused in manufacture or otherwise.

Mechanically damaged ties shall be replaced by the party that damages the tie.

CONSTRUCTION

Treating plant shall be equipped with the thermometers and gauges necessary to indicate and record accurately the condition of stages of treatment, and equipment shall be maintained in acceptable, proper working condition.

Some green gross ties must be checked periodically for moisture content prior to going in the cylinder. Green ties must be checked periodically for moisture content prior to going in the cylinder.

Several borings shall be taken from crossties, so that the moisture content level can be measured, to determine the amount of water that is to be removed from the crossties. Twenty borings per charge shall be taken from crossties, so that the moisture content level can be measured, to determine the amount of water that must be removed from the crossties.

Material shall be conditioned by air seasoning.

Material, either under vacuum or at atmospheric pressure, must be handled in a manner that will not cause injuries, checking splitting, warping or render it unfit for the service intended.

When air seasoning is used, material shall be treated before it begins to deteriorate. Air seasoned material may also be given a preliminary heating in the preservative for not more than 6 hours at a temperature of not more than 210° F, just before the regular treating operation.

Oak/Hickory ties will be seasoned for approximately 10 months to obtain moisture content not to exceed 45 percent on 2 inch cores.

Mixed Hardwood ties will be seasoned for approximately five months to obtain a moisture contents not to exceed 40 percent on 2 inch cores.

Boultonizing

Ties shall only be Boultonized as directed by the Director System Maintenance and Rehabilitation of Metrolink or his designated representative. Crossties and switch ties scheduled for Boultonizing shall be separated by size and species, incised, and forwarded to taming station for handling prior to initiation of the drying process. Hickory ties must be Boultonized with oaks. Each layer of ties on the tram shall be separated with one 3/4 inch steel cable, steel rod, or 1/4 inch Grade 30 steel chain placed on alternate ends as the layers are built. Switch ties will require two

cables, rods, or chains per layer for 9 feet – 12 feet, and three cables, rods, or chains per layer for 13 feet – 16 feet +lengths. Steel or wooden stickers must be removed prior to shipment to Metrolink.

When bouldonizing, the oil shall cover the material in the cylinder.

The temperature of the oil during the conditioning period shall not exceed 210° F.

If a vacuum is then drawn, it shall be of sufficient intensity to evaporate water from the material at the temperature of the oil.

The intensity of the vacuum or the temperature of the oil, or both, shall be adjusted so as to regulate the evaporation of the water satisfactorily.

The conditioning shall continue until the material is sufficiently heated and enough water removed from the cylinder before an empty-cell process is applied.

The Boulton process used is to conform to AWPA section C1-00 Section 1.3.3, most recent version.

Maximum moisture content is to be 50 percent for oak-hickory and 40 percent in mixed Hardwoods before press cycle begins.

Manner of Treatment

Following the conditioning period, material shall be treated by an empty-cell process to obtain as deep and uniform penetration as possible with the retention of preservative stipulated.

The range of pressure, temperature and time duration shall be controlled so as to get the maximum penetration by the quantity of preservative injected.

Empty Cell Process (Lowry and Rueping)

Treatment shall be by the empty cell method with a creosote/coal tar solution or creosote/petroleum (50 percent – 50 percent) solution in accordance with AWPA Standard P-2, P-3, AND P-4. The preservative solutions shall be tested monthly according to AWPA Standard A-1 with a copy of the results forwarded to the Metrolink representative. In no case shall treatment be less than that required for AWPA U1, UC4B.

Material shall be subjected to atmospheric air pressure or to higher initial air pressure of the necessary intensity and duration.

The preservative shall be introduced until the cylinder is filled while the air pressure is being maintained during the filling operation.

The Pressure shall be raised to not more than 250 pounds per square inch.

Material shall be held under pressure until there is adequate preservative injected to meet specified retention.

The temperature of the preservative during the entire pressure period shall not be more than 210° F but shall average at least 180° F.

After pressure is completed, the cylinder shall be emptied speedily of preservative, and a vacuum of not less than 22 inch at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative, or;

After pressure is completed, and before removal of preservative from tie cylinder, the preservative surrounding the material may be preheated to a maximum of 215° F, either at an atmospheric pressure or under vacuum; the steam to be turned off the heating coils and the leader lines opened immediately after the minimum temperature is reached.

The cylinder shall then be emptied speedily of preservative and a vacuum of not less than 22 inch at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

At the completion of treatment, material may be cleaned by final steaming, when authorized, at not more than 240° F for not more than 30 minutes.

Results of Treatment and Retention

No charge shall contain less than 75 percent nor more than 110 percent of the quantity of preservative specified for the class of material except when the character of the wood in any charge makes these requirements impracticable despite treatment to refusal.

The amount of preservative retained shall be calculated from readings of working tank gages or scales or weights before and after treatment of loaded trams on suitable track scales, with the necessary corrections for changes in moisture content.

The column of oil preservatives shall be calculated on the basis of 100 ° F.

Calculations of volume or weight shall be made by the use of temperature of specific gravity factor contained in the Volume of Specific Gravity Correction Tables of the AWPA.

Penetration

Penetration of ties shall not be less than the following for at least 80% of the pieces bored in each charge.

Thickness (Inches)	Depth (Inches)	Percent of Sapwood (%)
5 and over	1/2	90

Penetration of ties shall be determined by boring not less than 2 ties in each tram in each charge.

Penetration of timber and ties shall be determined by boring approximately midway between ends.

Only material meeting the penetration requirements shall be accepted.

Any charge not conforming to stipulated minimum requirements may be retreated and re-offered for acceptance.

Any holes, which may be bored, shall be filled with tight fitting treated plugs.

Process and preservative to be used on material and retention required shall be as follows, unless otherwise specified, for ties.

Type of Wood	50% Creosote/50% Oil	Process
Hardwood	7-1/2 pounds or ref.	L&R
Oak	7-1/2 pounds or ref.	Bethel or L&R

Retention will be determined by gauge. The amount of preservative solution retained shall be determined from readings of working tank gauges or scales made before and after treatment. The retention of preservative will be calculated after correcting the volume of preservative solution to 100° F.

Care of Treated Wood

In handling treated material, extreme care shall be used to avoid damage to the edges of the timbers or breaking through the portions penetrated by the treatment and exposing untreated wood.

The use of peaveys, timber dogs, picaroons, log hooks, or other pointed tools shall be such as not to break through the treated portion of treated timber.

Plant Storage

The storage yard for seasoning shall be in the open where the air current will circulate freely; shall not be in a low humid situation if it can be avoided; shall have good drainage; and shall be kept free from vegetation and debris, especially from scrap wood already infected with decay.

Treated materials shall be stored in a similar manner to untreated, but must not be piled in same area with untreated Materials.

Unseasoned material must be stacked separately from seasoned or partly seasoned Material.

Stacking

Sawn ties shall be stacked either 1x9 or 2x9 standard stacking method.

If necessary to retard evaporation of moisture, ties may be stacked parallel on edge, using crossties as separators.

Remove bark and inner skin before treatment.

Ties shall be delivered to the project site to locations indicated on the plans, in the Contract Documents or as required by the Engineer.

Banding of ties by length or grade for shipment shall be done by applying bands in a tight manner (2,500 pounds of tension) to prevent warping, splitting, and slipping during storage or shipment. Two steel bands per bundle (T= 5,450 pounds, 1 ¼ inch x 0.029 inch or better) shall be applied within one foot of each end of crossties or switch ties. These bands shall be applied to bundles of switch ties. No more than 9 switch ties shall be bundled together. No more than 25 crossties shall be bundled together.

No steel cables, steel rods, chains, or wooden strips, or any other sticker material shall be shipped in any bundle to Metrolink,

Rejects shall be marked with an "X" on the end. This is to preclude the accidental shipment of less than grade ties to Metrolink. Treated ties not handled directly from tram to car shall be carefully and neatly stored. Different size classifications shall be kept separate, and bundles or stacks shall be marked with Metrolink, grade or length, and treatment date. Ties shall be stacked to ensure that tie straightness is not impaired during temporary storage. Treated stringers shall be placed underneath stacks of treated ties. No loose windrows of Metrolink treated ties will be allowed. Shipments shall be made from the oldest stacks first. If ties become excessively bleached during storage, they shall be retreated or replaced by the supplier. Yard drainage conditions shall provide rapid drainage of water from beneath stacks of treated ties. Storage areas shall be kept free of grass and weeds. The Contractor shall be liable

for fire damage. A minimum 10 foot weed-free zone shall be maintained around Metrolink stored inventory. Care shall be exercised in handling of Metrolink ties for storage or shipment to prevent damage.

PAYMENT

The contract unit price paid for Wood Ties includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in Wood Railroad Tie, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.06 GENERAL SIGNAL REQUIREMENTS

GENERAL

Summary

The work in this Section includes general procedures and requirements for the planning, manufacturing, installation, removal, relocation, modification, testing, placing in service, and documentation of as-built conditions of the various signal systems.

Modify existing equipment and material as shown on the railroad plans to interface with the existing and proposed signal system.

Definitions

Owner-furnished materials for signal systems, if provided, along with delivery points or location of this material for pickup, is listed in the special provisions. Refer to Special Provision, Section, "State-Furnished Material", for responsibilities for receiving, accepting, and transporting Owner-furnished materials. Assemble and install this material as shown on the railroad plans.

Provide additional materials and installation services required for complete working signal systems, as described herein, and as shown on the railroad plans, including equipment not designated as being relocated or designated as Owner-furnished.

Materials and equipment for installation and for interconnection of the various signaling systems shall be fabricated, furnished, and installed as indicated on the railroad plans and specified herein.

The railroad plans represent a final design utilizing systems, components, and materials that meet the Contract Specifications. The Contractor may provide equivalent systems, components, and materials subject to the approval of the Engineer. If equivalent systems, components and materials are provided, the Contractor shall provide an alternate detailed final design as specified herein under Design Submittals.

Provide systems that are compliant with applicable rules and regulations of CFR 49, parts 234 and 236, and CPUC GO 75D. Refer to Design Submittals herein for Contractor's responsibility to indicate corrections or modifications to the railroad plans final design that the Contractor may determine are required to conform to these rules and regulations.

Be present at design meetings held with the Engineer by a signal engineer qualified in the design and application of the signaling equipment the Contractor proposes for use on this project.

No circuit is considered to have met the requirement of these Specifications for function and safety until it has been tested and verified in the field. Circuit changes made to meet the functional and safety requirements of these Specifications shall be considered as included as part of the Work.

Provide continuous train control and highway grade crossing warning during all phases of rail construction. The work of the Contractor must not cause delay to train operations, cause an unsafe signaling condition, or reduce the effectiveness or quality of grade crossing warning systems.

Refer to Design Submittals herein for requirements for submittal of plans for providing wayside signaling and highway crossing warning systems protection during the Work and plans for point protection and fouling when crossovers are installed or removed. Alternate methods shall conform to CFR 49, Part 234, Part 236 and local ordinances.

Provide rail bonding for new, temporary and relocated turnouts as shown on the railroad plans or as required by the Engineer. Provide rail bonding, as necessary, to maintain existing systems during construction.

Protect existing signal cabling and, where necessary, relocate existing cabling in order to prevent damage during track installation and surfacing.

Refer to Special Provision, Project Record Documents, and additional requirements specified herein. Record the final As-Built conditions of the signal systems for each system.

Perform and document tests and inspections in accordance with CFR 49 regulations, the AREMA C&S Manual, the "Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems", and these special provisions.

Refer to Special Provision, Contractor Qualifications and Requirements, and requirements specified herein. Provide at least one qualified signal person to accompany on-track equipment, and remove, relocate, or disconnect and reconnect signal equipment that could be damaged by on-track equipment.

Coordinate installation, inspection, and testing of new Owner-furnished material with the Engineer. Notify the Engineer in writing 30 days prior to installation, inspection, and testing as part of this coordination.

Perform acceptance testing and commissioning of the signal system as a normal part of the Work.

Contractor-furnished software and components shall be new and manufacturer certified.

Remove, salvage, retire, relocate, furnish, and install project related devices as indicated in the Contract Documents and as required to complete the Work.

To retire a grade crossing or a control point, first bulletin it as retired and then take temporary measures with the existing equipment, as required, before removing and salvaging it.

Refer to Special Provision, Section "Earthwork", for provisions for excavation and requirements for shoring of excavation as specified in Special Provision, Excavation and Fill Support Systems.

Refer to Special Provision Section "Earthwork" and "Railroad Facilities (Including Utilities)", for requirements in locating and protecting existing utilities. Details of signal cable runs, conduit runs, and pullbox installations including number, size, and type of cable are shown in the signal drawings of the railroad plans. Information regarding new conduit runs and pullbox installations appear elsewhere in the railroad plans. Conduit runs and pullbox locations, as shown, are the preferred locations. In case of conflict between the signal drawings and other railroad plans, the signal drawings take precedence as to detail, and in the event of conflict as to placement of equipment, the Engineer will determine the correct placement.

Make any minor deviations in location, minor meaning within 10 feet of the location as shown on the civil drawings of the railroad plans, as part of the Work. Deviations in excess of 10 feet may be subject to the changes provisions of General Conditions.

Underground signal cables shall be in conduit except for the final connection of the twisted 2 conductor number 6 track cable to the twisted flex to the rails.

Components or equipment proposed by the Contractor as an equal to those specified in these specification, which are not currently in use on the Metrolink system or that do not have spare maintenance parts in SCRRRA stocks, will require that the Contractor furnish sufficient spare components equal to 10% of the quantity order or a minimum of 2 additional units, whichever is greater. The Contractor shall arrange for manufacturer provided training for Metrolink maintenance personnel. Spares and training must be furnished by the Contractor at no additional expense to SCRRRA.

Fail-Safe Design Requirements

As used in these specifications, the fail-safe principle shall mean that whenever an equipment failure, human error or failure to act, or adverse environmental condition affects the specified operation of a system involved with the safety of life or property, that system shall revert to a state known to be safe.

Failure of a circuit or equipment that results in an indication of a dangerous or restrictive condition, whether or not there is actual danger, shall have met the fail-safe requirements. Conversely, a failure that results in an indication of safe or nonrestrictive condition when, in fact, a dangerous condition may exist shall not have met the fail-safe requirements.

Vital applications, such as detector locking of switches, shall be based on the following principles that permit the attainment of fail-safe operation in known or discovered failure modes:

1. Closed Loops: Fail-safe circuits shall employ the closed loop principle and shall protect against open circuits, shorts, or combination thereof.
2. Vital Relays: Relays used in vital circuits.
3. Vital Circuits: Line circuits which energize a vital relay shall be two-wire, double-break circuits and shall be energized from an ungrounded direct current (dc) power supply.
4. Grounds: Components or wires becoming grounded shall not cause an unsafe condition.
5. Spurious Oscillations: Any amplifier, generator, or device element, active or passive, breaking into spurious oscillations shall not cause an unsafe condition.
6. Filters: Filters used in fail-safe circuits shall be designed to prevent undesired signals from appearing at the filter output at levels which could cause an unsafe condition.

Equipment failures and conditions which shall be considered in producing a fail-safe design shall include the following, at minimum:

1. Relays (non-vital): Open coil, fused contacts, high contact resistance, shorted coil, armature sticking, contacts sticking, or broken spring.

2. Relay (vital as defined by the AREMA C&S Manual): Open coil, shorted coil, or high contact resistance.
3. Transformers: Open primary, open secondary, shorted turns, primary-to-secondary shorts, or combinations thereof.
4. Capacitors: Short, open, or leakage.
5. Resistors: Increase or decrease in resistance.
6. Transistors: Short, open leakage, or loss of Beta.
7. Diodes: Short, open, or reverse leakage.
8. Coils: Open or shorted turns.
9. Loss or degradation of power sources.
10. Appearance of abnormal signal levels, electrical noise levels, frequencies, and delays.
11. Effects of electrical interference.
12. Absent or abnormal input signals.
13. Opens or shorts in internal circuitry at inputs and at outputs.
14. Mechanical vibration or shock.
15. Drift or instability of amplifiers, receivers, transmitters, oscillators, switching circuits, and power supplies.
16. Deterioration of contacts, connectors, terminals, solder connections, printed circuits, circuit adjusting devices, and mechanical devices.

Fail-safe equipment proposed for vital signaling applications shall have been proven with 5 years of successful rail service operation in the United States of America.

Environmental Parameters for Equipment

Contractor provided material and equipment shall be fully operable with no impairment resulting from the effect of the environment throughout the range of worst values indicated below. The general operating environment shall be considered to be in salty atmosphere and in generally sunny weather.

Ambient outdoor temperature range: From minus 40 degrees F to plus 160 degrees F.

Relative humidity range: From zero to 100 percent.

Maximum rainfall: 4 inches in 24 hours and 1.5 inches in 1 hour.

Maximum wind velocity: 100 miles per hour.

Seismic Zone Location of Work Site: Seismic Zone 4 as defined in the Uniform Building Code.

Isokeraunic Level: Five per year.

Submittals

Submit product information, references, shop drawings, and test data as detailed.

Resumes and/or work histories and references for the Signal Engineer and Signal Managers shall be submitted a minimum of 30 days prior to starting work requiring their supervision for approval by the Engineer. The submitted information shall demonstrate compliance with the specified requirements below to the satisfaction of the Engineer.

Design Submittal

Undertake no work without the prior submittal to and approval by the Engineer of the relevant plans and procedures.

Alternate Detailed Final Design: Submit proposed equivalent systems, components, and materials, if proposed, for Engineer's approval no later than 90 days after Notice to Proceed. Utilize, at a minimum, the symbols, nomenclature, and CADD standards depicted on the railroad plans and SCRRA Signal Design Standards. The Contractor's alternate final design drawings shall be approved and stamped by a professional electrical engineer registered in California. The Engineer will render a decision concerning alternative design within 60 days of the Contractor submittal.

Submit marked-up railroad plans for approval, indicating any corrections or modifications to the final design that the Contractor may determine are required to conform to rules and regulations. Submit these revised drawings for the Engineer's approval within 60 days after Notice to Proceed.

Submit proposed plans, procedures, data sheets of proposed materials, application logic, installation details, shop drawings, mechanical drawings, proofs of compliance with applicable standards, and other pertinent data required to fully demonstrate the Contractor's proposed plan for the manufacture, installation, testing, and maintenance of the various signaling systems. Submit for Engineer's approval within 60 days after Notice to Proceed. Plans shall include:

1. Proposed plan for providing alternate methods of wayside signaling and highway crossing warning systems protection when signal components are relocated, deactivated, altered, or modified in order to accommodate construction work.
2. Plan for point protection and fouling when crossover or turnouts are installed or removed.

Signal system shop drawings and design submittals shall include any CADD files in Microstation V8 formats. Signal circuit drawings shall conform to the CADD standards. Submit electronic files on CD-ROM.

Prepare and submit a Signaling Construction Sequencing Plan for each location where a signal system or Crossing Warning System is to be modified, installed, or removed. The Plan, as a minimum, shall contain the following:

1. A narrative description of the work to be undertaken at the designated location. The narrative shall include consideration of coordination with other non-signal related construction activities in a logical and efficient fashion. The plan shall reflect an integrated construction plan such that non-signal & signal construction activities do not interfere with, prevent, undo or otherwise impinge on each other. The contractor is responsible for correct sequencing and shall not be compensated for work that has to be removed and recompleted so as to accomplish a forgotten task.
2. A step-by-step sequence of work description which identifies those steps during which the existing system will be disabled, and a description of what steps will be taken to assure that the signal system will be tested and returned to full operation without causing a delay to any train movement or undue interruption of automobile or pedestrian traffic that would interfere with timely commuter access to the Metrolink commuter rail service.
3. An estimate of time to complete the critical steps in the sequence specified in step-by-step sequence of work description. A schedule/time-line with minimum of ½ hour time intervals shall accompany this work description.

Submit circuit drawings indicating any required modifications to new systems or existing circuits where only a segment of the new work can be completed or the complete system must be placed in operation in phases. Submit these temporary interface drawings for the Engineer's approval a minimum of 30 days prior to the scheduled cutover.

Revisions to existing circuit plans shall use the "Xs" and "Os" convention to show changes. Encircling the change with "Xs" shall identify deletions. Encircling the change with "Os" shall identify additions. The Contractor may, with the prior approval of the Engineer, alternately use the "Red In"/"Yellow Out" convention if Contractor provides seven colored copies of the drawing.

Request approval from the Engineer prior to making any deviation, modification, or changes to the approved design drawings. During the field testing/cut-over period, obtain the approval of the Engineer's representative on site for any deviations, changes, or modification to the design drawings.

Qualifications and Duties of Signaling Personnel

Refer to Special Provision, Contractor Qualifications and Requirements. Key employees of the Contractor engaged in the final adjustment and testing of the various signaling systems shall be qualified and have had experience on an operating railroad in the type and level of signal installation and testing work as required herein.

Signal Engineer as used herein shall be understood to mean Contractor's railroad signal engineer or engineers approved by the Engineer. Signal Manager as used herein shall be understood to mean Contractor's railroad signal manager or managers approved by the Engineer. Signal Electrician, as used herein, shall be understood to mean Contractor's electricians used to perform wiring and installation of railroad signal and grade crossing warning system circuits, component, and control equipment and devices including their primary and backup power supply systems.

Signal construction and installation personnel shall work under the authority of the Signal Engineer. The Contractor's signaling construction forces shall work under the authority of a Signal Engineer.

Signal Engineer shall plan, direct, and oversee the adjustment, installation, and testing of signal related work and shall coordinate signal work with related track construction work and roadway work.

Signal Engineer shall be responsible for work under his charge and must have the authority to remove personnel from the project who are not performing the work in a satisfactory manner. The Signal Engineer shall obtain, review, and maintain documentation of the required minimum experience, a copy of the Electrician's licenses, and a record of wage rate paid for each Signal Electrician that performs Signal or Crossing Warning System work prior to that Electrician starting any Signal related work. This documentation shall be available for review by the Engineer upon request.

Signal Engineer shall be on site whenever signal related work or track construction work is in progress in the vicinity of existing wayside signaling equipment, highway grade crossings, and/or cabling.

The Signal Managers shall report to and work under the direct authority of the Signal Engineer and shall supervise and direct the work of signal construction and installation personnel.

Signal Engineer shall direct and organize the performance of tests on signaling equipment and systems, under direction of the Engineer, prior to releasing the systems for service. The Signal Engineer shall be responsible to ensure that applicable test documentation other than that documentation provided by the Engineer, is completed prior to, or immediately after, in-service testing is completed.

The proposed Signal Engineer shall demonstrate experience in the philosophy, application, and testing requirements of the various signaling systems. The proposed Signal Engineer shall have a minimum of 10 years signal supervisory or management related experience on a Class I railroad, or commuter railroad comparable to SCRRA. The proposed Signal Engineer shall also demonstrate knowledge of the governing General Code of Operating Rules, including CPUC and FRA regulations and procedures. This demonstration shall be by interview of the proposed Signal Engineer by the Engineer prior to commencement of any work that may affect the signal system. The work of this project includes working within tight windows on a live railroad consisting of freight trains, inter-city passenger trains, and Metrolink commuter trains. Candidate shall have a similar level of experience. The Engineer's decision concerning the candidate's qualifications will be final. Begin no signaling related work prior to obtaining Engineer's approval of the Signal Engineer. In addition, obtain the Engineer approval of each Signal Engineer prior to beginning any work that may affect the signal system. Obtain approval of and provide additional Signal Engineers as required depending upon the level and type of work being performed. Propose alternate personnel if the original candidate is found unacceptable.

The proposed Signal Managers shall demonstrate experience in the philosophy, application, and testing requirements of the various signaling systems. The proposed Signal Managers shall have a minimum of 3 years signal supervisory or management related experience on a Class I railroad or commuter railroad comparable to SCRRA. The proposed Signal Managers shall also demonstrate knowledge of the governing General Code of Operating Rules, including CPUC and FRA regulations and procedures. This demonstration shall be by interview of the proposed railroad Signal Managers by the Engineer prior to commencement of any work that may affect the signal system. The work of this project includes working within tight windows on a live railroad consisting of freight trains, inter-city passenger trains, and Metrolink commuter trains. Candidates shall have a similar level of experience. The Engineer's decision concerning the candidate's qualifications will be final. Begin no signaling related work prior to obtaining the Engineer's approval Signal Managers. Obtain approval of and provide additional Signal Managers as required depending upon the level and type of work being performed.

Propose alternate personnel if the original candidate is found unacceptable. Previous qualification as a Signal Engineer or Manager on other Metrolink projects does not constitute qualification as a Signal Engineer or Manager for this Contract.

The Engineer reserves the right to disqualify a Signal Engineer, Signal Manager, or Signal Electrician during the course of the Work at the discretion of the Engineer and is not subject to protest or appeal.

The Signal Electricians shall have a minimum 1,000 hours of experience in the wiring and installation of railroad signal and grade crossing warning system circuits, components, control equipment and associated devices including their primary and backup power supply systems. Signal Electricians shall perform the wiring, labeling and connection/continuity/resistance testing, as appropriate, of railroad signal and grade crossing warning system circuits, components, control equipment and associated devices including their primary and backup power supply systems. Signal Electricians shall be licensed: Journeyman or Inside Electricians or an approved equal. Signal Electricians shall be paid at the prevailing wage rate for the locality of the construction.

Contractor field personnel shall receive safety training in accordance with Special Provisions, Contractor Qualifications and Requirements, SCRRA Site Safety Requirements, and Worksite Security Requirements.

Quality Control and Assurance

Not Used.

MATERIALS

Deliverables

Submit manufacturers' warranties, instruction sheets, and part lists supplied with materials to the Engineer prior to Final Acceptance.

Operation and Maintenance Data: As specified in Special Provision, Submittal Procedures, for Operations and Maintenance Data Manual requirements. A minimum of 30 days prior to placing a system in-service, submit to the Engineer 10 sets of application, installation, operating, and maintenance manuals of new equipment and systems

utilized under this Contract which are provided by the Contractor. Include complete material ordering reference numbers for each type of product.

Warranty

Provide warranties for all equipment and material covering parts and labor for 2 years from the date equipment or material is "placed in service".

Equipment – General

Signaling materials and equipment shall be the products of manufacturers regularly engaged in the production of such material and equipment and shall be the manufacturer's latest design. The materials and equipment shall have shown proven performance in North America for a minimum of 5 years. Materials and equipment shall be delivered to the job-site in unbroken packages, reels, or other forms of containers.

Materials and equipment shall conform to the recommendations of AREMA Signal Manual, except as modified in the Specifications and railroad plans.

Reference to specific equipment and manufacturers is intended to establish quality, overall design, and fit, subject to compliance with criteria specifications. Equipment equal to or exceeding the specifications and requirements may be used subject to the Engineer's written approval. If alternate equipment is accepted, perform necessary work to fit the alternate equipment to these specifications and to revise the railroad plans.

Electrical and Electronic Components

Design and construct fusing of DC power supplies and circuitry according to the following requirements:

1. Circuit breakers and fuses shall be the correct side-band rating for circuit current interruption and shall protect the electrical equipment and circuits from short-term and long-term overloads.
2. Fuses shall be sized to protect the wire.
3. Fuses shall be in the positive leg of the power supply.
4. Fuses shall be of the nonrenewable indicating type.
5. Branch feeds for a circuit shall be from the same fuse.
6. Fuses shall be no smaller than 5 amperes unless otherwise shown on the Drawings.
7. Loads shall be divided so that no normal operating current is more than 75 percent of the fuse rating.
8. Fusing shall be functionally oriented to minimize the equipment affected by a blown fuse (i.e., per track, switch control circuits, etc.)
9. Fuse clips shall be constructed to retain their resilience under installation and service conditions and to ensure a positive contact between the clips and the fuse.

Printed Circuit (PC) Cards and Connectors:

The PC cards shall be mounted in 19-inch card files unless otherwise approved by the Engineer.

The PC wiring shall be organized so that wires serving the same function shall be connected to the same terminal of PC cards. PC cards containing the same circuitry and programming, where applicable, shall be interchangeable between subsystems.

The design and construction of PC cards of the same subsystems shall be the same. Cards of different subsystems shall be of the same design and construction wherever practicable.

PC cards shall be of glass epoxy construction. Card material shall meet the requirements of NEMA, Type FR-4. Cards shall have sufficient thickness to permit easy insertion and removal, and shall be physically keyed to protect against incorrect interchange. Circuits shall be formed by etching. Conductor material shall be copper and shall be protected from exposure to air.

PC cards containing components that may be damaged if a plug connector or plug-in unit is removed while the equipment is energized shall be clearly identified in the equipment maintenance manual. PC cards shall be marked or labeled with a warning note on the individual board, be conspicuously located on the module, or by an alternate means as approved by the Engineer. A means shall be provided to remove power from the module or card file.

Components mounted on the PC card, weighing more than 1/2 ounce or with a displacement of more than 1/2 cubic inch, shall have a mechanical supporting attachment to the card separate from electrical connections.

Do no stacking or piggybacking of PC sections to accomplish changes or modifications to wiring or components on printed circuit cards.

Connectors shall have plating with a minimum thickness of 0.00005 inch.

Printed Circuit Card Files:

There shall be not more than one type of card file for each size of PC card. The card file plug boards shall be registered to agree with the registry of the associated PC card. PC cards shall not project beyond the front of the equipment rack when mounted in the card file.

Card files shall be installed in dust-proof cabinets and protected with dust covers.

Insulated cable clamping devices shall be located on the back of the file in such a way that wires terminating in the files shall be installed in a neat and secure bundle, rigidly supported, and protected to prevent chafing of insulation. Cabling provision on the file shall permit wires to enter or leave the file from both the right and left sides. Such cabling shall not restrict access to the card file when the rear covers of the card files are removed.

Shop Finishes

Factory finish signal equipment with the exception signal system parts which are stipulated as field finished in AREMA C&S Manual, Part 1.5.10, and aluminum alloy and galvanized metal components. If manufacturer typically provides factory painted finish for aluminum alloy and galvanized components, include such information in equipment submittals for Engineer's acceptance.

Finishes shall comply with AREMA C&S Manual, Part 1.5.10, signal equipment manufacturer's standards, and provisions specified herein. It shall be understood that where AREMA C&S Manual, Part 1.5.10, uses the word "should" that the word "shall" shall be substituted except as accepted by the Engineer in writing.

1. Finish terminal boards and interior of shelters with white gloss fire retardant paint.
2. Factory finish signal equipment with aluminum paint except as otherwise specified herein and in AREMA C&S Manual.
3. For signal system parts which AREMA C&S Manual stipulates as shop primed and field finish, shop prime in accordance with requirements specified in Special Provision, Paints and Coatings and Special Provision, Graffiti Resistant Coating.
4. For signal system parts which AREMA C&S Manual stipulates to receive shop prime and finish coats followed by field finish coat, coordinate shop finish coat with field finish as specified in Special Provisions, Paints and Coatings and Graffiti Resistant Coating.

CONSTRUCTION

Field Paint Materials

Field finish as specified in Special Provisions, Paints and Coatings and Graffiti Resistant Coating and AREMA C&S Manual, Part 1.5.10. Exterior surfaces shall receive heavy duty finish system.

Touch-up Paint for Signal Manufacturer Finishes: Touch-up paints recommended by signal manufacturer, including aluminum touch-up paint.

As-Builts Documentation

Refer to special provision, Project Record Documents, for requirements preparation and submittal of Record Documents.

The following as-built documentation requirements augment requirements specified in Special Provision, Project Record Documents. After a location is placed in service, submit as-built documentation as follows:

1. Detailed circuit drawings within 3 days.
2. Submit four copies of as-built corrections to the Engineer within 3 days.
3. Railroad Plans which show the physical location of signal apparatus and conduits, along the tracks and perpendicular to it, and heights of signal structures within 60 days.

Annotate the As-Built drawing sets to show approved circuiting and wiring changes made during installation and testing of the location prior to placing it in service, and approved changes made after placement in service. Clearly identify changes on the drawings using the "Red In"/"Yellow Out" convention. Changes shall be dated and initialed by the Contractor's responsible Signal Engineer. Identify the date that the location was tested and placed in service in the revision block of the drawings.

In addition to the as-built drawings provided to the Engineer, one set shall be bound and shall be kept in the instrument enclosure at a location and manner approved by the Engineer. As-built drawings shall be clean and legible. The as-built drawings shall not be removed from the field location after the location is placed in service without the prior written approval of the Engineer.

The final as-built drawings shall be 11 inches by 17 inches, unless authorized by the Engineer to substitute another size.

Circuits that continue on another drawing shall be annotated with drawing number and routing information for the continuation of the circuit.

The circuit drawings shall show individual circuits. Typical circuits will not be accepted.

The location plans shall show cable installed with the number of conductors, the size of conductors, the type of cable, termination points of conductors, and the circuit on each conductor. Separate cable plans shall be drawn if cable information cannot be shown in a neat and organized manner on the location plans.

The shop drawings shall be detailed equipment drawings for each type of equipment installed.

Track Availability Requirements

Refer to Special Provision, Maintenance and Protection of railroad Traffic for track access and related provisions. Metrolink Commuter Service and any other passenger or freight service may not be interrupted by the Work of this Contract, except as provided in the Contract Documents.

Signal Cutovers may be required under traffic. Signal Cutovers under traffic will require coordination between the Contractor, Metrolink, other railroad, as applicable, and the Operating railroad of Record to keep train delays to a minimum.

Installation

Contractor shall make necessary modifications to the existing signal system, protect or relocate existing cabling, signals, switches, and signal shelters; and modify associated signal and highway grade crossing systems to ensure the existing signal system operates as intended during construction and installation of the new signal system. Protect operating signal and highway grade crossing systems to ensure train operations are not interrupted and safety is maintained.

Contractor shall take no action which will violate rules or regulations as specified by CFR 49, the General Code of Operating Rules, timetable instructions, general order, bulletin, or special instruction; which will reduce the integrity of the signal system; or endanger railroad personnel, the public, or employees.

Equipment installation shall be in accordance with the SCRRRA Design Standards.

Ensure that equipment within the instrument shelters and relay cases is securely anchored or otherwise fastened in enclosure upon completion of enclosure installation. Securing equipment shall not negate the requirements to maintain isolation between ground systems as otherwise called for in these Specifications.

An updated, detailed set of the approved signal design drawings shall be kept at the each field location for equipment as it is placed in-service.

FIELD FINISHES AND TOUCH UP

For signal system parts which AREMA C&S Manual, Part 1.5.10, stipulates as shop primed and field painted, field finish as specified in Special Provisions, Paints and Coatings and Graffiti Resistant Coating and AREMA C&S Manual, Part 1.5.10, including requirement to apply one field coat prior to field assembly and one field coat following field assembly.

COST BREAK-DOWN

The Contractor shall furnish the Engineer a cost break-down for the contract lump sum items of install railroad signaling. Cost break-down tables shall be submitted to the Engineer for approval within 15 working days after the contract has been approved.

Attention is directed to "Time-Related Overhead" of these special provisions regarding compensation for time-related overhead.

Cost break-downs shall be completed and furnished in the format shown in the samples of the cost break-downs included in this section. Line item descriptions of work shown in the samples are the minimum to be submitted. Additional line item descriptions of work may be designated by the Contractor. If the Contractor elects to designate additional line item descriptions of work, the quantity, value and amount for those line items shall be completed in the same manner as for the unit descriptions shown in the samples. The line items and quantities given in the samples are to show the manner of preparing the cost break-downs to be furnished by the Contractor.

The Contractor shall determine the quantities required to complete the work shown on the plans. The quantities and their values shall be included in the cost break-downs submitted to the Engineer for approval. The Contractor shall be responsible for the accuracy of the quantities and values used in the cost break-downs submitted for approval.

The sum of the amounts for the line items of work listed in each cost break-down table for railroad signaling work shall be equal to the contract lump sum price bid for install railroad signaling, respectively. Overhead and profit, except for time-related overhead, shall be included in each individual line item of work listed in a cost break-down table.

No adjustment in compensation will be made in the contract lump sum prices paid for install railroad signaling due to differences between the quantities shown in the cost break-downs furnished by the Contractor and the quantities required to complete the work as shown on the plans and as specified in these special provisions.

Full compensation for general signal requirements shall be included in the lump sum price for install railroad signaling and no additional compensation will be allowed therefor.

INSTALL RAILROAD SIGNALING COST BREAK-DOWN

Contract No. 07-1218W4

UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
Demolition and Removal of Existing Equipment Including Retiring CP Brighton, Buena Vista Street Crossing, Intermediate Signal Locations, Existing Gates, and Cabling.	LS	Lump Sum		
Furnish, Install, and Commission Antennas for Communication to Operations Center	EA	4		
Update and then Retire CP Brighton Communications to Operations Center	LS	Lump Sum		
Furnish and Install 2c # 6 Twisted Track Wire	LF	4900		
Furnish and Install 7c # 6 Twisted Track Wire	LF	5900		
Furnish and Install 7c # 14 Twisted Track Wire	LF	2200		
Furnish and Install 12c # 14 Twisted Track Wire	LF	6700		
Furnish and Install 3c # 6 Twisted Track Wire	LF	750		
House Wiring Changes and Cable Hookups in New Houses	EA	729		
House Wiring Changes and Cable Hookups in Existing Houses	EA	235		
Furnish and Install Signals and Foundations on Flyover (VY 12.74)	LS	Lump Sum		
Furnish and Install Signals and Foundations on Shoofly (VY 12.76)	LS	Lump Sum		
Furnish and Install Signals and Foundations between Arvilla St. and Sunland Blvd. (VY 14.40)	LS	Lump Sum		
Furnish and Install Signals and Foundations at CP Hollywood (VY 13.30)	LS	Lump Sum		
Transport, Install, and Test State Furnished Crossing and Signal Shelters	EA	5		
Relocate Case "B" 6'9" Crossing case at Buena Vista Street	LS	Lump Sum		
Transport, Install, and Test State Furnished Switch Machine and Layout	LS	Lump Sum		
Furnish, Install, and Test Track Connections and Bonds	EA	60		
Transport, Install, and Test State Furnished Roadway and Pedestrian Gates	EA	8		
Relocate Roadway and Pedestrian Gates during Buena Vista Staging	EA	2		
Furnish and Install Conduit in Duct Bank	LF	85000		
Furnish and Install Conduit Under Roadway	LF	1900		
Furnish and Install Conduit Under Tracks	LF	280		
Furnish and Install Conduit (General)	LF	8300		
Furnish and Install 4' x 4' Pull Boxes	EA	55		
Furnish, Install, and Test Flasher Unit for Intermediate Staging at Buena Vista Street	EA	1		

UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
Support During Signal Cutovers	LS	Lump Sum		
Furnish, Install, and Test Track and Gate Pull Boxes	EA	16		
Furnish, Install, and Test Miscellaneous Signal Equipment in Houses	LS	Lump Sum		

14-1.07 COORDINATION WITH SCRRRA PROCUREMENT CONTRACTOR

GENERAL

Summary

This Section includes requirements coordinating installation, inspection, and testing of new Owner furnished material with the Engineer and with the Owner's procurement contractor. Notify the Engineer in writing a minimum of 30 days prior to any installation, inspection and testing of such material.

Refer to Special Provision, SCRRRA Furnished Material and Equipment, in the paragraph "Materials furnished by the Authority".

Definitions

Not Used

Submittals

Submit Acceptance Test Procedure documentation on Owner Furnished Equipment prior to transport of the equipment.

Quality Control and Assurance

Not Used

MATERIALS

Source Quality Control

Test all Owner-furnished equipment before transporting it to the job site. Conduct this acceptance testing for equipment in accordance with the Contractor's Acceptance Test Procedure. Prior to transportation, submit a copy of the documentation of acceptance testing to the Engineer.

Warranty

Because the manufacturer's warranty for Owner-furnished material begins upon transfer of custody of the material, supplement the manufacturer's warranty for the amount of time elapsed between acceptance of the material and final cutover and as required under General Conditions, Warranty of Work. The supplemental warranty shall include costs to repair or replace material which is damaged while in Contractor's care or fails prematurely and as required under General Conditions, Warranty of Work. Make arrangements for and pay costs of such repairs performed by and replacements provided from the original equipment manufacturer.

CONSTRUCTION

Not Used

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefor.

14-1.08 SIGNAL WIRE AND CABLE

GENERAL

Summary

This Section includes requirements for cable and wire required for signal and signal power system wiring to wayside shelters, junction boxes, and factory wired mechanisms.

Definitions

Material and workmanship shall be of the highest quality, assuring durability for minimum life expectancy of 40 years. Cables shall be suitable for use in the environment to be encountered on a railroad signal system, and shall be certified for continuous operation, in wet or dry locations, with no conductor failing in continuity or with loss of insulation to cross or ground less than one mega ohm.

Submittals

Product Data: Manufacturer's catalog cuts, material descriptions, and specifications for each type of wire and cable the Contractor proposes to provide.

Quality Assurance: Submit a list of cable manufacturer's installations complying with the past performance and experience requirements specified herein.

Quality Control and Assurance

Cable manufacturer's qualifications shall be as follows:

1. Past Performance and Experience: Demonstrated previous successful experience in supplying cable to the railway or transit industry for use as vital signal control cables. A list of such installations shall be provided for each cable manufacturer to be considered.
2. Quality Assurance Program: The manufacture of cables in accordance with the requirements of these specifications shall be accomplished in compliance with a Quality Assurance Program that meets the intent of ISO 9001.

MATERIALS

Internal Wire and Cable

Individual cable make-up and conductor sizes shall be as shown on the railroad plans.

Internal wire and cable shall conform to AREMA C&S Manual, Part 10.3.14, and the following requirements:

1. Solid conductors shall be Type I in accordance with AREMA C&S Manual Part 10.3.14.
2. Stranded conductors shall be Type II in accordance with AREMA C&S Manual Part 10.3.14.
3. Internal wire and cable insulation shall conform to AREMA C&S Manual Part 10.3.24 and the following requirements:
4. The minimum insulation rating shall be 600 volts.

External Wire and Cable

General

Individual cable make-up and conductor sizes shall be as shown on the railroad plans.

Conductors shall be soft or annealed copper, coated with tin in accordance with Type I wire as shown in the applicable AREMA C&S Manual Part.

Stranded conductors shall be soft or annealed copper, coated with tin in accordance with Type II wire as shown in the applicable AREMA C&S Manual Part.

Track Wire

Track wire shall be Okonite-Okolene (EP-PE) manufactured by Okonite Co., or approved equal.

Track wire shall meet the requirements of AREMA C&S Manual, Part 10.3.15.

Signal, Switch, and Express Cable

Wire and cable used for signals, switches and express cable shall be Okonite (EP) Armored Underground Signal Cable manufactured by Okonite Co., or approved equal.

Conductors number six (#6AWG) and smaller shall be solid. Conductors number 4 (#4AWG) and larger shall be stranded.

Armored cable shall be furnished with a 10-mil flat bronze tape between the conductors and the outer jacket, helically applied, and adequately cushioned from the conductors.

Armored cable shall meet the requirements of AREMA C&S Manual, Part 10.3.17.

AC Power Cable

AC power shall be Okonite-FMR (EP) Okolon(CSPE) Type TC Cable manufactured by Okonite Co., or an approved equal.

Cable shall meet the requirements of AREMA Signal Manual, Part 10.3.16.

Modem Cable

Modem cables shall be C-L-X Type SP-OS manufactured by Okonite Co., or approved equal.

Modem cable shall be protected by moisture impervious, continuously welded, corrugated, aluminum sheath with an overall EFTE fluoropolymer jacket.

Individual twisted pairs shall be separately shielded with an aluminum polyester tape to provide shield isolation between pairs of 100 mega ohms per 1000 ft. minimum.

Source Quality Control

Coordinate with the Engineer for Engineer's inspections and tests at point of production. The Engineer shall have the right to make inspections and tests, as necessary, to determine if the wire or cable meets the requirements of this Specification. The Engineer shall have the right to reject wire or cable that is defective in any respect.

Provide, at the point of production, apparatus and labor for the following tests:

1. Conductor size and physical characteristics.
2. Insulation HV and IR tests.
3. Physical dimension tests.
4. Special tests on materials in coverings.
5. Final HV, IR, and conductor resistance tests on shipping reels.

Delivery, Storage, and Handling

Shipping, storage, and handling shall be in accordance with AREMA Signal Manual, Part 10.4.1.

During storage and handling, prior to final conductor termination, cable ends shall be sealed to prevent the entrance of moisture.

CONSTRUCTION

Installation

General

The installation of wire and cable shall conform to AREMA C&S Manual Parts 10.4.1, 10.4.30, except as specified herein.

External cable runs shall be in conduit in accordance with the Metrolink Standard Drawings, and as called for in the railroad plans.

The Contractor shall separate signaling cables from parallel run of ac feeder cables, where adjacent locations are fed from one ac service location.

Give the Engineer 24 hours notice prior to installing cables.

Provide sufficient slack in cable conductors at terminating posts to enable 3 terminations of the conductor, due to broken eyelets without re-servicing or re-pothedding the cable.

In certain types of installation, the cable cannot be constrained; therefore, ample cable slack shall be provided for additional flexibility due to vibration of such equipment.

Do not bend cables to a radius less than manufacturer's recommendation.

Distribution cable runs shall be continuous without splices between cable terminating locations. Express cable runs longer than cable lengths shall be spliced together in junction box, instrument case, or other acceptable shelter. Prior to cable or wire splicing, obtain the Engineer's approval. Approval will not be granted for cables damaged by the Contractor or vandalized by others. It is the responsibility of the Contractor to protect cables until final installation.

Identify individual cable conductors at each cable termination with plastic tags, as specified in Special Provision, Signal Systems Miscellaneous Products. Identify and terminate spare conductors in each cable.

Seal cable entrance openings in equipment enclosures and junction boxes with compression type fitting or pliable sealing compound after the cable is in place. Use sealing compound to seal the area around cable where the cable emerges from the end of a conduit or pipe. Seal and plug spare conduits.

Wherever multiple conductor cables are terminated, carefully remove the outer sheath of the cable to a minimum point of 3 inches from the cable entrance. At the end of the cable sheath or covering, apply 2 layers of plastic electrical tape.

Terminate cable conductors in conductor sequence from top to bottom.

Cable shields or sheaths shall be grounded at the entrance to signal shelters and shall float when terminated in field apparatus.

Underground Buried Installation

Cables shall not cross one another when they are pulled into a conduit or pipe; the conductors shall not be pulled tight or kinked in conduit fittings or boxes. Cables to be installed in a conduit or pipe shall be pulled and installed simultaneously.

Cables except final connection of flex wires to rail shall be installed in a conduit system as shown on the railroad plans.

Special Protection

Provide appropriate special protection for cables in areas where the cables are unavoidably exposed to hazardous conditions, such as vibration or sharp corners on equipment. Replace cable that is installed but subsequently damaged prior to acceptance as a result of the Contractor's failure to provide special protection.

AC Power Cable

AC power cable shall be installed in dedicated conduit from the service meters to the signal shelters and between signal shelters.

Repair

Immediately call to the Engineer's attention any instance of damaged cable observed at any time, whether prior to installation, occurring during construction, or discovered by test observation after installation. The method of correction shall be in accordance with the Engineer's written instruction. Promptly repair such damage.

Field Quality Control

Test installed external cable in accordance with the requirements as specified in Special Provision, Signal Systems Testing, and AREMA C&S Manual, Part 10.4.30.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.09 INTERLOCKING CONTROL

GENERAL

Summary

This Section includes requirements for installing, testing, and documenting Owner-furnished pre-wired vital microprocessor based interlocking controller racks and local control panels that provide the functionality shown on the railroad plans.

Final application logic programs, including EPROMS will be furnished by the Owner.

Definitions

Not Used

Submittals

Submit a narrative explanation of the electrical and/or mechanical methods of configuration control used to ensure that the application logic software installed is the correct software for the specific location and that it is the latest version. It shall explain Contractor's procedures for handling components of the vital interlocking controller.

Submit certified acceptance reports.

Submit test reports and verification of tests as described herein under Testing.

Quality Control and Assurance

Install and test the interlocking controller and local control panel (LCP) so as to conform to and provide applicable requirements of CFR 49, Part 236, and AREMA C&S Manual Part 2.2.10.

MATERIALS

Solid State Microprocessor Interlocking Controller

Controller shall be a Vital Logic Controller (VHLC) manufactured by GETS.

The interlocking controller shall be capable of operating 12 VDC vital and non-vital relays. A minimum of 8 vital inputs and 8 vital outputs shall be grouped on a single I/O module. Each module used exclusively for vital inputs shall accommodate a minimum of 16 inputs.

The vital lamp driver module provided to operate wayside signal lamps shall be capable of directly driving a minimum of 16 each 10 VDC, 18 watt or 25 watt lamps through isolated lamp driver outputs for on, off, and flashing. Flashing shall be at a nominal rate of 55 flashes per minute. Controller shall provide tumble - down indications based upon light out detection using both hot and cold filament checking.

Controller chassis shall be designed to house a minimum of 12 modules. Three slots shall be reserved for modules that control and process vital and non-vital application logic and communications. The remaining slots shall be designed to house any user defined configuration of input/output, lamp driver, and operating modules.

Plug connectors shall be keyed for each module type to ensure only the proper module can be connected. Plug connector cables shall be color-coded. No color code shall be repeated in a single plug connector.

The interlocking controller shall have the capacity to directly connect, via a cable, to a chassis that will generate and receive Electro Code 4 and Electro Code 5 track codes without use of relay interfacing.

The interlocking controller must be capable passing vital data, via a serial connection, to existing VHLC units utilized on SCRRRA properties.

The software associated with assuring the vitality of the system shall be an inherent part of the basic controller system and shall not be accessible for modification by the user. Changes to the application logic installed in the system shall not require re-verification of the software associated with assuring system vitality. The application logic shall be protected so that it is user modifiable by authorized personnel only.

The program compiler used in developing the site-specific application logic software shall be designed to allow the user to construct individual equation logic equations utilizing "ladder-logic" display elements. Reports generated by the compiler shall provide the user with a complete and detailed description of the system configuration including, but not limited to, module location assignments, internal timer settings, auxiliary input/output assignments, vital lamp output assignments, CTC control and indication bit assignments, electronic track code circuit assignments, data recorder equation selection, remote input/output assignments, and module plug-connector pin assignments.

The interlocking controller shall provide event recording. The event recording shall be designed so that the correct time is maintained when the vital logic and/or code system equipment is reset or powered down. The event recording equipment shall have sufficient storage capacity to store a minimum of 72 hours of events, without overwrite, at the interlocking, recording user selected status changes along with diagnostically important internal status changes.

The interlocking controller shall provide mitigation for "processor failure" via a fall back relay.

The interlocking controller shall interface with the solid-state track circuit detailed in Special Provision, Solid - State Coded Track Circuits.

The failure of an output shall not cause loss of functions not associated with those of the failed module.

The interlocking controller shall operate from a standard 12 VDC signal battery supply. Any special power supply filtering devices required for reliable operation shall be provided as part of the system.

The interlocking controller shall, at a minimum, enable a user to generate the following reports:

1. Configuration report that, at a minimum, indicates controller location, revision history, controller/software identification (chassis identification), chassis slot assignments, application software identification (Eprom crc/checksum), each vital and non-vital input/output assignment and nomenclature, each lamp driver vital output assignment and nomenclature, track code input/output assignment and nomenclature, serial and remote input/output assignment and nomenclature, vital timer configuration and time settings, and equation data recorder logging assignments.
2. Logic equation report that displays application logic equations in a ladder-logic format.
3. Cross-reference report that displays status names used in each logic equation.
4. Revision history report.
5. Real-time data logging that displays, on a user furnished computer display, changes in logic equation status.

Custom Local Control Panel (CLCP)

Local Control Panel (LCP) shall be a Custom Local Control Panel (CLCP). CLCP shall be provided by SCRRA and installed by the Contractor after instrument enclosures have been delivered to the SCRRA.

Delivery, Storage, and Handling

Package plug in modules for shipment separately from their card cage units using ESD safe packaging. Protect each item from damage or loss during handling and shipment.

Clearly identify each controller unit, LCP, and their associated components on the packing crate, referencing its intended location.

Warranty

Provide warranty from defects arising from improper handling for 2 years from the first date of service.

CONSTRUCTION

Preparation

Ensure that test and specialized installation equipment recommended by the manufacturer to make any readings or adjustments is in the Contractor's possession and within the project limits a minimum of 30 days prior to installation.

Installation

Wire and install the microprocessor-interlocking controller and the LCP in accordance with rack layout provided in the railroad plans.

Load programmable and configurable modules with application software and perform any configuration necessary.

Field Quality Control

Conduct tests as specified in AREMA C&S Manual Parts 2.4.1 and 7.4.1 to ensure proper operation of the signal and grade crossing warning systems.

Conduct tests to ensure that the signal system conforms to CFR 49, Part 236.

Conduct tests required under Special Provision, Signal Systems Testing.

Testing, including pre-testing, shall include operating switch machines and lighting signals. The use of lamp simulators in lieu of, or in parallel with, signal lamps will not be allowed in pre-testing. An exception may be authorized by the Engineer where a signal or switch machine is in service and will be reconfigured for final cutover or cannot be installed or wired until final cutover.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefor.

14-1.10 SOLID-STATE CODED TRACK CIRCUITS

GENERAL

Summary

This Section includes requirements for furnishing, installing, testing, and documenting solid-state track circuit elements.

Final application logic programs will be furnished by the Owner.

Definitions

Not Used

Submittals

Submit a narrative explanation of the electrical and/or mechanical methods of configuration control used to ensure that the application logic software installed is the correct software for the specific location and that it is the latest version. It shall explain Contractor's procedures for handling components of the solid-state track circuit equipment.

Submit certified acceptance reports.

Submit test reports and verification of tests as described herein under Testing.

Quality Control and Assurance

Install and test the solid-state track circuit equipment in accordance with applicable requirements of CFR 49, Part 236 and the AREMA C&S Manual, Part 8.1.2.

Perform operational testing of the equipment in accordance with the requirements specified in Special Provision, Signal Systems Testing.

MATERIALS

Electronic track circuits shall be compatible with highway grade crossing constant warning devices. Utilization of bi-directional, uni-directional, and auxiliary crossing control functions shall be provided per railroad plans and manufacturer's specifications. Track filters shall be installed in track leads, as shown on the railroad plans.

Where new equipment is to be furnished and installed in existing locations, the equipment furnished shall be the same make as called for in the Contract Documents.

Track circuit shall function to provide continuous train detection throughout the length of the circuit whenever a shunt of 0.06 ohms is applied to the rails, including the turnouts.

Furnish specialized test or calibration instruments, equipment, or tools that may be needed to test and place in-service the equipment installed under this Section, as shown on the railroad plans. Ensure tests and diagnostic equipment are in the Contractor's possession and within the project limits a minimum of 30 days prior to installation.

Electro Code 5, with Alternating Code 5, manufactured by GETS.

Provide a solid-state electronic coded track signal system to determine block occupancy and to pass signal aspect information from one interlocking or signal location to the next. The system referenced herein is Electro Code 5 (EC-5).

The electronic coded track circuit shall be user programmable to provide application logic changes as needed. The application program shall be specified on the release. The Contractor shall furnish the program specified with each electronic coded track circuit system.

The electronic coded track circuit unit shall be configurable for transmission/reception of the track circuit and signal codes over track.

The coded track circuit unit shall have available a minimum of 6 discrete code rates for vital signaling indication in addition to a code rate used for train detection. An additional code rate shall be available for reversal of the code transmission/reception signal orientation. Track circuit shall have 2 codes used to convey non-vital block information. Electrocode IV code rates are presently used on Metrolink with Alternating Code 5. Coded Track Circuit must be able to communicate on the rails with existing Electrocode without requiring any interface equipment.

Event recorder modules for electronic track circuits shall be provided as shown on the railroad plans.

Electronic coded track circuits shall conform to the requirements of the AREMA Signal Manual, Section 8.1.2, where these instructions and requisites are applicable and do not conflict with these Specifications.

Conduct an acceptance test on Owner-furnished units prior to loading at the warehouse.

Conduct acceptance testing of components before transporting from the warehouse and installing. Provide certified acceptance reports at time of delivery.

Delivery, Storage, and Handling

Ship the solid-state modules separately from the wired card cages. Package modules individually in ESD safe packaging, in a sturdy carton with the type of module printed on the outside of the carton.

Package plug-in modules for shipment separately from their card cage units using ESD safe packaging. Protect each item from damage or loss during handling and shipment.

Application Logic

The Owner will provide the application logic for each programmable module upon demonstration of readiness for pretest. This application logic will provide the functionality as shown in the railroad plans and shall conform to CFR 49, Part 236. Where specified in the Contract Documents, the Contractor shall furnish the program specified to the manufacturer for factory testing and certification.

CONSTRUCTION

Installation

Install solid-state coded track circuits at locations indicated on the railroad plans.

Install the solid-state track circuit equipment in signal instrument shelters or cases as shown on railroad plans.

The solid-state track circuit equipment layouts shall provide for easy access to test points, indicators, and adjustments.

Install equipment in accordance with the manufacturer's installation and adjustment procedures.

Testing

Conduct tests as specified in AREMA C&S Manual Parts 2.4.1, 3.3.1, and 7.4.1 to ensure proper operation of the signal and grade crossing systems.

Conduct tests to ensure that the signal system conforms to CFR 49, Part 236.

Conduct tests required under Special Provision, Signal Systems Testing.

Testing, including pre-testing, shall include operating any hand throw switches and lighting signals. The use of lamp simulators in lieu of, or in parallel with signal lamps will not be allowed in pre-testing.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.11 SIGNAL LAYOUTS, STRUCTURES AND FOUNDATIONS

GENERAL

Summary

The work of this Section shall include disassembling, relocating and installing existing or new signals.

Signal layouts, as specified herein, shall consist of foundations, signal heads and structures including cantilevers, bridges, ground mounted masts, ladders, platforms, and mounting hardware required to construct signals.

Contractor shall furnish and install signals as shown on the railroad plans at existing and new signal locations.

Definitions

Signal Foundation Structure: Provide for the foundation structure type selection and its design. The design of the signal foundation's structure and stability shall be in accordance with the AASHTO LTS-4. Design calculations shall be prepared by a licensed California professional civil engineer with a minimum of 5 years experience in the design of similar foundation structures.

Signal aspect shall be distinct and unmistakable when viewed from a height of 7 to 12 feet above top of rail at a distance of 1,000 feet. Nominal sighting distance shall be 2,000 feet. Where unobstructed sighting distance for a standard signal arrangement is less than 2,000 feet, supply and install color light LED signal and adjust the signal head for the maximum sighting range possible. Provide to the Engineer with written notification with any sighting problems and location of where spread or wide-angle lenses are installed.

Submittals

Submit shop drawings for each type of signal unit and each type of signal layout to the Engineer for approval. Show ladders, masts, bases, arms, and required mounting hardware. Show location and method of mounting the signals to the structure.

Provide necessary dimensions, hardware, method of mounting signal structures, and material specifications for items to be furnished.

Submit shop drawings for each type structure foundation.

Submit Installation Procedure for approval by the Engineer. The procedure shall include a detailed description of installation activity and sufficient detail to allow the Engineer to determine the validity of the installation procedure.

Submit design calculations for the signal cantilever/bridge foundation.

Quality Control and Assurance

Signals, structures, and related hardware shall meet the requirements of AREMA C&S Manual, Section 7, and applicable portions of Manual Part 3.2.5 where they do not conflict with any requirements specified herein.

Inspect each signal layout after it has been installed in the field. This inspection shall conform to the Contractor's Installation Procedure as accepted by the Engineer.

Foundations shall meet requirements of AREMA C&S Manual Parts 14.1.1.A through 14.4.36 inclusive, where requirements of the AREMA Specifications do not conflict with any requirements specified herein.

MATERIALS

Furnish LED color light signals, as indicated in the Contract Documents. Signals shall be in accordance with Metrolink Standard Drawings.

Furnish signal masts, signal cantilevers and signal bridges, as applicable, in accordance with Metrolink Standard Drawings.

Furnish mounting brackets for marker light assemblies, ladders, junction boxes, housings, backgrounds, hoods and any other nuts, bolts, and associated hardware.

Furnish foundations for signal masts, signal cantilevers and signal bridges, as applicable, in accordance with Metrolink Standard Drawings.

Signals

Signal mounting shall conform to the Metrolink Standard Drawings.

Signal LEDs shall be products specified in the Contract Documents or an approved equal.

Contractor furnished signal assemblies shall include a lamp adjusting resistor in the head.

Signal Masts

Mast assemblies for ground mounting shall conform to the railroad plans and Metrolink Standard Drawings.

Signal Bridges and Cantilevers

Refer to the railroad plans for Signal Bridge and Cantilever requirements.

The junction box shall have two terminals with insulated test links, as specified in Special Provision, Signal Systems Miscellaneous Products, for each cable conductor. Provide 10 percent spare terminals. Do not overcrowd terminals.

Cable entry to the junction box shall be direct from the signal structure. External conduit construction is not acceptable. Provide an opening approximately four by six inches near the base of the signal structure under each junction box location to allow access for cable sealing at the foundation. Provide bolt-on access plate which will cover the opening under normal conditions.

Locate junction box either at the base of a main support mast or on a main support mast at a height of between 3 and 5 feet above the finished grade level at the base.

The method of routing cables from the junction box to each signal mounted on the structure shall be to route the cables within the tubular members of the structure to the greatest extent possible. Pull cables entirely through the structure members, mast, and signal mounting brackets, unless otherwise approved by the Engineer. To facilitate this, provide appropriate pull box locations as needed, located a maximum of 5 feet from each signal. Edges shall be smooth and rounded to accommodate cable installation. Provide a means to prevent entry of rodents and insects at the bases of the vertical masts without cable entrances.

Use galvanized rigid steel conduit where wire is to be run external to the structural members, except as noted.

Use flexible armored conduit to make the connection from the pull box to the individual signal heads.

Use 5C #10 signal color coded cable for mast and jct. box wiring, type TC Okonite 202-10-35-05 or an approved equal.

Signal Foundations

Furnish galvanized steel foundations complete with galvanized bolts, washers, nuts, and associated hardware. Galvanizing shall conform to Special Provision; Signal Systems Miscellaneous Products, and AREMA Signal Manual, Part 15.3.1.

Construct galvanized steel foundations of steel angle and plate welded together. Foundations shall be constructed of 2-1/2 inch by 2-1/2 inch by 1/4-inch steel angle and 1/4 inch steel plate.

Bolt spacing shall be to manufacturer's standards for the equipment to be supported by the foundation.

Concrete Foundations: Cast-in-place in accordance with Special Provision, Cast-in-Place concrete, or precast concrete as manufactured by Dixie Precast or an approved equal.

Delivery, Storage, and Handling

Ship LED's separately from the signal in which they will be used.

CONSTRUCTION

Installation - Signals

Contractor shall install signal layouts in locations as indicated on the railroad plans and as shown on the accepted shop drawings. No part of any signal layout shall conflict with Metrolink Design Standards, Code of Federal Regulations, Part 49, or CPUC rules and regulations.

Locate signals centered between insulated joint, except where physically not possible. In such instances, submit a recommendation to the Engineer for approval.

Center line of signal mast shall be 15 feet 0 inches from centerline of track unless a deviation from this is approved by the Engineer, as shown on the railroad plans or required to meet CPUC clearance requirements.

Install signal units level and plumb on their foundations. Leveling nuts shall be used as shown on the Metrolink Design Standards.

Install signal layouts in accordance with the applicable requirements of AREMA Signal Manual, Part 7.4.1 and the Metrolink Design Standards.

Install platforms for each signal unit level.

Align signals for maximum viewing distance before placing in service.

Refer to Design Requirements herein regarding signal aspect and sighting distances. Install signals and verify sighting distances. Provide the Engineer with written notification with any sighting problems and location of where spread or wide-angle lenses are installed

Mount signal heads on an offset arm as shown in the Metrolink Design Standards. Signal heads shall also be able to swivel on the offset arm and be adjustable.

Signal nomenclature shall be as shown on the railroad plans.

The underground cable shall be dressed, potheaded, tagged, and terminated in the signal junction box as specified in Special Provision, Signal Systems Miscellaneous Products. The conductor size of the underground cables shall be at least as large as that shown in the railroad plans.

Wiring from the junction box base to the signal heads shall be minimum No. 10 AWG copper stranded wire or larger as shown on the railroad plans.

Install identification tags on each wire. These tags shall bear the nomenclature shown on the accepted Shop Drawings.

Set lamp voltage between 8.8 volts and 9.2 volts measured at the signal lamp.

Install signal cantilevers as shown on railroad plans.

Installation – Signal Bridges and Cantilevers

Signal bridges and cantilevers shall be installed as shown on railroad plans.

Installation – Foundations

Install each foundation in accordance with the approved Contractor's Installation Procedure for each type of foundation, as herein specified, and shown on the railroad plans. The absence of a specific task listing herein does not relieve the Contractor of the responsibility for providing a complete and functional installation.

Refer to Special Provision, Earthwork, for requirements for locating and protecting existing utilities. Advise the Engineer immediately if any utility or cable interferes with the foundation work. After locating interference, allow 72 hours for the Engineer to relocate or mitigate the interference.

Prior to placing steel foundations in the excavations, place and compact a crushed stone base in accordance with Special Provision, Earthwork.

When placing foundations, exercise care and ensure that anchor bolts are not bent or threads damaged. Protect anchor bolt threads, washers, and nuts by applying friction tape or other accepted method satisfactory to the Engineer, until the unit to be supported is installed.

After backfilling foundations, ensure that the foundation is plumb and level. Where galvanized steel foundations are installed, top of final grade shall be no more than 24 inches below top of foundation.

Install foundations to the lines, grades and dimensions required. Mounting bolts shall be of sufficient length to accommodate use of leveling nuts between the base of the equipment to be supported and the top of the foundation.

Painting

Touch up any damaged painted finish.

Field Tests

Make tests for proper operation and setting of lamp operating voltages in accordance with Special Provision, Signal System Testing.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefor.

14-1.12 RELAYS

GENERAL

Summary

This section includes requirements for relays. Unless indicated as Owner Furnished in Special Provision, Authority Furnished Labor, Materials, and Equipment, or as relocated on the railroad plans, relays shall be Contractor furnished.

Definitions

Not Used

Submittals

Contractor shall provide acceptance testing and documentation for each relay when it is transported from the warehouse to the job site.

Complete Test Report Form provided by the Engineer for each vital relay installed under this Contract. Use typewritten characters to fill in information requested on the form.

Quality Control and Assurance

Vital relays shall meet the requirements of AREMA C&S Manual Part 6.2.1, where they do not conflict with any requirements specified herein. Vital Relays shall be of the type as designated in the Metrolink Standard Drawings.

Before any relay is used, obtain the Engineer's written acceptance. Acceptance will be based on the test results and the proper completion of the Test Report Form.

MATERIALS

General

Relays shall be in dustproof enclosures, except a provision shall be made for ventilation where required for heat dissipation.

Vital DC Relays

General

Vital Relays shall be Alstom Type B, Safetran Type "ST", or an approved equal. Contractor shall use the specific relays shown on the railroad plans.

Vital dc relays, unless otherwise indicated on the railroad plans, shall be of the plug-in type and rack-mounted. Relays shall have a transparent dust cover made of a nonflammable composition that will not support combustion.

Vital Relays, with a nominal operating voltage of 10 to 16 volts, shall be capable of operating continuously without resultant damage, with a minimum voltage range of 7 to 21 volts inclusive, applied to their operating circuits.

Vital relays shall have a test terminal to allow convenient measurement of the coil voltage.

Design biased neutral vital relays so that gravity alone will prevent the armature from picking up if the permanent magnet is de-energized or if no current is applied to the coil, due to interruption of the normal magnetic circuit.

Front contacts shall be silver-to-metal carbon, meeting the requirements of the AREMA C&S Manual Part 6.2.1.

When 3 dc vital relays, suppressed as specified herein, are connected in parallel and operated as a test load from normal working voltage, a vital relay front or back contact that breaks this load shall be capable of at least five million operations at this load without the contact resistance, measured with ten milliamp current, exceeding five ohms.

Arc suppression for vital relays shall be built into the relay or into its plug board.

Equip vital plug-in relays, except vital time-element relays and special application relays, with front current testing facilities. Where shown on the railroad plans, provide facilities to enable the testing of voltage from the front of the relay, without having to remove the relay or remove adjacent relays.

Equip vital relays with a registration plate to prevent relays of the wrong style, contact arrangement, or operating characteristics, from being inserted into the plug board.

Identification

Facilities shall be included for mounting an approved typed or printed relay nametag for each relay, either on the relay cover or on the relay cabinet front plate, as applicable. The nametag shall be easily replaceable, but shall not come off during normal service.

Identification shall be in accordance with Special Provision, Signal Systems Miscellaneous Products.

Delivery, Storage, and Handling

Ship vital relays separately from the wired racks in which they are to be used. Package relays individually; each in a sturdy corrugated cardboard carton with the drawing number of the relay printed on the outside of the carton. Store relays in a protected area until tested and installed.

Spare Parts and Special Tools

Refer to Special Provisions, Temporary Facilities and Controls, and Quality Requirements for details regarding packaging and delivery of spare parts and special tools.

CONSTRUCTION

Installation

Ensure that the relay operating characteristics have not been altered due to damage during shipping procedures.

Ensure that ac and dc power buses are open while installing relays. Do not reconnect buses until relays have been installed.

Install and wire the relays as shown on the railroad plans.

Identify each relay with nametag.

Field Quality Control

Dc vital relays shall be tested and inspected in accordance with AREMA C&S Manual Part 6.4.1.

Perform tests in accordance with Special Provision, Signal System Testing.

Record test measurements on Test Report Form provided by the Engineer.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.13 AT GRADE CROSSINGS

GENERAL

Summary

This section includes constructing new at-grade crossings of SCRRRA railroad tracks and removing existing at-grade crossings.

Submittals

Submit product technical data including:

- A. Traffic Detour Plan signed by a Registered Professional Engineer using SCRRRA Engineering Standards ES4022 as guidelines and incorporating provisions of the State of California MUTCD and the WATCH Manual.
- B. Material test reports for products purchased and used in this project.
- C. Product Technical Data including:
 1. Acknowledgement that products submitted meet requirements of standards referenced.
 2. Manufacturer's installation instructions.
 3. Shop Drawings detailing dimensions, reinforcement and lifting apparatus for precast crossing panels.
- D. Furnish any required excavation drawings to Engineer for review and approval by SCRRRA and jurisdictional authorities.

Verification documentation that Contractor requested DigAlert field location of underground utilities and SCRRRA clearance of underground railroad utilities prior to starting any excavation.
 Qualifications and experience of installers of precast concrete grade crossings.

Quality Control and Assurance

Employ a skilled foreman for the Installation of grade crossings, having no less than 3 years experience in installation of the type of grade crossing panels used.

Track work shall be performed under the supervision of an FRA Part 213 Track Safety Qualified Foreman in accordance with requirements of the special provision, TRACKWORK.

The Engineer, will review test reports in accordance with the Specifications as applicable for the material item and may require additional testing to confirm requirements with the Specifications.

Prior to commencing Work, Contractor must examine the Contract Documents, inspect the site, obtain and review available Record Drawings of existing work and utilities and note conditions and limitations which may influence work required by this Section.

MATERIALS

Precast Concrete At-grade Crossing Panels shall be designed for use on 10 feet wood track ties and ballast track as shown in the plans.

Precast Concrete At-grade Crossing Panels shall be fabricated in accordance with SCRRRA Engineering Standards ES402.

Precast Concrete At-grade Crossing Panels shall have flangeways not less than 2 3/4 inches width and be electrically isolated to prevent shunt currents.

Crossing panels by Omega Industries are pre-approved for use on SCRRRA.

Omega Industries
 7304 NE St Johns Road
 Vancouver, WA 98665
 Phone: (360) 694-3221 Fax: (360) 694-3882.

Contractor may submit an alternative crossing panel to the pre-approved panel. Such panel must meet requirements in these specifications and SCRRRA Engineering Standards ES4021.

At-grade precast concrete crossing panels shall have a minimum 7-year manufacturer's warranty.

Ties shall be new 10 feet long and conform to the special provision, "Wood Rail Ties".

Ballast shall be new and conform to the special provision, "Ballast".

Rail size shall be 136# CWR.

Rail shall conform to the special provision, "Trackwork".

Rail fastenings shall be new and shall conform to the special provision, "Trackwork".

Geotextile filter fabric used for grade crossings shall be nonwoven fabric. The filaments shall be polypropylene, polyester, or polyethylene. The filaments must be dimensionally stable (i.e., filaments must maintain their relative position with respect to each other) and resistant to delaminating. The filaments must be free from any chemical treatment or coating that might significantly reduce porosity and permeability. Nonwoven fabric may be needle-punched, heat-bonded, resin-bonded, or combinations thereof.

The physical properties for Geotextile shall conform to the following:

Test Method	Property	Requirement
ASTM D3776	Minimum Weight (ounce per square yard)	3.5
ASTM D4632	Minimum Wet Grab Tensile Strength (pounds)	100
ASTM D4632	Minimum Grab Elongation at Break (%)	20
ASTM D4751	Apparent Opening Size(US Sieve)	30

Hot Mix Asphalt for crossing underlayment and roadway approach paving shall conform to Section 39, of the Standard Specifications and these provisions.

Contractor must submit the proposed pavement design to the Engineer for review and acceptance. Roadway approach paving will be reviewed and accepted by SCRRRA and the local agency governing the crossing.

Cast-in-Place concrete for new or replacement sidewalks, curbs, gutters and other concrete items shall conform to Section 73, Concrete Curbs and Sidewalks or as shown in the plans.

Perforated drain pipe shall be Schedule 80 PVC pipe in accordance with Section 64, Plastic Pipe and these provisions.

Signal conduits shall be electrical conduit in accordance to Section 86-2.05A, "Material," and 86-2.05B, "Use."

CONSTRUCTION

Coordinate with SCRRA Signal Department forces in accordance with Division 01 requirements.

Demolish and dispose of existing grade crossing material including asphalt concrete pavement, sidewalks, ballasts, curbs and gutters and other items as required in the plans in accordance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way" and special provision, "At-Grade Crossings".

Remove and salvage existing grade crossing panels or other crossing appliances as required in the plans in accordance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way" and special provision, "At-Grade Crossings".

Track subgrade, asphalt underlayment, and ballast shall be constructed to extend at each end, beyond the limits shown for each grade crossing in accordance with SCRRA Engineering Standards ES4021 or as shown in the plans, whichever is greater.

Contractor must execute Work under this Specification in such a manner as to minimize impact to the daily operation of the railroad, vehicular and pedestrian traffic in accordance with these provisions and the approved Traffic Control Plans.

Contractor must maintain vehicular traffic and pedestrian walkways using barricades, warning signs and warning lights in accordance with these contract documents.

Warning lights shall be set so they do not shine into the eyes of locomotive engineers in on-coming trains.

Temporary pedestrian walkways shall meet ADA Standards.

The Contractor must protect against erosion and uncontrolled run-off within and adjacent to right-of-way in accordance with the Storm Water Pollution Prevention Plan (SWPPP) and the approved National Pollutant Discharge Elimination System (NPDES) Permit.

The Contractor must obtain required permits for dewatering and legally dispose of water from dewatering operations.

Contractor must provide for site cleanliness, sweeping and dust control in accordance with the contract documents.

Contractor must provide noise abatement as required by environmental permits or local agency requirements in accordance with the contract documents.

Prepare subgrade in accordance with the Contract Documents, Section 19, Earthwork and SCRRA Engineering Standards ES4021.

Remove existing concrete foundations, curbs, sidewalks, storm drains, pavement and traffic striping as shown in the plans in conformance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way".

Cut lines for asphalt and concrete shall be straight and neat. Damage to facilities to remain shall be repaired to the approval of the Engineer at no cost to SCRRA or Caltrans.

Drainage and sub drainage work including placement of geotextile wrap of perforated drainage pipe, shall be performed as specified in the Contract Documents and in accordance with SCRRA Standard Plans ES4021 and ES4023.

Hot Mix Asphalt (HMA) paving for crossing underlayment shall be according to Section 39, Asphalt Concrete and as shown in SCRRA Engineering Standards ES4021.

Hot Mix Asphalt (HMA) paved end ramps shall be provided at concrete grade crossing panel installations in accordance with SCRRA Engineering Standards ES4021 if the preapproved crossing panel is used. End ramps shall be per the manufacturer's recommendation of a substitute is approved, but shall not be less than 3 feet in length.

Place new sidewalks, curbs, gutters and other roadway items as shown in the plans, the identified standards of the public agency identified in the plans responsible for the roadway and SCRRA Engineering Standards ES4001 through ES4004.

Highway-Railroad Crossing Crossbuck signs, when called for, shall be installed in accordance with SCRRA Standard Drawing ES 4101.

Private, Pedestrian and Bicycle Railroad Grade Crossing Sign, when called for, shall be installed in accordance with SCRRA Engineering Standards ES4102.

Temporary construction crossing signs, when called for, shall be installed in accordance with SCRRA Engineering Standards ES4023.

Install precast concrete grade crossing panels to the position and location shown in the plans in accordance with manufacturer's recommendations, the approved procedures and SCRRA Engineering Standards ES4021.

Contractor must use SCRRA Engineering Standards ES4021 when using the preapproved crossing plank.

Contractor must clean dirt and debris from the flangeways before releasing the crossing for the passage of trains.

Place and spread ballast in accordance with the details indicated on the plans, SCRRRA Engineering Standards ES4021 and the special provision, "Trackwork".

Grade crossing ties shall be spaced per crossing plank manufacturer's recommendations if not the pre-approved crossing plank, and spacing per SCRRRA Engineering Standards ES4021 if the pre-approved crossing plank. Other tie location and layout distances shall be per the SCRRRA Engineering Standards ES4021.

Tops of ties within the crossing limits shall lie in the same plane. A tie with an irregular surface dimension shall be adzed or replaced.

Construction and fastening of track through grade crossings shall be performed in accordance with details shown on the plans, SCRRRA Engineering Standards ES4021 and the special provision, "Trackwork".

Rail joints or thermite welds are not permitted within the limits of the grade crossing trackwork unless approved by the Engineer.

Rail joints consisting of field welds are permitted at the ends of rail strings placed for crossings. Welds shall conform to special provision, "Field Welding Rail".

Contractor must use a dynamic stabilizer after initial tamping and surfacing followed by a second surfacing pass in accordance with the special provision, TRACK SHIFTING, RELOCATION AND RESURFACING, prior to the final installation of the grade crossing panels.

Compaction testing for subgrade, trench backfill and sub-ballast shall conform to Section 19, Earthwork.

Compaction testing for asphalt concrete crossing underlayment shall conform to Section 39, Asphalt Concrete.

Contractor must coordinate with and provide 24 hours advance notice of crossing work to SCRRRA Signal Inspectors and verify that testing of crossing signal work has been completed and accepted by SCRRRA prior to opening crossing to vehicular traffic.

MEASUREMENT AND PAYMENT

The contract price paid per linear foot for Construct Concrete Grade Crossing Panels includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in At Grade Crossing, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.14 SIGNAL SHELTERS

GENERAL

Summary

This Section includes requirements for new factory-wired equipment shelters and relocating existing equipment shelters. The Contractor shall refer to the Special Conditions, Authority Furnished Materials, to determine if new factory-wired Signal Shelters are to be furnished by the Authority, or if the Contractor will be the responsible for supplying the new shelters.

When the Signal Shelters are furnished by the Authority they must be in conformance to these specifications. The Contractor shall inspect the supplied Shelters and equipment and notify the Engineer of any major deviation from these requirements prior to acceptance from the Authority.

Installation and field modification of the new factory-wired equipment shelters by the Contractor to meet the requirements of the railroad plans shall meet or exceed the requirements of this Section.

Definitions

Not Used

Submittals

Submit proposed Installation Test Procedures.

Submit load calculations, indicating sizes of load center panel, voltage drops, and other 240/120 Vac equipment.

Submit Contractor's Inspection and Acceptance Procedure.

Four copies of shop drawings showing the proposed size and equipment layout including rack, air conditioner, lighting, convenience outlet arrangement, and exhaust fan mounting and location.

Factory Test Procedures proposed.

Shop drawings shall be submitted within 30 days of contract approval.

Quality Control and Assurance

The Contractor shall provide documentation of acceptance "in good condition" before removing and transporting existing shelters to the job site.

The Contractor shall provide documentation of Factory Acceptance Testing before transporting new shelters to the job site.

Each shelter and case will be inspected after they have been installed and the Contractor shall correct any deficiencies. This inspection will be conducted in conformance with the requirements of the Contractor's accepted Inspection and Acceptance Procedure.

MATERIALS

House General

Furnish and install factory-wired equipment shelters, as described herein and as shown on the railroad plans. These shelters shall be complete with the equipment shown on the railroad plans. Wiring shall conform to the requirements of the AREMA C&S Manual, NEMA Standard ICS-70, or National Electrical Code (NEC), as applicable.

Equipment shelters shall be products manufactured by P.T.M.W., Safetran Systems, GETSGS, or an approved equal.

Equipment shelters shall be the size and layout shown on the railroad plans.

Equipment shelters shall be rain-tight and dust-tight, National Electrical Manufacturers Association (NEMA) 3R, ventilated, and have hinged doors with three point catch and handle and have welded construction throughout. Welds shall be 1-1/2 inch minimum in length with spacing not to exceed 6-inches where panels meet floor and roof. Spacing on panel welds shall not exceed 18-inches.

Equipment shelters shall be constructed of 12-gauge galvanized steel for floors, walls, and doors. Roofs shall be no less than 14-gauge galvanized steel with a minimum of 50 pounds per square foot loading.

The entire structure shall be powder coated on the outside with TGIC Polyester Powder (or equal polyester powder) with a nominal thickness of four mils, but no less than three mils at any point on the surface of the enclosure in accordance with AREMA C&S Manual Part 1.5.10. The exterior color shall be light gray.

The steel instrument enclosures shall be complete with moveable shelves, wire chase, and backboard.

The equipment shelters shall provide access to underground and aerial cable entrance behind the main terminal rack. The top and sides shall be lined with heat and cold insulating material and constructed to prevent sweating. Provide ventilation openings as required for the size of the shelter proposed. No ventilation opening shall be made in the roof of the shelter. Provide lift rings to facilitate the movement of the shelter.

Provide ventilation openings in each door. The exterior of the ventilation openings shall be hooded to minimize the entrance of precipitation. Equip the interior of ventilation opening with sliding plate to allow the adjustment of airflow and with a replaceable dust filter. The doors shall be hinged and gasketed so that they will provide a dust proof and weatherproof seal. Provide doors with exterior and interior handles, (interior handles not required on cases) welded to a three point locking device to ensure that the door cannot be locked until it is in the fully closed position. Provide doors with a two-position retaining device to secure the door when open.

Door openings shall be 32 inches wide by 86 inches tall unless otherwise specified on the railroad plans.

Provide thermostatically controlled exhaust fans, operated from 120 Vac and fused separately, in each shelter, as shown on the railroad plans. The thermostat that activates the fan control shall be adjustable and operate in the range of 70 degrees to 130 degrees Fahrenheit. Locate fans relative to the fresh air inlets to draw air over the equipment and size to renew the air within the shelter every 3 minutes. Exhaust fans shall have removable dust filters. Dust filters shall be either replaceable or cleanable.

Hinges shall be separate castings securely fastened to the shelter and door. The hinges shall be equipped with bronze hinge pins, shall be lubricated by the manufacturer before the case is shipped, and shall have grease fittings for later lubrication.

Furnish equipment shelters with interior lighting and duplex 120 Vac power receptacles. Equip shelters and cases with double tube fluorescent lights, minimum 40 watts each, as required to provide complete illumination for passages and sides, and operated from a switch conveniently placed near each entrance door. Furnish convenience outlets as part of each switch.

Shelter lighting and receptacle loads shall be fed from a ground fault interrupt circuit breaker used exclusively for these loads. Signaling logic and signal appliance power loads shall be fed from separate circuit breakers. The signal logic power and signal appliance power shall be ungrounded. The Contractor shall size circuit breakers and wiring.

Furnish shelters complete with a 120/240 Vac power distribution panel, circuit protective devices, and appurtenances necessary to supply the ac power required at each site.

Access points in the enclosure shall be sealed for weather protection and against entry of rodents. All interior and exterior seams shall be caulked with RTV silicone.

Enclosure foundations shall be the inner wall type and adjustable from the outside of the enclosure. The range of adjustment shall be from 36-inches to 52-inches in 1/2-inch increments. Located in the wall the foundations shall be galvanized steel, a minimum of 60-inches long, include hardware, and a 12-inch x 12-inch x 1/4-inch footing pad. Galvanizing shall conform to the AREMA Signal Manual, Part 15.3.1

Permanent vendor name plate, or equivalent, complete with vendor name, address, model number, serial number, and date of manufacture or equivalent shall be located on front.

Case General

Case shall have welded construction throughout. Welds shall be 1-1/2 inch minimum in length with spacing not to exceed 6-inches where panels meet floor and roof. Spacing on panel welds shall not exceed 18-inches.

Interior surfaces including top, sides, and shelves shall be finished with primer coat and 2 coats of white latex enamel paint.

Paint shall be fire retardant.

Key slot channels shall be provided on each side and extend to the full inside heights of the case. Keyhole spacing shall be 2-1/2 inch centers. Key slot channels shall be flush with insulation.

Sides, top, and doors shall include 1-inch of fiberglass faced polyisocyanurate insulation. Floor shall include 1/8-inch bi-directional pyramat rubber matting.

Permanent vendor name plate, or equivalent, complete with vendor name, address, model number, serial number, and date of manufacture or equivalent shall be located on front.

Cases shall be equipped with a minimum of 2 lifting/tie down lugs located at roofline on each side.

Cases shall include 4 knockouts with cover plates and gaskets on sides 'A' and 'C' in the upper corners. Internal insulation at entry locations shall be pre-cut for ease of removal and equipment installation.

Access points in the case shall be sealed for weather protection and against entry of rodents. Interior and exterior seams shall be caulked with RTV silicone.

Exterior shell shall be constructed of 12-gauge galvanized steel.

Exterior surfaces, including bottom of floor, shall be powder coated with TGIC polyester, color light gray, nominal thickness of 4 mils but not less than 3 mils thick.

Shelving and backboard shall be constructed of 3/4-inch MDO two-sided plywood and finished on all sides, with primer coat and 2 coats of fire retardant white latex enamel paint, before mounting.

Shelving shall be adjustable vertically in 2-1/2 inch increments and conform to the keyhole specifications.

Shelves shall be 12-inches wide and covered with 1/8-inch bi-directional pyramat rubber matting. The shelf length will be determined by case size or as shown on the railroad plans.

Exposed edges on shelving, including rear edge, shall have a 1-inch facing constructed of 14-gauge sheet metal, designed for this purpose. Facing shall be aluminum or steel with rust preventive paint or plating. Facing shall be attached with screws and be free of burrs or sharp edges.

Surface area of backboards and shelves shall be free of protrusions such as bolt heads. The bottom of the backboards shall be cut level as shown on the railroad plans.

The width of the backboard shall be determined by the size of the case or as shown on the railroad plans.

Door gasket shall be compressed 1/2-inch free height when door is closed and locked. The gasket shall be coated with an approved lubricant to prevent sticking.

Three bolt on hinges, separate castings, with bronze hinge pins and grease-able, (3/16-inch zerk), fittings shall be installed with an anti-theft arrangement.

Doors shall be lubricated before leaving the factory.

Heavy-duty three point locking system shall be furnished with each door. Latch and locking system shall operate smoothly through complete opening and closing cycle. The door handle must accept a large bail padlock. (Polar Hardware brand #7011) or approved equivalent.

Doors shall be provided with rods to hold door open at 90 degrees and near 180 degrees. Door insulation shall be covered by an interior sheeting to protect the insulation and to add rigidity to door.

Louvers shall be provided in doors with adjustable cover plates for winter and summer usage. The door shall accommodate an adjustable air intake sized to accept a 1-inch x 10-inch x 20-inch replaceable filter.

A drip channel (or roof design) shall be incorporated into the design to direct water away from opening. Y. Case shall include six- 4-5/8 inch knockouts in the floor behind the backboard with cover plates. Four cable risers 36-inches long, complete with male adapters, lock nuts, and bushings shall be included. The knockouts shall be equally spaced behind the backboard.

House General Electrical Specifications

Vendor installed electrical products shall be UL listed. Electrical work shall conform to the National Electrical Code (NEC) standards and accepted practices.

Conduit and device box sizes shall conform to NEC Article 370.

The typical Breaker box shall be Square 'D' 100 AMP; Model QO12M100. The breaker box shall be furnished with the following breakers, one QO120 GFI, one QO230, one QO130, and 7 QO120.

Bushings shall be installed on conduits entering or leaving the breaker or device boxes. An SDSA-1175 surge arrester shall be mounted on the top of the breaker box.

The Breaker box ground buss shall be bonded to the breaker box and the nearest keyway using an ERICO 'VS' welded connection designed for this purpose. The neutral buss shall not be bonded during manufacture. The field shall bond the neutral at the remote (main) disconnect when used.

The neutral bonding screw shall be packaged and shipped in the breaker box for installation in the field if necessary.

Conduits shall be installed above the wire chase and secured to enclosure structure. Flex conduit shall not be used except when used as a drop or attached to equipment that maybe removed. Circuits must be routed in separate conduits. The fluorescent lamp fixtures shall not be used for a junction box, raceway or conduit for circuit other than the one intended for lamp operation.

One separate 20 AMP plug circuit shall be provided on the 'A' and 'C' walls as shown on the railroad plans. The end plugs shall be 8-inches from the 'D' wall and 18-inches from the 'B' wall the remaining plugs shall be centered between them.

Separate 20 AMP circuits (equipment power drops) shall be provided on the 'A' and 'C' walls. The junction boxes shall be located, above the wire chase, as shown on the railroad plans. The wires from the panel shall be terminated (wire nut and taped) in the junction box. One piece of aluminum flexible conduit, 48-inches long shall be supplied for each junction box and installed by the wiring shop. The conduit shall be coiled up and shipped along with other house material.

Bungalows to have provisions for connection of an auxiliary generator as shown on the railroad plans. Provisions for this arrangement to include the following: 1ea. 125/250V 3-pole 4 wire flange male inlet plug NEMA Type L14-30P with exterior spring loaded weather proof outlet cover (Bryant #71430-MBWP). Main breakers to be 100 AMP (Square 'D' #QO2100) for bungalows with 2-pole 30 AMP breaker (Square 'D' #QO230) positioned adjacent to main breaker with mechanical interlock (Square 'D' # QO2DTI). DO NOT SUBSTITUTE.

General color code and wire specifications for AC wiring are as follows. Wiring shall be THHN or THWN solid copper or as required by the NEC.

GFI Breaker to Receptacle/Thermostat	#10 Black
GFI Breaker to Receptacle	#10 White
GFI Receptacle Ground	#10 Green
Thermostat to Vent Fan	#14 Red
Fan Neutral	#14 White
Breaker to Light Switch	#10 Black
Light Switch to Light	#10 Red
Light Neutral	#10 White
Breaker to Receptacle A & C walls	#10 Black
Receptacle Neutral	#10 White
Receptacle Ground	#10 Green

The service entrance shall be a 2-inch EMT conduit, entering the bottom of the breaker box. The conduit shall extend through the floor. Sufficient length shall be left to allow easy coupling. The open end shall be capped and protected while in transit.

One 36-inch piece of 2-inch EMT conduit shall be included along with a compression coupling. The conduit and coupling shall be secured and shipped inside the enclosure.

A single or 3-way light circuit shall be provided based on house size and door arrangement. One 115/120V-20 AMP duplex receptacle shall be mounted with each light switch, near the main enclosure entrance (D and/or B-wall). The fan thermostat control unit shall be mounted to the light switch/duplex receptacle handy box on 'D' wall.

A minimum of 2 double tubes, 4-foot fluorescent fixtures, 40 watts each and tube guards shall be installed in each enclosure. The actual quantity and location of lights shall be based on the enclosure size or as shown on the railroad plans.

An air conditioner, sized for the structure, shall be supplied and located as shown on the typical drawings. A 30 AMP circuit, with a single 30-amp receptacle, shall be provided.

Bushings shall be installed on all conduits entering or leaving the breaker or device boxes. An SDSA-1175 surge arrestor shall be mounted on the top of the breaker box.

Case General Electrical Specifications

Vendor installed electrical products shall be UL listed. Electrical work shall conform to the National Electrical Code (NEC) standards and accepted practices.

The breaker box for cases shall typically be a Square 'D' 100 AMP; Model QO6-12L100S mounted as shown on the typical drawings. Circuit breakers supplied with the case shall be Square 'D' QO series as follows, one- QO120 GFI, two- QO120.

Conduit and device box sizes shall conform to NEC Article 370.

Bushings shall be installed on conduits entering or leaving the breaker or device boxes. An SDSA-1175 surge arrestor shall be mounted on the top of the breaker box.

The breaker box ground buss shall be bonded to the breaker box and the enclosure frame using an ERICO 'VS' welded connection designed for this purpose. The neutral buss shall not be bonded during manufacture. The field shall bond the neutral at the remote (main) disconnect when used.

The neutral bonding screw shall be packaged and shipped in the breaker box for installation in the field if necessary.

General color code and wire specifications for AC wiring are as follows. Wiring shall be THHN or THWN solid copper or as required by the NEC.

GFI Breaker to Receptacle	#10 Black
GFI Breaker to Receptacle	#10 White
GFI Receptacle Ground	#10 Green
Breaker to Light Switch	#10 Black
Light Switch to Light	#10 Red
Light neutral	#10 White

The service entrance shall be a 2-inch EMT conduit, entering the bottom of the breaker box. The conduit shall extend through the floor. Sufficient length shall be left to allow easy coupling. The open end shall be capped and protected while in transit.

One 36-inch piece of 2-inch EMT conduit shall be included along with a compression coupling. The conduit and coupling shall be secured and shipped inside the case.

Cases must have provisions for connection of an auxiliary generator as shown on the railroad plans. Provisions for this arrangement to include the following: 1ea. 125/250V 3-pole 4 wire flange male inlet plug NEMA Type L14-30P with exterior spring loaded weather proof outlet cover (Bryant #71430-MBWP). Main breakers to be 60 AMP (Square 'D' #QO260) for signal cases with 2-pole 30 AMP breaker (Square 'D' #QO230) positioned adjacent to main breaker with mechanical interlock (Square 'D' # QO2DTI). DO NOT SUBSTITUTE.

6-9 cases shall include one switched incandescent light circuit. The fixture shall be complete with 100 watt equivalent lamp and metal lamp guard.

A GFI protected duplex plug and light switch shall be mounted inside on the end (C) wall as shown on the railroad plans. The light with metal guard shall be mounted in the front at the top-center of the case.

Equipment Mounting

General

Mount equipment as shown in the railroad plans.

Mount equipment so a seismic event within the parameters of Special Provision, General Signal Requirements, will not cause damage or excessive motion.

Relay Plug boards

Design plug boards for insertion of removable type contacts. The method of attaching the wires to the removable contacts shall be solder less connections. Design plug board so that the removable contact will have a direct connection with the contact and coil prongs. The plug boards shall be in accordance with the applicable sections of AREMA C&S Manual, Part 6.2.2.

Wires shall be of sufficient length to permit them to be moved to any contact on the same relay.

Equip the plug boards for vital relays with a registration plate to prevent relays of the wrong type, contact arrangement, or operating characteristics from being inserted.

Identification

Stencil a white identification number at the top of the front and rear frames of each rack or panel.

There shall be an identifying nameplate for each relay or other instrument mounted on the rack or panel.

Equip the back and front of the relay plug boards with a tag, as specified in Special Provision, Signal Systems Miscellaneous Products. This tag shall indicate the nomenclature of the relay.

Identify terminals and both ends of wires with a wraparound tag printed with the circuit nomenclatures and terminal designations as shown on the railroad plans and Special Provision, Signal Systems Miscellaneous Products.

Wire and cable conductor identification tags for terminal board mounting shall be specified in Special Provision, Signal Systems Miscellaneous Products.

Cable Entrance Terminal Boards

Cable Entrance Terminal Boards shall be 3/4-inch Type AB exterior (five ply) plywood mounted on a rack and painted with a fire retarding paint.

Cable Entrance Terminal Boards shall be located as shown on the railroad plans.

Multiple-unit terminal blocks for wire and cable conductors shall be in accordance with AREMA C&S Drawing 14.1.6. Furnish each binding post with two binding nuts, one clamp nut, and three washers.

Provide Safetran or equal test links on terminal pairs where conductors enter shelters.

Equip binding posts and exposed terminals of other apparatus for circuits exceeding 50 volts or greater (ac or dc) with insulating nuts and sleeves.

Cable entrance facilities shall be located as shown on the railroad plans.

Lightning arresters shall be specified in Special Provision, Signal Systems Miscellaneous Products.

Cable Entrance Pipes

Supply Cable entrance pipes shall be specified in Special Provision, Signal Systems Miscellaneous Products.

Grounding

Shelter shall be fitted with four 48-inch long No. 2 ground wires cadwelded to floor frame of the shelter at each corner. Cadwelding shall take place prior to powder coating the structure. The pigtailed shall be coiled and secured in a manner that prevents damage during construction and while in transit. Cases shall have two 48-inch long No. 2 ground wires cadwelded to floor frame of the shelter at each end.

Supply and install grounding material shall be specified in Special Provision, Signal Grounding.

Internal Wiring

Internal wiring shall be in accordance with Special Provision, Signal Wires and Cables.

Minimum wire conductor sizes shall be as shown on the railroad plans unless otherwise approved by the Engineer.

Adhering to minimum wire size specifications does not relieve the Contractor's responsibility of using wire sized large enough to safely and effectively provide power to the circuit it serves.

Solderless terminals, for stranded wire, shall be in accordance with Section 34 42 60 Signal Systems Miscellaneous Products.

Solid terminal connectors shall be used for short terminal jumpers.

Wire shall conform to the requirements as specified in Special Provision, Signal Wires and Cables.

Painting – Insulation

Instrument enclosures shall be furnished complete with a layer of rigid insulation on the walls, doors, and ceiling. Instrument shelters shall have a minimum 2-inch thick layer of rigid closed cell foam insulation rated R13. Instrument cases shall have a minimum 1/2-inch thick layer of rigid closed cell foam insulation rated R3.3. Insulation shall be suitable for residential installation.

The interior including the ceiling, walls, terminal boards, and shelves shall be finished with a primer and two coats of white latex enamel paint.

Paint shall be fire-retarding type.

Apply typical legend for control point shelters, highway grade crossing shelters and cases as indicated on the Metrolink Standard Drawings. Consult with manufacturer of shelter prior to paint application.

Equipment Racks

Equipment racks shall be the manufacturer's standard for the type of equipment furnished and shall be sized in conformance to the railroad plans.

Equipment racks shall include necessary supports for wire and equipment.

Secure equipment racks by bolts attached to a threaded mounting plate structurally secured to the floor of the shelter. Attach stabilizing straps to the top of the racks as needed. Racks and mounting shall be secure enough to withstand a seismic event as specified in Special Provision, General Signal Requirements.

Other Equipment

Wiring Raceway (Wire Routing): Internal case wiring shall be contained within surface-mounted plastic raceway. Raceway shall be of a polycarbonate, low smoke type with a solid snap-on cover and flexible sidewalls. The sidewalls shall be of "finger" type construction allowing for insertion and removal of wire runs with terminations attached. The manufacturer shall determine sizes. Fill capacity shall not exceed 60 percent.

Panel Board: Furnish a single-phase, three-wire 120/240 VAC, 60 Hz panel board for each shelter furnished under this Contract. Size panel board as shown on the railroad plans. The capacity rating shall be in accordance with the Contractor's load calculations and the railroad plans.

Service meters shall conform to local codes.

Galvanized Shelter Foundations

Houses shall be equipped with telescoping foundations as described in Part 2.01 Q of this Section complete with galvanized bolts, washers, nuts, and associated hardware. Galvanizing shall conform to as specified in Special Provision, Signal Systems Miscellaneous Products, and AREMA C&S Manual, Part 15.3.1.

Galvanized steel foundations for cases shall be constructed of steel angle and plate welded together. Foundations shall be constructed of 2-1/2 inch by 2-1/2 inch by 1/4-inch steel angle and 1/4-inch steel plate.

Bolt spacing shall be to manufacturer's standards for the equipment to be supported by the foundation.

Delivery, Storage, and Handling

Properly fasten and brace equipment shipped within shelters and cases to prevent damage during transit. Replace any equipment damaged during transit or prior to in-service operation at no cost to the Owner.

Package vital relays, batteries, and electronic plug-in modules in separate containers for shipment and do not install until the shelter is set at its final location.

CONSTRUCTION

Installation

Mount shelters and cases level and plumb and secure thereon with the hardware provided. Do not use shims, spacers, or other filler devices to level and plumb shelters or cases.

Install cable entrance pipes through the cable knockout holes provided in the floor of the shelter behind the terminal board(s) as shown on railroad plans. Fill pipes with a substance designed for the purpose that prevents entrance of debris, rodents, and other pests.

Ground shelters as specified in Special Provision, Signal Grounding.

Locate shelter as indicated on the railroad plans. If conditions do not allow placement as shown on the railroad plans, submit alternate placement for Engineer's approval.

Install relays on the relay plug boards corresponding to the relay nomenclature and identification plate, and securely fasten in place with the hardware provided by the relay manufacturer.

Place batteries on rubber matting on the floor of the house or bottom shelf of the case. Coat battery posts with approved grease and securely fasten battery connectors to the battery posts. Strap batteries or otherwise secure using a method approved by the manufacturer so that they will not tip or move in the event of an earthquake.

Mark each grade crossing warning device case or shelter with the street name, milepost location, emergency response number, and DOT inventory number per SCRRRA Standards.

Install pull boxes and conduits. Provide slotted pull box covers to accommodate the cable chute at new house locations. Place the house so the chute aligns with the slotted cover.

Make any modifications to the cable chute required to fit the pull box and accommodate the cable installation. If it is necessary to cut the cable chute, ensure no rough edges, sharp edges, burrs, or other surfaces exist which have the potential to injure the cable.

Install foundations, including telescoping foundations, for shelters including Owner-furnished shelters.

AC Power

Wall mount load center as shown on the railroad plans. Mounting height from floor, wire terminations, and clearances shall be in accordance with the NEC.

Install service meters as described in Special Provision, Service Meters.

Field Quality Control

Test the functioning of the equipment contained within the instrument shelter in accordance with the requirements of Special Provisions, Signal System Testing, CFR Title 49, Parts 234 and 236, and AREMA C&S Manual Part 2.4.1.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum paid for install railroad signaling and no additional compensation will be allowed therefor.

14-1.15 POWER SWITCH AND LOCK MOVEMENT

GENERAL

Summary

This Section includes requirements for dual control switch and lock movement for each interlocked track switch at new switch locations as shown on the Drawings. Relocate existing switch machines where indicated on the railroad plans.

Refer to Special Provision, Track Work, for track construction requirements.

Definitions

Not Used

Submittals

Submit installation drawings showing the tie straps and the mounting details of the switch and lock movement, including the connections to the track switch points and target.

Submit copies of field test reports.

Quality Control and Assurance

Switch and lock movements shall meet the recommendations of AREMA C&S Manual Part 12.2.1, where they do not conflict with requirements specified herein.

MATERIALS

Furnish complete dual control Electric Switch and Lock Movement Layouts. Electric Switch and Lock Movement shall lock the switch points in hand operation. Electric Switch and Lock Assembly shall be 110Vdc with an electronic switch circuit controller such as the US&S M23E. The gear ratio shall be 189:1. Existing M23A switches shall be retro-fitted with Electronic Switch Controllers and converted to 110Vdc permanent magnet motors with the 189:1 gear ratio.

Contractor-furnished Junction Box shall be Model N349656 manufactured by U.S. & S. Co. or an approved equal.

Furnish Insulated Vertical No. 1 Rod with Basket.

Furnish Rotary Assist Assembly, Switch Rods (#1 through #5), Rod Point Brackets, Bolts, Nuts, Lugs, Washers and Pins.

Miscellaneous Fittings: Furnish connectors such as threaded nipples, cable clamps, and electrical fittings as required for each switch and lock movement layout including 18-inch-long, 2-inch-diameter flexible conduit and connectors from movement to junction box.

Security

Padlocks will be Owner-furnished.

Source Quality Control

Test each switch and lock movement before shipping it to the job site. Conduct this acceptance testing in accordance with the Contractor's Acceptance Test Procedure for switches and lock movements. Submit a copy of documentation of acceptance testing to the Engineer prior to shipping.

Delivery, Storage, and Handling

Protect switch and lock movements and their component layout parts against damage during handling and shipment.

During storage, properly lubricate and maintain switch and lock movement layouts on a regular timed program.

CONSTRUCTION

General

Mount and adjust the complete switch and lock movement layout as specified herein and as indicated on the railroad plans.

Wire control and indication circuits for power-operated switches as shown on the railroad plans.

Installation

Prior to installation, coat parts of the switch and lock movement that are not painted, or made of non-corroding material with an approved grease. Suitably plug or cap unused threaded outlets.

Where existing concrete ties are not used, install two 14 foot long timber ties for mounting the switch mechanisms where shown on the railroad plans. If a helper assembly is required, one of the switch mounting ties shall be 16 foot long.

Prior to mounting the switch mechanism on either concrete or timber ties, align the switch head block ties at right angles to the straight stock rail, and space the ties in accordance with the switch shop drawings, and condition the switch points to move without binding.

Install the switch and lock movements at the locations shown on the railroad plans.

Secure switch and lock movement to the switch ties using (8) eight 7/8-inch bolts.

Remove any ballast necessary for the installation of each switch and lock movement layout and replace and tamp ballast after the installation has been completed. Spread excess ballast evenly between ties in the vicinity of the switch and lock movement layout. Remove ballast from between ties to allow unrestricted movement of switch rods.

Make a preliminary adjustment of switch and lock layout at the time of installation and a final adjustment when placing it in service, which shall result in the adjusting nuts being centered on the threads plus or minus 30 percent of the thread length. Make final adjustment at the time of the functional test. Make final adjustments in conformance with the requirements of AREMA C&S Manual Parts 12.2.1 and 2.4.1, and the SCRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems.

Do not apply power to the motor until the switch machine has been fully lubricated, thrown, and adjusted in hand throw. There shall be no rubbing or binding of switch rods or points on gauge plates, rails or ties. Follow manufacturer's adjustment and installation procedure.

During storage and after installation, properly lubricate and maintain switch and lock movement layouts on a regular timed program until accepted by the Engineer.

Exercise care and ensure that the switches, including switch tie plates, are thoroughly lubricated at lubricating points, that machined surfaces susceptible to rusting, both external and internal, are thoroughly coated with grease, as acceptable to the Engineer, and that threaded portions of switch rods and nuts are coated and protected.

Lubricate the switch tie plates with graphite lubricant, as acceptable to the Engineer. Thoroughly steam clean the plates to remove oil or grease prior to application of the graphite. Periodically renew the protective coating until the Owner assumes responsibility for maintenance of the equipment.

Security

Install Owner-furnished switch padlocks on trainman's access side of electric locks, and power and hand throw levers of switch and lock movements.

Touch-up

Touch-up the finish of equipment described in this Section in accordance with the AREMA C&S Manual, Part 1.5.10. Color shall match factory finish.

Field Quality Control

Inspect each switch and lock movement after it has been installed and correct any deficiencies noted. Conduct this inspection in conformance with the requirements of the Contractor's Installation Inspection Procedure as accepted by the Engineer.

Conduct final operational tests of switch and lock movements as described in Special Provision, Signal System Testing.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefor.

14-1.16 SWITCH CIRCUIT CONTROLLER

GENERAL

Summary

This Section includes requirements for switch circuit controllers.

Definitions

Switch circuit controller layouts shall include the controller unit, junction box, point lug, detector rod, shims, required bolts, nuts, washers, pins, grease fittings, cotter keys, plates, adjusting brackets, and hardware to mechanically couple the switch circuit controller to the track switch points and mount it on the ties.

Refer to Special Provision, Track Work, for track construction requirements.

Submittals

Submit installation drawings showing the tie straps and the mounting details of the switch circuit controller, including the connections to the track switch points.

Submit Contractors Acceptance Test Documentation on switch circuit controllers prior to transport.

Submit copies of field-test reports.

Quality Control and Assurance

Switch circuit controllers shall meet the recommendations of AREMA C&S Manual, Part 12.1.1, for a 4 front/back contact configuration where they do not conflict with requirements specified herein. Mounting details shall conform to the Metrolink Design Standards.

MATERIALS

Furnish Electric Switch Circuit Controller Layout complete with rod, lug, and associated hardware.

Contractor furnished Switch Circuit Controllers and layouts, if required, shall be: Model 7J as manufactured by Alstom Signaling, Model U-5 as manufactured by Union Switch and Signal, or an approved equal, complete with rod, lug and associated hardware.

Contractor furnished Junction Box shall be Model 091 428-ABX manufactured by Safetran Systems or an approved equal.

Furnish Insulated Vertical No.1 Rod with Basket.

Miscellaneous Fittings: Furnish connectors such as threaded nipples, cable clamps, and electrical fittings as required for each switch and lock movement layout including 18-inch-long, 2-inch-diameter flexible conduit and connectors from movement to junction box.

General

Stranded wire: Furnish insulated No. 10 AWG stranded wire between the pedestal-mounted junction box and the switch circuit controller. Insulated wire shall be in accordance with Special Provision, Signal Wires and Cables.

Miscellaneous Fittings: Furnish connectors such as threaded nipples, cable clamps, and electrical fittings as required for each switch circuit controller layout.

Security

Padlocks will be Owner-furnished.

Source Quality Control

Test each switch circuit controller before transporting it to the job site. Conduct this acceptance testing in accordance with the Contractor's Acceptance Test Procedure for switch circuit controllers.

Delivery, Storage, and Handling

Protect switch circuit controllers and their component layout parts against damage during handling and shipment.

During storage, properly lubricate and maintain switch circuit controller layouts on a regular timed program.

CONSTRUCTION

General

Mount and adjust the complete switch circuit controller layout as specified herein and as indicated on the railroad plans.

Circuits for switch circuit controllers shall be as shown on the railroad plans.

Installation

Prior to installation, coat parts of the switch circuit controller that are not painted or made of non-corroding material with an approved grease. Suitably plug or cap unused threaded outlets.

Install one 10-foot long timber tie or concrete tie for mounting the controllers as shown on the railroad plans.

Mount controllers on new and existing timber or concrete ties in conformance to Metrolink Design Standards.

Dap and drill timber ties to meet the requirements of these Specifications. Limit of cutting or dapping shall not exceed 2 inches.

Secure the switch circuit controller to the switch ties, by 3/4 inch by 10 1/2 inch bolts.

Remove any ballast necessary for the installation of each hand throw switch layout and replace and tamp the ballast after the installation has been completed. Spread excess ballast evenly between ties in the vicinity of the switch and lock movement layout.

Make a preliminary adjustment of the controller layout at the time of installation and a final adjustment when placing it in service, which shall result in the adjusting nuts being centered on the threads plus or minus 30 percent of the thread length. Make final adjustment at the time of the functional test. Make final adjustments in conformance with the requirements of AREMA C&S Manual, Parts 12.1.1 and 2.4.1.

Underground cable terminating in the controller junction box shall be dressed and potheaded as specified in Special Provision, Signal Wires and Cables. Fan the individual conductors in a neat workmanlike manner, properly tagged and terminated. Wiring between switch junction box and switch circuit controller shall be No. 10 AWG insulated stranded flex wire. These wires shall also be tagged and terminated. Install the wires between the controller junction box and the controller mechanism in an approved flexible conduit with a minimum length of 10 inches and a maximum length of 21 inches. Fasten this flexible conduit to the switch junction box and switch mechanism with appropriate connectors.

After installation, properly lubricate and maintain switch circuit controller layouts on a regular timed program until accepted by the Engineer.

Exercise care and ensure that the controllers, including switch tie plates, are thoroughly lubricated at lubricating points, that all machined surfaces susceptible to rusting, both external and internal, are thoroughly coated with grease, as acceptable to the Engineer, and that threaded portions of switch rods and nuts are coated and protected.

Lubricate the switch tie plates with graphite lubricant, as acceptable to the Engineer. Thoroughly steam cleaned the plates to remove oil or grease prior to application of the graphite. Periodically renew the protective coating until the Owner assumes responsibility for maintenance of the equipment.

Connect switch circuit controller rods to the normally closed switch point.

Switch assemblies connected to the open point sides, or which have a reverse switch indication shall be equipped with an insulated front rod.

Security

Install Owner-furnished switch padlocks on trainman's access side of electric locks and hand-throw levers of switch and lock movements.

Touch-Up

Touch-up the finish of equipment described in this Section in accordance with the AREMA C&S Manual, Part 1.5.10. Touch-up shall match factory finish.

Field Quality Control

Inspect each switch circuit controller after it has been installed and correct any deficiencies noted. Conduct this inspection in conformance with the requirements of the Contractor's Installation Inspection Procedure as accepted by the Engineer.

Conduct final operational tests of switch circuit controllers as described in Special Provision, Signal System Testing.

Test functions of each switch and lock movement layout in accordance with Special Provision, Signal System Testing.

PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.17 RECTIFIERS, BATTERIES AND BATTERY CHARGING EQUIPMENT

GENERAL

Summary

This Section includes requirements for rectifiers, batteries, and battery charging equipment.

Calculate the loads based upon the equipment proposed. Size batteries to provide a minimum 48 hours standby capacity for systems based on normal operating conditions. Verify the ampere-hour capacity shown on the railroad plans is adequate to provide a minimum of 48 hours standby capacity.

Size battery to provide a minimum of 48 hours of uninterrupted power to the signal systems at the normal operating load.

Size batteries which provide power for crossing warning devices, such as gates and flashing lights, to provide 12 hours of continuous operation with the gate arms in the horizontal position and lights flashing. This requirement is in addition to the requirement for 48 hours standby capacity in the previous paragraph.

Submittals

Load calculations of each dc and ac load. Submit calculations identifying normal and worst case conditions for each load.

Quality Control and Assurance

Not Used

MATERIALS

Acceptable Materials

Exide ELM IRONCLAD Single Wet Cell low maintenance Lead Acid Batteries conforming to AREMA C & S manual parts 9.1.1 and 9.1.30 such as:

1. Model (ELM 240, 240AH)
2. Model (ELM 340, 340AH)
3. Model (ELM 425, 425AH)

NRS Battery Charger: Charger conforming to the requirements specified herein as manufactured by Exide Corp. or an approved equal.

1. Model ERBC (24/30 1/36V, 30A)
2. Model ERBC 12/401C (12/40 1/20V, 40A)
3. Model ERBC 12/201C (12/20 1/20V, 20A)

Battery Charger

Ratelco Electronics Part Number FF1230AC3 12 Volt/30 Amp manufactured by C&D Charter Power Systems.

Battery Charger/Power Pack

Model ELC 120/6 manufactured by National Railway Supply, Inc.

Equipment Details

Battery charging equipment shall be designed for continuous operation.

Battery charging equipment shall be designed to deliver rated outputs with input voltage of 100 Vac to 130 Vac at 60 Hz, single phase, two wire input.

Battery charging equipment shall have a reserve capacity of at least 25 percent above the calculated high load requirements.

Each charger shall be provided with programmable output voltage adjustment.

Terminal markings for ac and dc terminals shall be permanent.

The charger shall provide a stabilized output voltage, temperature compensated with output current limiting. The capacity of the battery charger shall be determined by the Contractor and approved by the Engineer. The charger shall adjust its output current automatically, according to the load and to the demand on the battery.

Battery charger shall conform to requirements in AREMA C&S Manual Part 9.2.1. The output of the charger shall be sufficiently filtered to be compatible with the input voltage requirements of the solid-state interlocking units, and other electronic equipment for the signaling system.

Battery Cells shall be square tubular type design, flooded lead acid. Individual battery cells shall have handles incorporated into their design.

Batteries shall not release gas, fumes, or toxic substances when operated under normal conditions or when charged or discharged at a maximum recommended rate. Each battery cell shall be equipped with a dual action bayonet type flame-arresting vent plug, having an integral electrolyte level gauge.

Batteries shall be capable of a minimum of 1,500 charge-discharge cycles to 80 percent discharge without loss of capacity. Totally discharged batteries, even if polarity has reversed, shall be capable of being recharged to rated capacity with charging voltage of no more than 2.30 volts per cell. Contractor shall warrant that all batteries supplied shall be free from defective workmanship or faulty materials for a period equal to, or greater than, 20 years, 10 full years of coverage plus 10 full years of pro-rata coverage. The Engineer reserves the right to reject a bid that fails to comply with these specifications.

Miscellaneous Materials

Furnish mounting hardware, terminals, and terminators, and similar items for mounting chargers and batteries in wayside cases and signal instrument shelters.

CONSTRUCTION

Installation

Install batteries and battery charging systems as shown on the railroad plans.

Tests

Perform tests as specified in Special Provision, Signal System Testing, ensuring system operation.

Test batteries and battery chargers in accordance with the manufacturer's standard when installed.

MEASUREMENT AND PAYMENT

Batteries and Chargers are included as part of a new case, house or site specific equipment per location.

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.18 RAIL BONDING

GENERAL

Summary

This Section includes requirements for rail bonds, fouling bonds, frog bonds, track circuit connections, and other material required for bonding of track circuit joints, track frog and switch bonding, and track circuit connections.

Definitions

Welded Bonds and track connections shall be in accordance with the requirements of Metrolink Standards.

Rail track joints shall be bonded with welded railhead bonds per Metrolink Standards.

Track switch, frog fouling bonds, and track connections shall be stranded bonds.

Crimped sleeves shall not be used for any fouling or frog bonding unless allowed by the Engineer.

Submittals

Product Data: Manufacturer's catalog cuts, material specifications, installation and maintenance instructions, and other data pertinent to the bonding material, staples, and circuit connections, specified herein and as shown on the railroad plans.

Quality Control and Assurance

Not Used

MATERIALS

Rail Head Bonds: Railhead bonds shall be 3/16-inch in diameter with steel terminals welded to the conductors. They shall have a nominal length of 6 1/2 inches.

Web Bonds: Web Bonds shall be 3/16-inch, 12-inch long welded to the web.

Track Circuit Rail Connectors: Track circuit connectors shall be 3/16-inch stranded bronze conductor, 1-inch tap for welded connection on one end and compression sleeve on the other end for a direct crimp type connection to the track wire, and shall have a nominal length of 4 inches. Use no crimped connections on fouling wires or frog bonding unless authorized by the Engineer.

Bond Strand: Bond strand for fouling wires shall be 3/16-inch single strand with 1/16-inch black PVC insulation.

Acceptable Manufacturers:

Erico Products or SCRRRA approved equal.

CONSTRUCTION

Installation of Welded Bonds

Install welded bonds at non-insulated rail joints within the limits of this Contract that are not equipped with a bond.

Grind clean with a vitrified grinding wheel the surfaces of the rails where the bond is to be applied. After grinding, clean surface with an approved non-toxic solvent to remove grease and dirt. After the surface has been ground and cleaned, weld the bond wire to ensure a thorough mechanical and electrical connection.

Before beginning work on these bonds, weld in the field, under conditions similar to those of the regular installation, not less than 3 complete bond connections, and as many more as the Engineer considers necessary to determine that the welds are being made satisfactorily. Welds shall be subject to inspection and testing by the Engineer and acceptance as to the method and quality of workmanship will depend on the results of these inspections and tests.

Ensure that each bond connection is thoroughly welded to the rail. The Engineer may require a test of each weld by hammer and striker, or other manner, which in the opinion of the Engineer is reasonable.

Remove welded bond installed by the Contractor that is found to be defective prior to acceptance, and install a new bond.

Welded bonds shall be installed per manufacturer's recommended installation procedure.

Installation of Track Circuit Connections

The plug end of the track circuit connector shall be as specified herein, at a maximum 3 inches from the end of the insulated joint.

Strip back underground cable a sufficient distance for the exposed conductor to be fully inserted into the compression sleeve. Then compress sleeve with the type of compression tool designed for that purpose.

Track wire installation shall conform to the Metrolink Design Standards.

Install track circuit connections. Remove defective circuit connections prior to acceptance, and install a new track circuit connection.

Testing

Test track circuits for continuity of circuit and ensure main line track circuit is de-energized with 0.06-ohm shunt at any point within the track block.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.19 SIGNAL GROUNDING

GENERAL

Summary

This Section includes requirements for a grounding system for the equipment shelter and other wayside equipment apparatus.

Definitions

Not Used

Submittals

Submit Schematic Drawings showing the design and detail of the proposed grounding system for the signal and power equipment proposed to be furnished and installed.

Submit catalog cuts or drawings showing the type of components to be used for the proposed grounding systems.

Submit Installation and Test Procedure proposed for equipment grounding.

Submit test reports.

Quality Control and Assurance

Materials and equipment furnished and installed under this Section shall conform to applicable State and local ordinances pertaining to electrical power installations and the National Electrical Code (NEC).

MATERIALS

Ground rods: As manufactured by Copperweld Corp. or an approved equal.

Ground wire as specified herein.

Cadweld connections: As manufactured by Erico Corp. or an approved equal.

General

Ground rods shall be copper-clad stainless steel, in accordance with AREMA C&S Manual Part 11.3.4. The rod shall be at least 10 feet in length and at least 3/4-inch diameter.

Ground rod clamps shall be made of a cast bronze clamp body, with non-ferrous set-screws in accordance with AREMA C&S Manual Part 11.3.4.

Internal ground wire, from the equipment to the ground bus, shall be insulated No. 6 AWG standard copper wire in accordance with AREMA C&S Manual Part 11.4.1. Insulated ground wire shall be colored green.

Provide a grounding bus of nickel-plated hard drawn pure copper in the equipment shelters.

Bare Ground Wire: Soft drawn copper, Class A or Class B stranded, shall meet the requirements of ASTM B8. Sizing of ground wire shall be in accordance with the NEC, except where sizes specified herein or shown on the railroad plans are larger than those required by NEC; UL listed, Label A for lightning protection conductors. Grounding cable shall be continuous without joints or splices throughout its length.

Bolted Grounding Connectors: Use connectors made of high strength electrical bronze, with silicon bronze clamping bolts and hardware in accordance with AREMA C&S Manual Part 11.3.4; designed such that bolts, nuts, lock washers, and similar hardware which might nick or otherwise damage the ground wire, shall not make direct contact with the ground wire.

CONSTRUCTION

General

Ground the following as described herein and in accordance with the applicable requirements of the National Electrical Code (NEC) and local city electrical codes: Service equipment, motor frames, switchgear and equipment enclosures, lighting and power panel boards, transformers, raceways, fences and gates, building or structure steel frames, lighting standards, floodlight poles, and power/light pull boxes/maintenance holes.

The grounding system shall preclude any closed loop grounding arrangements.

Do not ground connections to the track rails; do not use the neutral conductors of the ac power supply.

Grounding under these specifications shall conform to AREMA C&S Manual Part 11.4.1. In cases where these instructions differ, the Engineer will make final decision.

Ground wire/cable runs shall be as short and straight as possible and shall not be interrupted by any device.

Exterior: Equipment Shelter Grounding

At equipment shelters, drive four ground rods into the ground, one near each corner of a structure. At equipment cases, drive two ground rods into the ground, at opposite corners of the structure. The ground rods shall be a minimum of 6 feet apart and shall be driven below ground level. Dig a 12 inch deep trench between the ground rods. Electrically connect each of the ground rods connected to the others, using a No. 2 AWG bare stranded copper cable, welded using "Cadweld" or an equivalent thermal process. Coat Cadweld connections with epoxy resin. Place the ground wires in the bottom of the trench. Backfill trench, returning the soils removed during construction of the trench.

Cadweld shelter's copper ground cables to the ground rods.

Ground resistance, as measured by the "Fall-Of Potential" method, shall not exceed 15 ohms.

Where flexible conduit is used, provide a bonding jumper.

Interior: Equipment Grounding

Equip shelters with a prime ground terminal securely attached electrically to the shelter structure and to the made ground network.

Run ground connections from lightning arresters and equipment chassis separately to ground buses in the shelters, as shown on railroad plans. Connect ground buses to the prime ground with green insulated No. 2 AWG stranded wire.

Properly ground equipment that is powered by or switches voltages greater than 35 volts ac or dc.

Properly ground equipment that has conductors that leave the shelter.

Testing and Inspection

Ground Resistance Testing: Verify that resistance between ground buses and absolute earth, as measured by the "Fall-Of Potential" method, does not exceed 15 ohms without benefit of chemical treatment or other artificial means.

Test Reports: Provide test reports to the Engineer upon completion of ground tests that completely describe ground resistance test procedures and test results. Test reports shall be signed by a technician and witnessed by a representative of the Engineer.

Prior to final acceptance by the Engineer, arrange to have the new ac power service inspected by state and local jurisdictional authorities as required.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.20 SIGNAL SYSTEM TESTING

GENERAL

Summary

This Section includes requirements for tests and inspections to demonstrate that systems, subsystems, assemblies, subassemblies, and components supplied and installed under this Contract are in compliance with these Specifications and with applicable regulatory requirements.

Definitions

It shall be understood where this Section states "as authorized by the Metrolink Signal Manager or Metrolink Signal Engineer" or "submit to the Metrolink Signal Manager or Metrolink Signal Engineer" such authorization or submittal shall be through the Engineer.

Tests and inspections shall be made both during the progress of this Contract and after completing installation of equipment, and shall consist of factory tests of Contractor Furnished equipment, circuit breakdown tests, wiring verification tests, continuity tests, resistance tests, voltage and current tests, applicable locking tests, operating tests, simulation tests, and other electrical and mechanical tests and inspections.

The work shall include tests required to ensure proper and safe operation of systems and subsystems, and to prove the adequacy and acceptability of the total installation. Tests to be performed shall cause each system and subsystem to be sequenced through its required operations, including imposition of simulated conditions to prove that the installation complies with specified fail-safe requirements.

Each Contractor furnished component and unit of the wayside signal and highway grade crossing system shall have an inspection performed at its point of manufacture and evidence of this inspection and acceptability shall be indicated on the item where practicable.

Conduct an acceptance test on Owner furnished equipment prior to loading at the warehouse. Provide certified acceptance reports with each unit at time of delivery.

Work shall include costs of the Contractor's personnel and special equipment and assistance required to conduct tests with complete documentation.

Supply test equipment of proper type, capacity, range, and accuracy to perform required tests and inspections.

Test equipment used shall be in good working order and properly calibrated within 6 months of the date of the tests. This equipment shall display a sticker indicating its calibration date and the agency that performed the calibration.

Calibration of each instrument shall be certified by a recognized testing facility. Instruments with out-of-date calibrations will be considered non-certified. Tests conducted with non-certified instruments will be rejected.

In the event that the system does not meet requirements, make necessary corrections and retesting. Complete tests and inspections prior to performing final in-service tests.

Work shall include necessary disconnecting and reconnecting to perform the specified tests.

Signal systems test work specified elsewhere in these Specifications shall be construed as related to an inclusive with the testing described herein.

Field tests shall be coordinated with the Engineer. As many tests and inspections as possible shall be completed prior to the final cutover to avoid train delay, inconvenience to the travel public, and cost to the Owner. Place systems in-service in phases where possible, reducing the actual cutover period.

Tests shall ensure conformance with CFR 49, Parts 234 and 236, and shall be recorded on forms provided by the Engineer and signed by the Contractor's Signal Engineer directing each test and inspection.

Tests and inspections shall conform to the SCRRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems. Owner will provide 3 copies of this Manual at the Pre-Construction meeting. Refer to Special Provision, Project Management and Coordination, Contract Meetings. Request guidance from the Engineer where the test and inspection requirements written herein conflict with Metrolink's Test and Maintenance Manual.

Testing, including pre-testing, shall include operating switch machines and lighting signals. The use of lamp simulators in lieu of, or in parallel with signal lamps will not be allowed in pre-testing. An exception may be authorized by the Metrolink Signal Manager or Metrolink Signal Engineer where a signal or switch machine is in service and will be reconfigured for final cutover, or cannot be installed or wired until final cutover.

An appropriate meter shall be used when testing circuits. Visual observation of a relay is only valid when coil voltage or current or contact voltage, as applicable, is also measured.

Test and inspection procedures shall be subject to the Metrolink Signal Manager or Metrolink Signal Engineer's acceptance and shall comply with regulatory requirements and the manufacturer's recommended test procedure.

Notify the Engineer in writing at least 48 hours prior to each field test. No part of the signal system shall be placed in service without an authorized representative of the Engineer being present and witnessing the in-service tests.

Submittals

Submit a pre-testing authorization request to the Engineer 15 days in advance of proposed pre-testing for acceptance. The request must include:

- A. Names of Contractor's Signal Engineer in charge of pre-testing.
- B. Other personnel assigned to the pre-test who will be performing the tests or assisting with the tests.
- C. List the assigned locations of the Contractor's personnel and their designated duties during the pre-test.
- D. An outline of the tests to be performed on each type of component, unit, or system, together with samples of the corresponding test records. The outline shall be arranged to indicate the proper sequence of each test to be performed on each component or unit. In addition, the date and time will be shown for each test.
- E. Description of each test to be performed, including the operating parameter to be tested. Test equipment to be used for the test, including the model number, serial number, calibration period, last calibration date and a brief description of the purpose of the test equipment.
- F. Description of equipment to be used for communication purposes.
- G. Schedule of pre-testing Contractor proposes to perform which includes beginning and ending dates, times, and locations in a time-line format.

Identify any test or operation that may disrupt or disarrange the existing signal circuits or systems. Include description of proposed safety provisions and back-up contingency plans.

Submit the following in-service testing information to the Engineer for acceptance:

1. Submit, 30 days in advance of any in-service testing, a detailed cutover and in-service test procedure. This procedure shall indicate the Contractor's personnel involved, their assigned location, and responsibility during the in-service testing. Include the following for Contractor-directed signal cutovers (the following does not apply to Owner-directed signal cutovers): The test procedure shall adequately reflect the test to be performed and the sequence in which the tests shall be performed. A signal aspect chart indicating the appropriate signal aspect to be displayed as train simulation tests are made shall be included. The signal aspect chart shall indicate the progressive down grading of signals and track codes and shall reflect the resulting signal aspect displayed as a result of a light-out condition.
2. The test procedure shall include an outline of the tests to be performed on each type of component, unit, or system, together with corresponding samples of test record forms and cards. The outline shall be arranged to indicate the proper sequence of each test to be performed on each component or unit; the numbers of each type of component or unit to be tested to demonstrate adequacy of design and quality control; and a line diagram showing the grouping and sequencing of system and subsystem.

Contractor's testing procedures and cut-over plan must pass the Metrolink Signal Manager or Metrolink Signal Engineer's and the Operating railroads review. Allow 30 days for this approval process.

Record the results of each test, as herein specified, and submit copies of the field test reports to the Engineer immediately at the completion of the cut-over testing. Prepare final type-written test reports as indicated herein and submit to the Engineer within 5 days after the completion of each test. Final Type-written test reports shall include complete details of the test results and corrections or adjustments performed or which remain to be completed. The type-written test reports shall be signed and dated by the Contractor's responsible employee. Furnish certified test results for tests performed by any subcontractors, when such tests are required within these Specifications.

Where required in this Section, submit test results on completed Metrolink test record forms.

Submit test reports for any additional tests required by the Contractor to ensure the safe operation of the system to the Engineer.

Upon completion of tests, submit a letter certifying that tests necessary to comply with current regulatory requirements of these specifications have been performed.

Quality Control and Assurance

The Work and testing shall comply with the following standards and regulatory requirements: AREMA Communications and Signals Manual, Part 2.4.1. and CFR, Title 49, Parts 234 and 236.

MATERIALS

Site Test Instruments and Equipment

Test instruments and equipment necessary to conduct the tests specified herein shall be available, ready for use not less than one week in advance of test need. "Ready for use" shall mean properly matched for test parameters, properly calibrated, sufficiently supplied with leads, probes, adapters, stands, and similar items necessary to conduct the particular test in a completely professional manner.

Temporary Test Materials

Temporary or interim test related materials, special tools, connections, jumpers, and similar items shall be furnished and available not less than one week in advance of the test need.

Factory Tests and Inspections

Wiring and equipment shall be checked to verify conformance to the railroad plans and the Specifications.

Each control point, intermediate signal, grade crossing warning system shelter or other signal equipment shelter shall be tested to verify that it functions properly before it is shipped to the field for installation. These tests shall involve connecting control systems (excluding signals, switches, and similar equipment) that make up a control point, intermediate signal, grade crossing warning system shelter, or other signal equipment shelter; applying power; and then exercising each function of the system and verify proper result.

Provide confirmation that required factory tests of Systems, sub-systems, assemblies, sub-assemblies and components supplied under this Contract have been performed. Each component and unit shall be inspected at its point of manufacture and evidence of this inspection and acceptability shall be indicated. Certified test reports shall be furnished.

CONSTRUCTION

Field Test Procedures

Perform as many pre-tests as possible in advance of in-service testing. Include, at a minimum, the adjustment of tunable joint couplers, microprocessor based coded track circuits, verify signal aspects against received and transmitted codes. Verify operation of, calibrate grade crossing prediction units, and adjust grade crossing signal control equipment as required to assure proper operation. In order to have a successful cut-over, it is essential that as much pre-testing and advance wiring be completed on the Main tracks before in-service testing begins.

Condition precedent for in-service testing and cut-over will be the completion of pre-testing and the Metrolink Signal Manager or Metrolink Signal Engineer's acceptance of the results. Complete pre-testing and submit the results to the Engineer not less than one week prior to the proposed cut-over date.

The field tests performed shall cause each installed system and subsystem to be sequenced through its required operations, including the imposition of simulated conditions, to demonstrate that the installation complies with specified fail-safe design requirements and operational functions.

Demonstrate the quality of installation by field tests for continuity, insulation resistance, resistance of ground connections, circuit breakdown, visual inspection, and other tests required by these Specifications. Perform these tests prior to operational testing of systems or subsystems.

The Contractor's test procedures shall consist of preprinted data sheets or inspection forms. Where applicable, results of test results shall be recorded on Metrolink forms. These forms will be provided by the Engineer. When completed by the field test personnel and checked for accuracy and completeness, submit the sheet as the test report.

When tests require specific meter or test instrument readings, the preprinted data sheet shall show the allowable range of values, for each part of the test. The test report shall also contain a check off system for each action and a blank space adjacent to the expected value in which to record the test readings.

Test reports shall be dated and signed by the responsible employee of the Contractor or subcontractor on the day the test is performed. Space shall be provided for the signature of the witnessing inspector.

The report shall show the specific test instruments used on each test, with instruments identified by name, type, serial number, calibration date, and calibration due date.

If an error is discovered during field testing due to field wiring and connections that do not agree with the accepted circuit plans, the Contractor may correct errors without prior acceptance of the Engineer. The Contractor shall not make changes that deviate from the railroad plans without prior written acceptance of the Engineer.

The Engineer will make final determinations if only a part, or the whole test, shall be rerun when a specific field test does not meet the requirements specified for the test.

Any changes made after completion of test procedure shall be re-tested in accordance with the applicable test procedure and regulatory requirement.

General Field Tests and Inspection

Perform general field tests including the tests listed herein.

- A. Ground verification test.
- B. Dielectric Breakdown test of vital circuitry.
- C. Wiring verification of non-vital circuitry.
- D. Vital function tests.
- E. Operating tests.

Applicable tests prescribed by AREMA C&S Manual Part 2.4.1, where the AREMA inspections and tests do not conflict with the requirements of these Specifications

Applicable tests as required to ensure systems comply with CFR 49, Parts 234 and 236.

Specific Field Tests and Inspection

Perform specific field tests listed herein.

Grounds

Ground resistance shall be tested and reported as described in Special Provision, Signal Grounding.

Low voltage dc circuits shall be tested to verify that they are free of grounds.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer to obtain acceptance of this test requirement.

Insulation Resistance

Insulation resistance tests shall be made between conductors and ground, and between conductors in each cable in accordance with FRA rule 236.108. The insulation resistance of wires and cables installed by the Contractor shall provide an "infinite" reading when using a direct reading instrument (megger) having a self-contained source of direct current test voltage. The megger scale shall have a minimum range of zero to 20 mega ohms and be rated at 250 volts minimum and 650 volts maximum.

Insulation tests shall be performed after the equipment and cables are installed in the field.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer to obtain acceptance of this test requirement.

Vital Relays

Dc vital relays shall be tested for pick-up and drop-away values. These values shall be in accordance with field requirement values stated in Table I of AREMA C&S manual, Part 6.4.1.

Contractor shall perform tests required to complete the appropriate Metrolink form.

These tests shall be performed at the shelter locations after the shelter has been set.

Record test results on the appropriate Metrolink form and submit this completed form to the Engineer to obtain acceptance of this test requirement.

Energy Distribution: Energy-Off Tests

With power to the signal instrument shelter or wayside case off, the following checks and tests shall be performed. These tests shall include:

- A. Removing fuses.
- B. Verifying that circuit breaker size compares to that of railroad plans.
- C. Comparing wire gages with those called for on the railroad plans. Discrepancies in wire sizes shall be replaced with the proper size wire.
- D. During energy distribution breakdown, a wire count on each terminal, relay contact, etc. shall be taken to ensure that only the number of wires called for on the railroad plans is present at each terminal, relay contact, etc. Any discrepancies found shall be corrected and additional wires, if found, shall be removed.
- E. Verify proper system voltage for each power supply, ac and dc.
- F. Verify power supplies for correct setting quantities.
- G. Verify that no cross, shorts, or grounds exist.
- H. Tags shall be verified for proper nomenclature and terminal location.

Breakdown of Control Circuits:

Circuits shall be tested in their entirety for the correct operation of and response to each contact on each circuit element, such as relays and contactors. Where parallel paths exist, the tests shall validate each path, and circuits shall be opened when required to ensure the proper test.

Each circuit shall be tested by simulating operating conditions to verify that the circuit operates in accordance with the Specifications and accepted plans.

Electric Switch and Lock Movements (when applicable):

Continuity checks of field wires to switch-and-lock movements to verify nomenclature.

Adjust throw bar so that proper tension is placed on switch points in both directions.

Manually operate switch machine normal and adjust lock rods and point detector rods to allow switch machine to lock up with no obstruction. Repeat above for switch machine in reverse position.

Turn on switch machine power, call switch machine normal and observe in field that switch machine corresponds to position called, and observe in wayside instrument shelter that proper switch correspondence relay is energized.

With switch machine called normal, check gaps on circuit controller contacts to see that they meet equipment specifications. Operate machine reverse and repeat.

Break each contact in switch circuit controller and observe that proper switch correspondence relay drops. Repeat this procedure for both positions of the switch.

Place ammeter in series with motor control energy and adjust clutch such that it causes overload relay to pick up in less than ten seconds with 1/4-inch obstruction in switch point and record current reading. Repeat for opposite position.

Place switch and lock movement in "hand" operation and observe switch mechanism cannot be operated by power. Place back in "motor" and verify that switch mechanism can be powered.

Operate switch, then shunt detector track circuit and observe that switch machine is stopped in middle of stroke and not allowed to complete movement. Remove shunt and verify switch completes movement.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer in order to obtain acceptance of this test requirement.

Signal Layouts

Tests shall be performed on signal layouts. These tests shall include the following:

- A. Continuity check of field wires and verification of nomenclature.
- B. Apply energy to signal lighting circuits and adjust all lamp voltages to 10 percent less than the lamp rating.
- C. Sight signals for maximum visibility.
- D. Check that light-out feature, where used, complies with FRA Rule 236.23(f).

Line Circuits

This test procedure shall verify the integrity of line circuits between wayside instrument locations. These tests shall include the following:

- A. Nomenclature shall be verified and line circuits tested for continuity.
- B. Each repeater relay shall be tested to determine that it follows the proper track relays de-energized in the signal shelters.

Control Office to Wayside Interface (when applicable)

Upon completion of the wayside tests, a system test shall be performed to ensure continuity of operation of wayside equipment by the supervisory control system. This test shall consist of controlling office wayside functions from the supervisory control console, and the transmission back to the control office of indications from the field stations. The functions to be tested shall include the following:

- A. Controls from Supervisory Control Console
 - 1. Control of switch machines.
 - 2. Lining of routes.
- B. Indications to Supervisory Control Console
 - 1. Switch machine positions
 - 2. Track circuit occupancy.
 - 3. Signal indications.
 - 4. Power-off and alarm indications.
- C. Design changes found necessary to obtain proper operation shall be submitted to the Metrolink Signal Manager or Metrolink Signal Engineer for acceptance.

Local Panel Test (when applicable):

Verify proper operation of controls and indications.

Switch Circuit Controllers (when applicable):

Each switch circuit controller shall be tested to verify wiring, mechanical connectors, point obstruction, and point detection in accordance with AREMA C&S Manual, Part 12.5.1.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer in order to obtain acceptance of this test requirement.

Track Circuits

Each track circuit shall be tested for shunting sensitivity and polarity in accordance with the AREMA C&S Manual, Part 8.6.1.

Insulated joints

Each insulated joint installed by the Contractor shall be tested with one of the following insulated joint testers, the Harmon 1501A1JC, S&C Model 324 Track Circuit Short Finder, or accepted equal, and shall measure no less than 100 ohms across the joint.

Interlocking and Control Point Tests (when applicable):

A detailed list of the tests and complete test procedures shall be provided by the Engineer to establish safe and proper operation of interlockings. The Contractor shall provide the necessary personnel and equipment, along with support functions, as part of the Signal Test Crew. The test sequence shall be designed to test each function for correct performance, in accordance with these Specifications and the accepted plans. Furthermore, the test sequence shall include simulated unusual conditions to determine that the interlocking circuits will respond in a safe and desirable way.

The functions to be tested shall include the following:

- A. Time locking.
- B. Route locking.
- C. Verification of timing of time releases.
- D. Indication locking.
- E. Signal operation in accordance with route and aspect charts.
- F. Interconnection with existing block signal systems.
- G. Interconnection with existing interlockings.

With an established direction of traffic, the controlled signal governing entrance to that particular route shall be put to stop. Traffic in the opposite direction shall not be established until a predetermined time has passed. This predetermined time shall be as indicated on the accepted plans. It shall be ascertained that time locking is effective for this test.

Time tests shall be as follows:

- A. Loss of shunt.
- B. Time locking.
- C. Flashing rate time.

Record test results on the appropriate Metrolink forms. Submit these completed forms to the Engineer to obtain acceptance of these test requirements.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.21 TRACKWORK

GENERAL

Summary

This Section consists of removing, salvaging, repairing, modifying, rehabilitating, or constructing trackwork, turnouts, crossings and crossovers.

Work includes ballast, walkways, ties, rail, fastening systems, other track material (OTM), turnouts and other special trackwork.

Quality Control and Assurance

Quality Assurance

Perform track construction under the supervision of Qualified personnel.

Corrections

During the installation and testing period, Contractor must make available personnel, equipment, and materials necessary to make required corrections to the track including replacements, re-ballasting, resurfacing and realigning, or repair of constructed items.

Ties shall be lifted and supported during storage, transportation, and placing.

Ties shall not be dropped to the roadbed.

Wood ties shall be handled in accordance with AREMA Manual Volume 1, Chapter 30, Section 3.5 and Concrete Ties shall be handled in accordance with AREMA Manual Volume 1, Chapter 30, Section 4.11.

Refer to special provisions for Concrete Ties and Wood Ties for on-site storage requirements.

Rail shall be unloaded and distributed to prevent damage to ties, rails and structures. Do not bump or strike rail.

MATERIALS

Track surfacing and alignment equipment shall be laser guided.

As a minimum at least 70 percent of the original surface area of the track surfacing equipment tamping tool pad must be available and these tools must closely match adjacent and opposite tamping tool pads in the amount of wear.

Equipment shall be compatible with and shall be operated within the clearances indicated in SCRRRA Engineering Standards.

Wheel contours of rail-mounted equipment shall conform to the Association of American railroads (AAR) wheel standards or AREMA maintenance of way equipment wheel standards.

All construction loads borne by equipment shall be applied between gage lines of running rails on each track unless approved by the Engineer.

Vibratory compaction equipment for compaction of base ballast shall be specifically manufactured for compaction purposes.

The self-propelled, pneumatic-tired roller shall have a gross weight of 10 to 15 tons, and the vibratory compactor shall have a weight of not less than 10 tons and shall be capable of applying a dynamic load of not less than 18,000 pounds at 1300 to 1500 cycles per minute.

Furnish tools and equipment necessary to construct the track.

Track gages, track levels, and other tools shall conform to the AREMA Volume 1, Chapter 5, Part 6, "Specifications and Plans for Tools."

Tools and equipment shall be maintained in such a condition as not to endanger personnel nor damage the Work and shall be subject to inspection by the Engineer.

Tools not conforming to standard shall be repaired to AREMA standards or shall be replaced.

Substitution of tools other than AREMA standard will be permitted only with approval of the Engineer.

Track levels and gages shall be checked for accuracy at the start of every work shift and at any time the tool is dropped or struck.

Adjustments shall be performed anytime it is found to have more than 0.050 inches deviation from the nominal measurement value.

Sub-Ballast

SubBallast shall conform to the requirements of special provision for Sub-Ballast and Aggregate Base.

Ballast and Walkways

Ballast shall conform to the requirements of the special provision for Ballast.

Walkway rock shall conform to the requirements of the special provision for Ballast.

Wood ties shall conform to the requirements of the special provision for Wood Railroad Ties.

Cross ties and switch ties shall be of the lengths detailed on the Contract Documents or the designated SCRRRA Engineering Standard.

Ties

Concrete ties, shall conform to the requirements of SCRRRA Engineering Standard Plan ES2402 and ES2406 for Pre-stressed Concrete Track Tie or ES2403 and ES2407 (for bridge deck locations requiring a neoprene pad). Ties shall be new unless indicated otherwise in the Contract Documents.

Rail

Rail shall be new 136 RE continuous welded rail (CWR) Head Hardened rail conforming to AREMA Volume 1, Chapter 4, Section 2.1, Specifications for Steel Rails, unless otherwise stated in the Contract Documents.

Other Track Material (OTM)

OTM shall be new and conform to SCRRRA Engineering Standards and the following requirements:

Bolts, Nuts, and Washers shall conform to AREMA Volume 1, Chapter 4, Section 2.9, "Specifications for Heat-Treated Carbon-Steel Track Bolts and Carbon-Steel Nuts".

Rail Anchors shall be one-piece conforming to the requirements of ES 2363 or approved equivalent, of standard weight.

Anchors shall conform to AREMA Volume 1, Chapter 5, Part 7, "Rail Anchors," may be normally applied with a sledge hammer or manufacturer's application tool, and of a design, size and construction to properly fit the base of rail on which being applied.

Joint bars shall be 6-hole, 36 inches in length and conform to AREMA Volume 1, Chapter 4, Section 2.8, "Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars".

Bar detail shall conform to SCRRA ES2502, "Rail and Joint Assembly for 136 pounds RE Rail".

Compromise Joints or connections to other rail weights on SCRRA mainline track (track used in passenger revenue service will be considered mainline track for purposes of this section) will be made through the use of transition rails as specified in SCRRA ES2372 or ES2373 as appropriate.

Other rail weight connections or those connections necessary for "Industry Track" or "Other than main line" will be made using Compromise Bars.

Compromise Bars shall be 6-hole conforming to AREMA Volume 1, Chapter 4, Section 2.8, "Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars" and conform to the requirements of SCRRA ES2503, "Compromise Joints for Various Weights of Rail".

Final configuration of the track shall utilize field welds to join transition rails wherever applicable in mainline track.

Compromise joint bars may be used for interim phases of construction on mainline track provided interim phase duration is expected to be 6 months or less.

Temporary Compromise joint bars as noted above shall use track bolts in the outer 4 holes only.

Joint bars used to temporarily connect rails that will be field welded in the final configuration shall be bolted with the rails ends drilled in the outer 4 holes only.

Resilient Rail Fastening Systems

Resilient fastening system for wood ties shall be a Pandrol rail fastening system per relevant SCRRA Engineering Standards, "Pandrol Rail Clip – Type "e" 2055", consisting of elastic fastener "E-Clip" galvanized, type elastic clips, screw spikes, and elastic fastener tie plates or approved equal or as otherwise indicated in the railroad plans.

Resilient fastening system for concrete ties shall be a Pandrol Rail fastening system consisting of "Fast-Clip" type elastic fasteners pre-installed in the "off" position on concrete ties, or approved equal, unless indicated otherwise on the railroad plans.

Rail seat pads shall be "3-part" with steel interior plate.

Resilient fasteners for Insulated Joints shall be type specified in SCRRA Engineering Standards for the type of resilient fasteners to be used.

The Contractor must provide suitable fasteners in accordance Relevant Engineering Standards requirements.

Screw Spikes shall conform to the requirements specified in SCRRA ES2355.

Tie plates for resilient fastening shall conform to SCRRA ES2454.

Standard Fastening System

Tie plates shall conform to AREMA Volume 1, Chapter 5, Section 1.1, Tie Plates - "Specifications for Steel Tie Plates" and appropriate SCRRA Engineering Standard.

Tie plate dimensions shall conform to SCRRA ES2451, "Standard 14-inch Tie Plate For 6 inches Base Rail".

Track spikes shall conform to SCRRA ES2355, and shall conform to AREMA Volume 1, Chapter 5, Part 2.1 for "Specifications for Soft-Steel Track Spikes."

Rail anchors shall conform to AREMA Volume 1, Chapter 5, Section 7.1 for "Specifications for Rail Anchors" and SCRRA Engineering Standards.

Switch Stands

Manual throw switch stands for hand throw switches and derails shall conform to SCRRA Engineering Standards or approved equal.

Connecting rod shall be type rod in accordance with standard turnout SCRRA Engineering Standards.

Turnouts shall be as indicated on the railroad plans, fabricated with all new Material, and in conformance with SCRRA Engineering Standards.

Derails shall be of constructed using new Material and conform to SCRRA Engineering Standards with type (double switch point derail or sliding derail with crowder) as indicated in the Contract Documents.

Road Crossings shall be of new Material and conform to SCRRA ES2006 and as indicated on the railroad plans and the special provision for At-Grade Crossings.

Lubricant for special trackwork shall be Whitmore's Railmaster Curve grease except that Dixon L-5550 graphite shall be used for switch plate lubricant. Approved equals shall be submitted for approval by the Engineer.

New insulated joints must be furnished by Contractor and shall conform to SCRRA ES2504.

Elastic fasteners for ties supporting insulated joints shall be designed to prevent electrical bridging between rails and joint bars.

CONSTRUCTION

Work shall be completed in accordance with SCRRA Engineering Standard Drawings, SCRRA Track Maintenance and Engineering Instructions, AREMA Manual for Railway Engineering, and as specified herein.

Each fully completed segment of track, as approved in the SSWP, placed into operational service shall comply with the requirements of FRA 49 CFR 213 for the specific classification of train operation.

Track must have ballast section full to top of ties, have joints fully bolted or welded, have anchors or elastic fasteners applied, and the rail shall be fully de-stressed.

Bottom of rail, fastener assemblies, and bearing surfaces shall be broom cleaned before laying rail.

The low rail (inside rail of curves) on superelevated track shall be designated as the profile rail.

Install track, OTM, turnouts, derails and road crossings in accordance with the railroad plans, SCRRA Engineering Standards, Track Maintenance and Engineering Instructions and California Public Utilities Commission requirements.

Sub-Ballast

Sub-ballast construction shall conform to typical cross sections as depicted in SCRRA Engineering Standards or as shown on railroad plans and must also comply with the requirements of the special provision for Sub-Ballast and Aggregate Base.

Cross Ties

Wood or concrete ties shall be used in special trackwork, grade crossings, turnouts, and crossing diamonds as shown on the railroad plans.

Use of wood ties or concrete cross ties shall be designated on the railroad plans for use in track construction as indicated.

Ties damaged as a result of improper handling or installation by Contractor and rejected by the Engineer must be removed and replaced with new ties at no cost to the SCRRA or the State.

Installation and placement of wood ties shall be as follows:

- A. Place wood Crossties on 19-1/2" centers for mainline track, except through grade crossings.
- B. Space cross ties for grade crossings in accordance with the applicable SCRRA Engineering Standard.
- C. Space Crossties for turnouts in accordance with the applicable SCRRA Engineering Standard and the railroad plans.
- D. Obtain approval for any deviation in crossties spacing from the Engineer prior to Installation of spikes or hold down devices.
- E. Place wood ties with heartwood face down and square to the rail, except as otherwise shown on the railroad plans.
- F. When handling or spacing ties, prevent damaging them with picks or spiking hammers. Tie tongs, lining bars, other suitable tools or tie spacing equipment shall be used.
- G. Do not drive nails or spikes other than those called for into wood ties.
- H. Do not re-spike new wood ties.
- I. Place concrete Crossties as shown in the railroad plans and SCRRA Engineering Standards.
- J. Ensure that the proper rail cant is established.
- K. Concrete Crosstie spacing shall be 24 inches centers.
- L. Transition ties shall be installed where concrete ties abut timber track in accordance with SCRRA Track Maintenance and Engineering Instructions and SCRRA ES2351-03.

Bridge decks with less than 12 inches of ballast under the tie will require use of a concrete tie with embedded neoprene pad (SCRRA ES2403 or ES2407). When calculating the depth of ballast under the tie, include any HMA underlayment as a part of the ballast depth for determining the requirement for use of the concrete tie with embedded neoprene pad. Bridge decks with 12 IN or more of ballast under the ties will utilize standard concrete ties (SCRRA ES2402 or ES2406).

Tie Plates

Plates shall be positioned so that the rail will cant inward towards track centerline and the plate shall be centered on tie and applied as to obtain full proper bearing on both the tie and rail.

Tie plates shall be installed as shown on the SCRRA Engineering Standards, in SCRRA Track Maintenance and Engineering Standards, and on approved Shop Drawings.

Rail Fastening

OTM shall be installed in accordance with SCRRA Engineering Standards and where applicable, manufacturer's recommendations.

Installation of screw spikes and specified resilient fasteners shall be in accordance with manufacturer's recommendations, and SCRRA Engineering Standards and SCRRA Track Maintenance and Engineering Instructions.

Spiking for standard cut spike fastening systems shall be performed using new cut spikes unless otherwise indicated in the railroad plans and as follows:

Spiking pattern shall conform to SCRRA ES2460.

Spikes shall be started vertically, square to the base of rail and driven straight.

Shank of rail-holding spikes shall have full bearing against base of rail.

Do not strike rail or fastenings when driving spikes.

Bent spikes shall be removed and replaced with a new spike as approved by the Engineer.

Spikes shall not be over-driven.

Holes for the screw spikes shall be pre-drilled and applied perpendicular to the plane of the base of tie plate.

Sufficient torque shall be applied to bring the bearing face of the screw spike into flush bearing contact with the tie plate so no gap exists.

Not more than 2 each cut spikes per plate may be used to hold the elastic fastening system plates until the screw spikes are installed.

Cut spikes used in this manner as temporary fasteners may be salvaged or used material.

Cut spikes used as temporary fasteners in this manner shall not be removed; however 4 screw spikes per plate shall be provided if cut spikes are used in this manner.

Rail Anchors

Rail anchors shall be installed per SCRRA ES2351-01 through ES2351-04, as applicable.

Rail anchors shall be set with full bearing against the side of the tie.

Anchors shall not be over-driven.

Fractured or spread rail anchors will be rejected.

Rail anchors shall be applied prior to operation of trains.

If, in accordance with the Engineer-approved SSWP, a slow order will be required, the Contractor must submit proposed anchor pattern to the Engineer for approval prior to commencement of the rail anchor work.

Anchors shall be removed and re-applied when CWR is de-stressed.

Rail anchors shall be applied in accordance with manufacturer's recommendations.

Installing Track

Installation, laying, raising, lining, tamping and dressing of track over ballast shall be performed as follows:

- A. Ballast shall only be installed over sub-ballast, which has been prepared in accordance with the special provision for Sub-Ballast and Aggregate Base and approved by the Engineer.
- B. Place base ballast in lifts not more than 6 inches in thickness before compaction.
- C. Layers shall extend beyond the edge of the ties as shown on the railroad plans before compaction.
- D. Compact ballast thoroughly to form a stable section able to support the subsequent layers and loads.
- E. Compaction of base ballast shall be by means of vibratory compaction equipment.
- F. Each lift of ballast within the initial layer shall be uniformly spread and compacted with not less than 4 passes of either a self-propelled, pneumatic-tired roller or vibratory compactor.
- G. Ballast surface that exhibits ruts or crowns is not acceptable and shall be re-graded and re-compacted prior to the placement of the cross-ties.

Obtain the Engineer's verification of the compacted ballast prior to the installation of track and appurtenant Work over the ballast.

The track shall be assembled on the compacted ballast to permit placement of additional ballast for subsequent raising and tamping and to provide the full depth under the ties.

The ballast shall be tamped with a 16 tool vibrating squeeze-type mechanical tamper, making a minimum of one full tamping insertion per tie for each inch of raise.

The final track raise shall not exceed 1 inch.

The ballast in the crib areas shall be mechanically stabilized by a ballast stabilizer approved by the Engineer.

The track shall be raised, aligned and tamped to within the specified tolerances.

Ballast shall be thoroughly tamped within a space from 15 inches inside either rail to the ends of the ties.

In tamping ties within the above-described limits, simultaneous tamping shall be performed under each rail.

Tamping is not permitted at the center of the tie except within limits of turnouts and crossings where the center of the ties shall be tamped unless prevented by trackwork components.

Pneumatic or electric tamping tools, either hand held or machine mounted shall be used to perform tamping at portions of turnouts not accessible to a production tamper. Hand tamping with shovels or picks will not be permitted unless authorized by the Engineer.

Two tamping tools shall be used opposite each other on the same tie.

Tampers shall be started from a nearly vertical position and worked downward past the bottom of the tie, after which the tool must be slanted downward to force ballast under the tie.

Double tamp every joint tie.

Ballast shall be mechanically dressed to provide the section as shown on the SCRRA Engineering Standards and the railroad plans.

Excess ballast shall be removed.

Payment will not be made for ballast in excess of dimensions shown on the railroad plans.

Ballast damaged by overwork or excessive tamping or fouled by dirt or other deleterious material as determined by the Engineer must be removed and replaced at no cost to the SCRRA or the State.

Where new track joins existing track, the existing track shall be surfaced for a minimum distance of 500 feet on mainline or siding tracks, or 200 feet on industrial tracks, from the point of connection.

Existing track surfacing may be longer as needed to meet FRA requirements.

After the track has been raised to its final elevation and super-elevation, ballast consolidation of tracks shall be performed before the track is placed in service.

Each segment of track may be placed in full service, as approved in the SSWP, if that segment complies with FRA 49 CFR 213 for specific classification of train operation, has ballast section full to top of ties, has joints fully bolted or welded, has all anchors or elastic fasteners applied, and has the rail fully de-stressed and ballast compacted.

When raising track, a spot board or other approved device shall be used to maintain grade, and a level shall be used to keep track to proper cross level.

Laser guided alignment is required, and horizontal alignment must be maintained during the raising operation.

Use of automated controls on tampers will satisfy this requirement.

Newly constructed mainline and mainline siding tracks, upon completion of final surfacing operations, shall be mechanically stabilized using a Ballast Stabilizer.

Installing Turnouts

Installation of frog plates, switch plates, and plates under the closure rails shall conform to SCRRA Engineering Standards and AREMA trackwork standards.

Plates shall be secured by screw spikes except rehabilitation of existing turnouts with cut spikes, which shall be fully spiked.

Following the installation of turnouts on the initial layer of ballast, the turnouts shall be lifted, aligned and supported prior to placement of final ballast.

Ballast shall be uniformly placed and spread.

The turnout shall then be raised and the ballast tamped under both sides of each tie for the full length of the tie.

Tamp ballast thoroughly throughout the length of all ties in the turnout or other special trackwork.

Final top of ballast shall conform to the ballast section as indicated except in cribs wherein switch operating rods, locking rods or connecting rods are located and between point of switch and heel of switch where the crib ballast shall be 3 inches below the base of the rail.

When installing the various components of the turnout, attention shall be given to the following:

- A. Check that alignment, gage, and surface meet Specifications.
- B. Verify that bolts, nuts, cotter pins, and other fastenings are in place, in good condition, and properly tightened.

- C. Verify that switch points are properly aligned and fit tightly against rail when switch is thrown in either position.
- D. Verify that connecting rod and switch rod bolts are equipped with cotter pins properly applied.
- E. Test-operate the switches for lost motion, difficult throw, or loose connections and adjust as necessary.
- F. Examine the rod and fastenings that connect the switch point to the switch stand to see that they are in place and in good condition.

Joints within turnouts shall be welded.

Switch stands shall be installed to hold the switch point tightly against the stock rail when stand is in normal position, per the manufacturer's instructions.

Switch rods shall be adjusted to hold the opposite point tightly against the rail when stand is in reverse position.

Switch stands, for both switches and derails, shall be mounted on two 16 foot ties.

Switch stands shall be kept securely fastened to the head block ties, use approved screw spike fasteners.

The head block ties shall be set square with the track and kept firmly tamped.

Correct any walkway deficiencies adjacent to the head block ties that would impact SCRRRA employee or operating personnel access to the operating levers or controls for the switch stand.

Switch stand target colors shall conform to SCRRRA ES2106 for Derail Switch Target or to SCRRRA ES2703 for standard switch target.

During installation, sliding surfaces of special trackwork assemblies shall be lubricated with a dry film graphite lubricant in accordance with the manufacturer's recommendations.

Insulated joints for non-interlocked switches shall be installed as shown on the railroad plans and in accordance with AREMA (Former AAR) Signal Manual.

Install joint using manufacturer's recommended procedure.

Signal System Point Protection

No switch point shall be installed in the main track unless it has the proper signal system point protection in place and tested.

No switch protection shall be removed from a normally closed signaled switch point unless the switch point is replaced by a straight rail and signal circuits have been corrected and tested.

Rail bonding and fouling circuit protection must be intact at all times on signaled switches.

SCRRRA will perform installation and testing of signal devices.

The Contractor must coordinate installation or removal of turnout with SCRRRA Engineer for required signal testing.

Installing Derails

Install derails per manufacturer's instructions at locations designated in railroad plans and in accordance with SCRRRA Engineering Standards.

Drilling

Rail ends for bolted joints shall be drilled in accordance with SCRRRA Track Maintenance and Engineering Instructions Section 2.1.15.

Additional holes in rail will be sufficient cause for rejection.

A variation of 1/32" in size and location of bolt holes will be allowed.

Holes shall be located with the proper size rail-drilling template and marked with a center punch prior to drilling.

Drilling through joint bars is prohibited.

Rail Ends

Rail shall be cut with rail saw to a tolerance of 1/32" from square.

Burrs shall be removed and ends made smooth.

Torch cut rails will be rejected.

Battered or mismatched ends shall be built up or ground off to conform to minimum tolerance of 1/16" on top and gage side to adjoining rail.

Rail End Hardening

At all rail end locations not eliminated by field welding, rail ends shall be field end hardened in accordance with the AREMA Manual, Volume 1, Chapter 4, Section 2.1.17.1, "Supplementary Requirements" including all insulated joints.

Placing Continuous Welded Rail

Rail shall be laid or adjusted to the Preferred Rail Laying Temperature in accordance with SCRRA Track Maintenance and Engineering Instructions Section 2.2.2, Preferred Rail Laying Temperatures.

Tie cribs shall be filled with ballast immediately after laying rails and after each track raise.

Track shall be surfaced, stabilized, and lined and all ties tamped and anchored, prior to returning track to full service.

If the rail temperature exceeds 120 °F, the Engineer may suspend rail-laying operations, or direct that the rail be cooled.

These actions shall not entitle Contractor to additional compensation or time.

Welded rails shall be positioned for installing to minimize handling and to prevent buckling.

The rail base and tie plate or concrete tie rail seat area shall be cleaned to remove foreign material that may interfere with the full bearing contact with the base of the rail.

Rails shall be placed base down, parallel with track, avoiding excessive bending or damage, using suitable mechanical equipment.

Do not place rails on signal equipment, manhole covers, electrical connections, or near any other installation that could be susceptible to damage.

An approved rail thermometer shall be used to determine rail temperature.

The thermometer shall be placed on the web or base of rail shaded from the sun and left long enough to record the rail temperature accurately.

The temperature shall be checked frequently.

Rail thermometers shall be calibrated.

Tools used for field cutting rails shall be approved rail saws.

Torch-cut rails shall not be installed in the track.

Rail damaged by torches shall be rejected and removed before Installation in the track.

Rail shall be de-stressed in accordance with SCRRA Track Maintenance and Engineering Instructions Section 8.3 only after final track line and grade has been achieved and ballast stabilized, or as required by the Engineer.

Rail shall be re-anchored after de-stressing has been achieved.

Rail shall have adequate anchor patterns installed at all stages of construction.

Anchoring Continuous Welded Rail

The term "rail anchor" also refers to elastic rail fasteners. Install rail-anchoring devices when the rail is within the permissible anchoring temperature.

Anchor opposite rail only when its temperature is within 5 °F of the previously anchored rail's temperature at the time of its anchoring.

Temperatures shall be measured in accordance with SCRRA Track Maintenance and Engineering Instructions Section 2.2.3, Instructions for Taking Rail Temperatures.

No train operation is permitted over rail that does not have a full complement of anchors per SCRRA ES2351-01 through ES2351-04.

If it is necessary to operate trains before de-stressing rail, following the movement of trains, anchors shall be removed for the de-stressing procedure and re-applied.

Prior to joining CWR strings, adjust the CWR strings to the Preferred Rail Laying temperature, vibrate to relieve internal rail stresses, and fully anchor.

Join CWR strings when the rail gap is at the specified gap.

If the rail gap is not within the recommended tolerances for joining CWR strings, and the remainder of the string has been adjusted, un-anchor the CWR strings for 400 feet on each side of the rail gap and readjust each CWR string to within the Preferred Rail Laying Temperature.

Re-anchor the CWR strings before installing the rail joint or weld.

If the recommended rail gap cannot be obtained in this manner, cut a section of rail from the end of one of the CWR strings and insert a rail plug not less than 19 feet-6 inches long on tangent track and curves less than 2 degrees; and not less than 30 feet long in curves of 2 degrees or greater to provide the recommended rail gaps, or crop the rail as necessary to provide the recommended gap.

If the Contractor elects to use an artificial means of adjusting the rail for anchoring, submit the method and equipment proposed to the Engineer and obtain Engineer's acceptance.

A rail vibrator shall accompany the rail heating process to assure free expansion of the rail in advance of the heated area.

Witness marks shall be made at 4 or more stations on unanchored rail across the base of the rail and tie plates to confirm actual expansion of the rail in accordance with the calculations.

The Contractor shall not make any joints or welds within the body of a curve unless approved by the Engineer.

Adjustment by Mechanical Heating

Rail shall be adjusted for temperature after it has been laid on tie plates but before it is anchored.

Rail gaps shall be provided at the end of each continuous welded rail equal to the amount of the expansion that is required for that rail.

Heating shall begin at the end of the rail and be steadily applied moving forward and without reversing direction until the required expansion has been obtained for that rail.

Complete anchoring application shall follow heating as closely as possible.

Deviation or delay will require reheating the rail.

Prevent damage to other work during the heating process.

Thermal Adjustment Calculation

When it is necessary to adjust the rail already in track, the required increase or decrease may be found by taking the difference between the Preferred Rail Laying Temperature and recorded rail temperatures at each string of CWR and calculating the amount of adjustment as specified herein.

The number of inches by which a CWR segment shall be increased or decreased to adjust its length for a temperature higher or lower than that at which it was anchored or adjusted may be calculated using the following formula:

Req. Adjustment (inches) = $0.0000065 \times \Delta T (^{\circ}\text{F}) \times L (\text{Feet.}) \times 12$, OR

Req. Adjustment (inches) = $0.000078 \times \Delta T (^{\circ}\text{F}) \times L (\text{Feet.})$.

Example:

To adjust the length (L) of a 400 foot CWR, fastened at a rail temperature of 60 degrees, to correspond to the length of this rail at a temperature of 110 degrees, subtract 60 from 110 to obtain a difference of 50 degrees (ΔT) and multiply as follows:

$0.000078 \times 50 \times 400 = 1.56$ inch.

Rail Temperature	Inches of Increase for 400 feet of Rail to 110 Degrees F.
20	2.81
30	2.50
40	2.18
50	1.87
60	1.56
70	1.25
80	0.94
90	0.62
100	0.31
110	0.00

Rail Anchorage Record

Compliance record shall be kept in the format similar to that shown in SCRRA Track Maintenance and Engineering Instructions Section 2.2.3 Instructions for Taking Rail Temperatures and provided to the Engineer in an acceptable, reproducible form.

It shall contain the following data for each end of a CWR and at each 400 foot interval during installation:

- A. Date and time.
- B. Track number and rail (East or West, North or South).
- C. Station location.
- D. Weather, air and base of rail temperature.
- E. Type of fastener.
- F. Length of rail being anchored.

Placing Jointed Rail

This specification covers both the permanent construction and rehabilitation of jointed rail and the temporary use of rail joints in the CWR pending field welding.

When laying jointed rail, each rail shall be carefully placed on the ties with ends square, using standard expansion shims placed between the ends of adjoining rails to ensure proper opening of joint.

Shims shall be removed after all joint bolts are tightened.

Using temperatures taken on the rails when they are being laid or adjusted; the thickness of the shim to be used for 39 feet rails will be determined by the following table:

Ranges (Deg F)	Shim (Inches)
-20 – 0	3/8
0 – 25	1/4
25 – 50	3/16
50 – 75	1/8
75 – 100	1/16
Over 100	Laid Tight

Joint Bars shall be well oiled and with full number and correct size of bolts, nuts and spring washers.

Joint bolts shall be tightened before spiking rail and the two center bolts shall be tightened in advance of the end bolts.

Bolts shall be placed with the nuts alternatively on the inside and outside of the rail.

Nuts shall be placed with the flat side toward the rail.

Track bolts, joint bars and finishing surfaces of rails at joint bars shall be swabbed with oil.

Use outer four bolt holes only when installing bolted joints that will be eliminated by field welding.

Do not drill inside holes (holes closest to rail ends) at future field weld locations.

Track Criteria and Tolerances

Track shall be constructed to the alignment and grade prescribed.

Gage shall be 4'-8-1/2".

Deviation from established gage and cross-level shall not exceed 1/8 inches, and profile grade and horizontal alignment variation shall not exceed 1/8 inches measured at the center of a 62 foot chord.

Provide vertical and horizontal control stakes every 50 feet on curves and every 100 feet on tangents.

Tangent track shall be level and superelevation and runoff spirals shall be provided on all curves in conformance with SCRRRA ES2201 through ES2204 unless otherwise indicated in the railroad plans.

The Contractor must not cut rail strings except as required to fit rail to turnouts, crossings or limits of work.

A thermometer designed to measure rail temperature shall be used in accordance with SCRRRA Track Maintenance and Engineering Instructions during rail Installation to assure compliance with the SCRRRA Preferred Rail Laying Temperature.

Final installed or Adjusted Rail Temperature shall be within 10 degrees below or 10 degrees over the Preferred Rail Laying Temperature.

Welding Continuous Welded Rail

Rail welding shall be in accordance with the approved procedure and the special provision for Field Welding Rail.

Walkways

CPUC walkways shall be provided within track work limits in accordance with the railroad plans, SCRRRA ES2105, SCRRRA Track Maintenance and Engineering Instructions, CPUC General Order No. 118.

Insulated Joints

Each insulated joint installed by the Contractor must be tested with an insulated joint tester, either the Harmon 1501A1JC or equal approved by the Engineer.

Test shall measure no less than 100 ohms across the joint.

Test results shall be uniquely identified with a specific joint and submitted to the Engineer in Compliance Record.

The rail ends at each insulated joint shall be beveled and hardened in accordance with the manufacturer's procedures as approved by the Engineer.

The Contractor must comply with rail end hardening and beveling requirements specified in this Section.

Inner Guard Rails

Inner Guard Rails will be required:

- A. For all bridge spans where exposed structural steel is present above the top of rail.
- B. Where individual spans are over 100 feet in length
- C. Where entire structure is over 800 feet in length and at least one span crosses over a waterway that normally contains water which is at least 15 feet deep.
- D. On any bridge as directed by SCRRRA or the Contract Documents.

Inner Guard Rails shall extend 50 feet beyond the span or spans to be protected as required above. SCRRRA ES2302 and ES2304 indicate details for construction of Inner Guard Rails. Inner Guard Rails require use of special Concrete Ties as shown in ES2406 and ES2407.

Salvaging Material

Salvaged material shall be taken to a location within a 75 mile radius of the jobsite designated by the Engineer.

MEASUREMENT AND PAYMENT

Trackwork will be measured by the individual unit constructed in accordance with the Contract Documents and as measured by the Engineer.

All work must be complete prior to payment being made, including but not limited to welding, distressing, final surfacing, and completion of punch list items related to track work.

The contract price paid per track foot for Remove Existing Track, Ties and Ballast, and Install Bumping Post includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove existing track, ties and ballast and install bumping post, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Remove Grade Crossing (Shoofly and Mainline) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove grade crossing (shoofly and mainline), as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract unit price paid for Salvage Turn-out and Return to Metrolink includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove turn-out and return to Metrolink, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per cubic yard for Haul off and Re-use of Ballast includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in salvage, haul off and re-use of ballast, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Test and Store Existing Rails and Ties for Re-use includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in salvage, test and store existing rails and ties for re-use, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The lump sum price paid for Remove Existing Railroad Bridges Over San Fernando includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove existing railroad bridges over San Fernando, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Running Rail includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in running rail, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The lump sum price paid for Cutover Track from Mainline to shoofly and reverse includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in cutover track from mainline to shoofly and reverse, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Ballasted Track includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in install ballasted track, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The lump sum price paid for Ballasted Turnout includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in construct ballasted turnout, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Track on Bridge includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in construct track on bridge, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.22 SIGNAL SYSTEM MISCELLANEOUS PRODUCTS

GENERAL

Summary

This Section includes requirements for miscellaneous components and products for signal systems.

Definitions

Not Used

Submittals

Product Data: Submit manufacturer's catalog cuts, material descriptions, specifications, and other data pertinent to the miscellaneous products required.

Submit samples of solderless crimp-on type terminals.

Quality Control and Assurance

Not Used

MATERIALS

General

Electrical components shall be rated to operate at power, voltage, current, and temperature levels exceeding by 20 percent those which the components will be subject to in service, unless otherwise specified herein.

Miscellaneous components and products shall be clearly and permanently labeled with value or type identification.

Circuit Breakers and Fuses

Circuit breakers and fuses shall be of suitable capacity to protect the various pieces of signal apparatus from the effects of short circuits or overloads. Circuit breakers and fuses required for the equipment and systems shall be in accordance with these Specifications.

Circuit fuses shall be non-renewable, and shall be of the fiber-case, time lag, fusion type.

The circuit breakers and fuses shall be the correct size and rating for circuit current interruption and shall protect the electrical equipment and circuits from short-term and long-term overloads.

Circuit breakers and fuses shall be centrally located on the power distribution panel and power racks.

Fuse clips shall be constructed so that they shall retain their resilience under installation and service conditions, to ensure a positive contact between the clips and the fuse.

Diodes

Diodes to be furnished under this Contract shall carry a JEDEC number or shall be available from more than one manufacturer, and shall be used within the published specifications for such number. Diodes shall be silicon type, unless otherwise accepted by the Engineer.

Resistors

Resistors, other than those required for electronic circuits, shall be in accordance with AREMA C&S Manual Part 14.2.15.

Reactors

Reactors, other than those required for electronic circuits, shall be in accordance with AREMA C&S Manual Part 14.2.20.

Signal Terminal Blocks

Signal system terminal blocks shall be in accordance with the applicable requirements of AREMA C&S Manual Part 14.1.5.

Terminal Binding Posts

Signal system terminal binding posts shall be in accordance with the applicable requirements of AREMA C&S Manual Part 14.1.10.

Terminal binding posts for interface with plug-coupled wires to rack mounted electronic equipment shall be in accordance with the AREMA C&S Manual, Part 14.1.2.

Terminal Post Insulators

Terminal posts, located on terminal boards in the wayside cases, signal instrument shelters used to terminate 50V, or greater, ac or dc circuits shall be provided with a protective insulator.

The type of insulator shall be individual for each terminal post and shall be fire-resistant.

Insulated Test Link

Type 024620-1X as manufactured by Safetran, Inc., or an approved equal.

Lighting Arresters and Equalizers

Safetran Clear view No. 022485-28X, Equalizer No. 022700-1X, or an approved equal. Lightning arresters and equalizers shall be mounted on accepted type base and shall be in accordance with AREMA C&S Manual Part 11.3.1.

Surge Protectors

Safetran SP-17, SP-18, SP-19, SP-20, or an approved equal. Surge Protectors shall be in accordance with AREMA C&S Manual Part 11.3.3.

Terminals for Wires and Cables

Solderless terminals shall be in accordance with the AREMA C&S Manual, Part 14.1.1, unless otherwise specified herein.

Terminals shall be of the solderless crimp-on type. Samples of solderless terminals shall be submitted for approval.

Stranded copper wire shall be fitted with an approved type of terminal at points where the wires are to be terminated on terminal binding posts.

The terminating means shall be of four types:

1. A lug for terminating heavy wires or signal power wires.
2. A solderless type of terminal as manufactured by American Pamcor, Inc., under the trade name of "Pre-Insulated Flags" with translucent insulation similar to Catalog No. 322313, or an approved equal, for terminating No. 16 and No. 14, American Wire Gauge (AWG) stranded wires.
3. An AMP Solistrand "Ring Tongue-Flat" terminal, similar to that shown on the AMP Drawing P64044, together with slip-on nylon post insulator, similar to that shown on AMP Drawing P64-0264, or an approved equal, for terminating wires larger than No. 14 AWG to a maximum diameter over the insulation of 0.40 inch.
4. An AMP preinsulated; diamond grip ring nylon insulated wire terminal shall be used for terminating other stranded wires, No. 20 and No. 18 AWG, having maximum diameter of 0.125 inch. AMP Catalog No. 320554, or an approved equal, shall be furnished for No. 8 studs and AMP Catalog No. 320571, or an approved equal, shall be furnished for 1/4-inch studs.

Terminals shall be for attaching to the ends of the conductor in such a manner that the flexibility of the conductor will not be destroyed and the possibility of breakage at the terminal will be reduced to a minimum.

Terminals shall be for attaching to the wire with a tool made by the manufacturer of the terminal and recommended by the manufacturer for the terminals being furnished.

The tool shall be equipped with a ratchet device to ensure proper indentation of the terminal, which will not release until proper indentation is complete.

Tagging for Cables, Wires and Equipment

Except as otherwise specified in this Section, permanently identify with a tag both ends of each cable, each cable wire, and single wires that terminate in the junction boxes, switch mechanisms, signal instrument shelters, on equipment racks, relay bases, shelter and any equipment of the signal system outside of such locations. Install tags so that they may be read with a minimum of disturbance of the tags. Each conductor of the cable shall be rung out

and identified before applying the tag. Tagging shall follow the three-line convention with the termination in the first line, nomenclature in the second line, and termination of the other end of the wire in the third line. (From-To)

Tags for wire and cable identification and for identification of transformers, resistors, reactors and other components shall meet the following requirements and shall be subject to Engineer's acceptance:

Sleeve Type Tags

Tags for identifying individual cable conductors and field-installed wires within the signal instrument shelters, wayside cases, switch mechanisms, switch layout junction boxes, base of signal junction boxes, and similar applications, shall be the sleeve type as manufactured by Raychem Corporation, Thermofit Marker System (TMS), or an approved equal. The application of the conductor nomenclature shall be in accordance with the manufacturer's instructions and shall result in a permanently bonded and legible identification.

Flat Plastic Tags

Tags for identification of vital relay plug boards, individual transformers, resistors, reactors, terminals, and other miscellaneous components within the signal instrument shelters, wayside cases, and outside terminal cases, shall be the flat plastic laminated type.

Tags shall be 1-1/2 inches long by 1/2-inch-wide. The untreated tag shall be milk white "vinylite", or an approved equal.

The identifying nomenclature space shall allow for two rows of lettering, and the tag material shall be capable of receiving typed-on characters by conventional means. The height of the lettering shall not be less than 1/8 inch.

After lettering, both the face and backside of the tag shall be covered with a clear plastic coating, "vinylite", or an approved equal.

Hardware

Mounting hardware exposed to the elements and used for signal equipment, cases, conduit, hangers, brackets, clamps, and the like, shall be hot-dip galvanized in accordance with AREMA C&S Manual Part 15.3.1, except as otherwise accepted by the Engineer.

Galvanizing

The hot-dip process of galvanizing shall be used. Parts shall be picked so scale and adhering impurities are removed. The zinc coating shall be of commercially pure zinc, and shall be continuous and thorough. It shall not scale, blister, or be removable by handling or installation. The finished surface shall be free from fine line cracks, holes, or other indications of faulty galvanizing. It shall be smooth and free from adhering flux and other impurities. The edges and ends of parts shall be free from lumps and globules. Parts shall be coated with at least 2 ounces of zinc per square foot of galvanized surface, after bending, cutting, drilling, and final fabrication.

Cadmium Plating

Nuts, bolts, and washers shall be cadmium plated or stainless.

Cadmium plating shall be an impervious, dense, hard, fine grained, continuous, closely adhering coating of commercially pure cadmium, free from capillaries and shall completely cover the surface of the part in a smooth, bright layer. Plating on raised or prominent portions shall show no evidence of blackness or loose crystalline structure. It shall have a minimum thickness of six ten thousandths of an inch and shall withstand the salt spray test for at least 1,000 hours or an equivalent test accepted by the Engineer.

Conduit

Rigid conduit

Steel conduit shall conform to ANSI C80.1 and shall be installed as shown on the railroad plans. Where elbows are used, they shall be long radius type. Steel conduits shall be protected in shipping and handling by approved thread protectors.

Thick wall polyvinyl chloride conduit, high impact schedule 40, herein referred to as PVC conduit, shall be installed as shown in the railroad plans. Where elbows are used, they shall be the long radius type.

Flexible Conduit

Conduit for track circuit leads, switch-and-lock movements, and electric lock layouts shall be Liquid-Tite flexible conduit or an approved equal. The conduit shall be clamped at both ends with stainless steel clamps. Clamps are not required for track wire risers.

Where acceptable to the Engineer, metallic flexible conduit, Type UA, or an approved equal may be used.

Fittings

Approved fittings for flexible conduit shall be used.

Approved fittings for PVC conduit shall be used.

Fittings for rigid steel conduit shall be of cast malleable iron and shall be protected by hot-dip galvanizing.

Padlocks

Switch padlocks will be Owner-furnished.

Signal padlocks will be Owner-furnished. The Contractor shall provide temporary padlocks until such time the equipment is placed in-service.

Sealing Compound

Sealing compound for use in sealing cable entrances shall be in accordance with AREMA C&S Manual Part 15.2.15.

Cable Entrance Pipes

Cable entrance pipes for wayside signal shelters shall be 4-inch PVC, Schedule 40, and 3 feet 6 inches long and extend 18 inches below the final grade.

Cable entrance for wayside signals shall be 4 inch Liquid-Tite flexible conduit or an approved equal. Entrance pipe shall extend 18 inches below finished grade around signal.

Cable entrance pipes are not required where a cable chute directly enters a pull box.

Junction Boxes

Junction boxes shall be provided with gaskets to prevent the entrance of moisture and dust, in accordance with AREMA C&S Manual Part 15.2.10.

Junction boxes shall be provided to terminate underground cables at switch and lock movements and switch circuit controllers.

Junction boxes shall be provided with means for applying padlock.

Lubrication

Lubrication for switch tie plates for switch and lock movement layouts installed by the Contractor shall be an accepted graphite lubricant, similar to Dixon's Graphite "railroad 60".

Environmental Protection (Corrosion Preventive Compound)

Protection, as hereinafter specified for machine-finished surfaces, threaded rods, nuts, and other parts that are susceptible to rusting or corroding, shall be a corroding preventive compound, NO-OX-IDE No. 90918, or an approved equal. The product shall have sufficient body to resist weather and rusting for at least 6 months.

DC Track Circuits

Transmitters shall be a 1TC, 2TC, or 3TC manufactured by GETS Global Signaling or an approved equal.

Style C Track Circuits

Transmitter shall be a TD-1A driven by an ACG-2T or TD-4 manufactured by GETS Global Signaling or an approved equal.

Audio Frequency Island Track Circuits

Audio frequency island track circuits shall be AFTAC-II manufactured by GETS Global Signaling, PSO manufactured by Safetran systems, or an approved equal.

AC Track Circuits

AC Track Circuits shall be steady energy such as the SE-3 manufactured by Safetran or an approved equal. Vane Relays shall not be used.

Data Radio

Data radio package shall be comprised of Safetran Systems Inc. WCP II Radio, PN A53412; DC/DC Converter, PN A53106; and Wayside Control Unit, PN A53105.

Power off Strobe Light

Power off strobe light and miscellaneous materials shall be packaged and shipped with each shelter to be installed as shown on the railroad plans. Power off strobe light and miscellaneous materials shall be installed in the field by the installation contractor.

Each shelter requiring a power off strobe light and Miscellaneous materials will include the following:

1. 1 ea. Power Off Indication Light – S&C Distribution Company p/n 120-10, or an approved equal.
2. 1 ea. Protective Cage 5" x 5" x 5" – Fumio Fukaya Enterprises p/n UPRR0012, or an approved equal.
3. 1 ea. Rubber Grommet 3/8" x 1/8" – Newark Electronics p/n 32F1353.
4. 4 ea. Bolt, 1/4" – 20 x 2" Hex Head Cap Plated – McMaster Carr p/n 013194-002.
5. 4 ea. Nut, 1/4" – 20 Hex Plated – Grainger Industrial Supply p/n 4P408.
6. 8 ea. Washer, 1/4" Flat Stainless Steel – Grainger Industrial Supply p/n 4P484.
7. 1 ea. Silicone, RTV Sealant (Blue) – Grainger Industrial Supply p/n 5E220.

Enclosure Alarm System

Intrusion alarm system to be supplied and installed inside of enclosure as depicted on the railroad plans. Intrusion alarm system supplied by "ADEMCO No. V20 Pack", or equivalent system approved by the Engineer.

Extra Materials

Furnish two gallons or equivalent volume of corrosion preventive compound. Compound shall be the same product as approved for use in the Work.

CONSTRUCTION

Installation

Material and apparatus specified herein shall be installed in accordance with the details of respective Sections of these Specifications, manufacturer's recommendations, and in accordance with the Contractor's accepted installation drawings.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.23 SERVICE METERS

GENERAL

Summary

This Section includes requirements for 120/240, 100A three-wire, single-phase meter service and upgrading existing meter service to 120/240, 100A, 3-wire, single-phase meter service.

Provide interface with and in conformance to the standards of the Local Power Company (LPC), in order to obtain the commercial metered power service at the locations shown on the railroad plans and as required by the Engineer.

Definitions

Not Used

Submittals

Submit Meter Service Drawings, indicating mounting pole, meter base, breaker box, and grounding.

Submit Peak load calculation for each meter location. Submit load calculation within 90 days of Notice to Proceed.

Submit letter certifying that the installation of the meter service has been approved by the local electrical inspector.

Quality Control and Assurance

Electrical service shall conform to the provisions in NFPA 70 National Electrical Code and these Specifications. Materials and equipment furnished and installed under this Section shall conform to applicable State and local ordinances pertaining to electrical power installations and the National Electrical Code (NEC).

MATERIALS

Circuit Breakers

Circuit breakers shall be sized by the Contractor for the projected loads. Circuit breakers for 120 Vac power shall be 2 pole rated for 240 Vac. Panels shall contain 25 percent spare circuit breaker space.

One double pole circuit breaker shall be provided for future use, in addition to the 25 percent space circuit breaker space, specified herein.

Meter Bases shall meet the requirements of LPC.

Ground rods and ground rod clamps shall meet the requirements specified in Special Provision, Signal Grounding, and those of the LPC.

Wood Poles: Shall meet the requirements of LPC.

Meter Pedestals and Bases shall meet the requirements of LPC.

CONSTRUCTION

General

Make the necessary arrangements with LPC and pay fees in connection with having the new meter service hooked up at least one month prior to placing signal system in service.

Arrange to obtain the service connection from LPC. Pay LPC charges for this service connection.

Where the Contract Documents specify that the Owner will make arrangements with the LPC, Contractor shall be responsible for installation and coordination with the LPC.

Coordination

Coordinate the connection and interface of new cables and equipment with LPC in accordance with its standards.

Installation

The installation of the various equipment and materials for the signal power distribution system that are specified herein shall be in accordance with LPC's requirements and the NEC.

The requirements included within this section shall cover incidental installation work necessary to affect an integrated, tested, and operable signal power system for the work as shown on the railroad plans.

Arrange utility power service at equipment shelter locations requiring services. Connections to equipment shelters from meter may be by underground or aerial connection. Where aerial connection is used, maximum aerial length between meter and shelter shall not exceed 125 feet without the Engineer's prior acceptance.

The Contractor, in cooperation with the Engineer, shall meet as necessary with LPC representatives to negotiate for the upgrade, relocation, or addition of required power services needed to complete system operation.

Grounding

Meter service grounding shall be in accordance with Special Provision, Signal Grounding, the NEC, and the LPC's requirements. If there is a conflict between the above specifications, LPC's requirements shall govern.

Testing and Inspection

Simulated load tests, in accordance with approved signal power system test procedure, shall be satisfactorily completed prior to final connection of signal facilities at each equipment location.

Prior to final acceptance by the Engineer, obtain inspection of the new AC power service by state and local jurisdictional authority(s), as required.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.24 HIGHWAY GRADE CROSSING WARNING SYSTEMS

GENERAL

Summary

This Section includes requirements for highway grade crossing warning systems. These requirements shall also apply to pedestrian grade crossing warning systems, as applicable.

Where shown on the railroad plans or as required to accommodate associated other work of the Contract, make modifications to the existing highway grade crossing warning systems including such work as replacing, rewiring, or relocating of existing equipment or providing new control equipment and trackside equipment.

Provide continuous operation of the highway grade crossing warning systems in preparation for, and during, track installation and rehabilitation work.

Definitions

Furnish and install new train detection equipment, wideband shunts, narrowband shunts, tuned joint couplers, dummy loads, shunt housings, insulated joints, and track connections for designated existing crossings.

Provide continuous highway grade crossing warning during rail construction. Refer to Special Provision, Work Planning. At no time shall the work of the Contractor cause delay to train operation, cause an unsafe signaling condition to exist, or reduce the effectiveness or quality of the existing or new grade crossing warning systems.

Provide rail bonding for new or modified rail joints or turnouts as shown on the railroad plans. Provide rail bonding, as necessary, to maintain existing systems during construction.

Protect existing signaling cabling and, where necessary, relocate existing cabling to prevent damage to the cabling during track installation, profiling, or grade crossing work.

Record the final as-built conditions of the crossing warning system for each crossing.

Perform and document tests and inspections in accordance with CFR 49 regulations and these specifications.

Submittals

Provide submittals for highway grade crossing devices, equipment, systems, assemblies, and detailed design in accordance with the requirements of Special Provision, General Signaling Requirements.

Submit, for approval by the Engineer, proposed plan for providing alternate methods of crossing warning during cutover and whenever the existing automatic crossing warning devices are deactivated, altered, or modified in order to accommodate construction work. Alternate methods shall conform to applicable parts of CFR, Title 49, including Part 234, and local ordinances.

Alternative Foundation Design

If the Contractor proposes foundations different from those shown on the railroad plans, submit drawings of the type of foundations, including size and details of the galvanized anchor bolts, nuts, and washers the Engineer's approval. Include structural calculations with loadings and wind shear parameters. The Contractor's alternate final design drawings and calculations shall be approved and stamped by a professional engineer registered in California.

Detailed Work Plan

The following work plan shall be coordinated with and integrated with submittals made under Special Provision, Work Planning. Submit a detailed work plan, for approval and coordination by the Engineer, prior to making the changeover from the existing crossing warning system to the new crossing warning system. The Contractor's proposed plan shall detail the amount of time the warning system will be out-of-service and the substitute warning which will be provided to allow normal railroad operations to be maintained. Change over of control, testing, and temporary-warning procedures shall be coordinated with the Engineer.

Submit for approval of the Engineer a procedure plan for conducting quality assurance, component integrity, circuit continuity, circuit breakdown, and system operation tests.

Submit product data for products furnished under this Section.

Submit documentation of acceptance testing.

Submit test reports.

Quality Control and Assurance

Not Used

MATERIALS

Equipment - General

Furnish materials and equipment for installation and for interconnection of the highway crossing warning as indicated on the railroad plans and specified herein. Materials and equipment shall be the products of manufacturers regularly engaged in the production of such material and equipment and shall be the manufacturer's latest design. Signaling materials and equipment shall be of a type and model that are in standard operation on major railway systems.

Only those existing materials and equipment specifically identified on the railroad plans for re-use, relocation, or modification shall be incorporated in the highway grade crossing warning systems. Materials and equipment shall conform to the provisions of AREMA Signal Manual, except as modified in this Section.

Furnish trackside equipment, such as tuned joint couplers, narrow band shunts, and wideband shunts, as shown on the railroad plans. Furnish equipment shelters, predictors, track filters, chokes, and other equipment as shown on the railroad plans and as required for complete installation.

Refer to Special Provision, Authority Furnished Material and Equipment, for lists of Owner-furnished equipment. Conduct and document acceptance testing of components prior to transporting them from Owner-designated storage location.

Electrical and Electronic Components - General

Design fusing and furnish fuses and printed circuit cards, connectors, and files in accordance with Special Provision, General Signaling Requirements.

Crossing Warning Train Detection Equipment

Furnish and install constant warning time (CWT) type crossing train detection equipment, terminating shunts, surge panels, and arresters for the crossing configurations shown on the railroad plans.

Furnish and install each CWT unit complete with the basic complement of printed circuit cards and additional circuit card(s) for functions such as upstream detection, downstream detection, preemption initiation, event recording, and the like, as shown on the railroad plans.

Make CWT unit audio frequency assignments following manufacturers' application guidelines with special attention being paid to frequency versus approach length and placement of adjacent channel narrow band termination shunts. Acceptable primary frequencies in Hz are 86, 114, 156, 211, 285, 348, 430, 525, 645, 790, and 970. Constant warning time systems shall include a high frequency, AFO track circuit for the island circuit. Acceptable island frequencies are 10.0, 11.5, 13.2, and 15.2 kHz or the Harmon (GETSGS) Random Signature Island frequency.

Each highway grade crossing unit shall consist of a primary grade crossing CWT controller and a redundant standby grade crossing CWT controller. Provide an automatic transfer unit to transfer the approach control function from the primary CWT controller to the standby CWT controller in event of the failure of the primary unit and back to the primary unit if the standby unit were to fail. House the automatic transfer unit in the same cabinet as the CWT normal and standby controller.

Furnish and install constant warning time controller capable of detecting train movements on two separate track sections. Design CWT unit to allow selection of a different frequency for each track.

Constant warning time crossing train detection equipment shall be GETSGS (Harmon Electronics') Model HXP-3R2, Safetran GCP 3000-D2, GCP 4000 as shown on the railroad plans, or Approved Equal. Termination shunts shall be the CWT manufacturer's recommended type shunt for the frequency and application used. Furnish multi-frequency selectable termination shunts.

Furnish and install termination shunts, adjustable inductors, filters, code isolation units, and the like, as recommended by the CWT controller equipment manufacturer, as shown on the railroad plans.

Provide solid-state vital "AND" gate or equal as shown on the railroad plans.

The placement of the crossing approach start shunts shown on the railroad plans is based upon the maximum authorized train speed of 79 MPH and a crossing warning time of 30 seconds. Four seconds has been added to account for equipment reaction time. Additional time, if required to accommodate the individual crossings' unique characteristics or as required for traffic signal preemption requirements, shall be as specified in the Contract Documents. Take necessary field measurements at the grade crossing and verify that the crossing warning time and shunt placement are valid for site conditions. Bring any discrepancies to the attention of the Engineer.

Furnish and install an internal data recorder with the CWT unit capable of recording train speed, warning time, time and date, adjacent and auxiliary crossing detection times, and equipment errors. The recorder shall be capable of furnishing a report with only warning time, train speed, and time and date information and a separate report that includes error data.

Furnish and install a separate solid state data recorder and crossing monitor, which shall be capable of being integrated into the Metrolink Railway Works crossing monitor and alarm system, and capable of remote interrogation. The North American Signal Micro Data Analyzer II with data radio (MDA II) as shown on the railroad plans or Approved Equal shall be used.

Furnish and install a Roof mounted VHF antenna and 7db YAGI antenna and associated antenna cables, on each shelter as shown on the railroad plans.

Crossing Warning Gates and Flashing Lights

Furnish and install each highway grade crossing warning device assembly complete with associated hardware consisting of mast mounted gate mechanism, mast, junction box base, gate arm, flashing light units, bell, signs, and miscellaneous hardware as shown on the railroad plans and as specified herein.

The crossing gate warning device assembly shall conform to the requirements of CPUC GO No. 75D; CFR, Title 49, Part 234; and the relevant sub-parts of the AREMA C&S Manual Part 3.2.

The gate mechanism housing shall be cast aluminum for mounting on a 5-inch diameter 16 feet aluminum pole and furnished complete with mounting brackets, counter-weight assembly, and counter-weights. Provide either single sided counter-weight brackets or double-sided counter-weight brackets as recommended by the manufacturer. Fit gate arm bracket with a breakaway arm adapter as shown in the AREMA C&S Manual, Part 3.2.21.

The gate mechanism shall be of the power-up, power-down electro-mechanical type complete with internal relay and adjustable snubbing resistor.

Furnish gate arms lengths required per Metrolink signal standards and site conditions. Arms shall be of the aluminum with fiberglass extensions and fiberglass tip type. Gate arm lamps shall be LED conforming to the AREMA C&S Manual, Part 3.2.40. Provide high intensity lamps when shown on the railroad plans. Fit lamp wiring harness with a five wire pull-apart connector for interconnection to the gate mechanism and securely fasten to the gate arm.

Provide gate arm wind guards conforming to AREMA C&S Manual Part 3.2.22 with each gate assembly.

Provide flashing light crossing signal units as shown on the railroad plans. Light units shall have 12-inch roundels with LED's and be complete with steel backgrounds, steel hoods, junction box, and cross-arm brackets.

Provide a crossing warning bell conforming to the AREMA C&S Manual, Part 3.2.60 with each gate assembly, except that the bell shall be mounted on the cantilever structure when a cantilever is shown.

Railroad crossing signs, multiple track signs, and the like, shall be extruded aluminum, reflex-reflective sheet type as recommended in the AREMA C&S Manual Parts, 3.2.70 and 3.2.75, respectively. Provide signs complete with all hardware for mounting on 5-inch mast or on a cantilever mast. All highway grade crossings shall conform to CPUC required signage.

Exit Gates will default to the vertical position when energy is removed. At a grade crossing, the entrance gates and the exit gates must be provided by the same manufacturer. The Safetran S-40 and S-40EXIT or the US&S Model 95 Entrance Gate and Exit Gate are acceptable.

Exit Gate Systems shall incorporate dynamic vehicular detection utilizing preformed inductive loops with a modular processor assembly incorporating a minimum of 4 inputs and 8 outputs per module. Operating parameters shall be accessible and programmable from the front of the module such as the Reno A & E Model E-1400 or equal. Modules shall be capable of synchronous loop frequency scanning. Loop detector modules shall be integrated within the Exit Gate System

Control of Exit Gate operation shall be by a solid state processing system which is user configurable with permission and password protection. The Exit Gate System shall be configurable to process gate position information for up to 8 individual gate mechanisms selectable to be either Entrance or Exit Gates. The Exit Gate System shall be configurable to process vehicular detection information for vehicle presence and detector health for up to 16 individual inductive loops. User configuration and event analysis must be by a front panel LCD touch screen panel. The front panel LCD shall provide a graphic display depicting collective positions of entrance and exit gates along with occupancy status of entrance, intermediate and exit vehicular loops for both traffic directions. Exit Gate controller shall have an event recording capability and the ability to serially connect with another Exit gate controller of the same manufacturer. The railroad Controls Limited Exit Gate Management System or Approved Equal shall be used.

Control of Entrance Gates shall be by a solid state microprocessor system which contains a charging system and programmable gate delay. This controller may be a separate unit such as the Safetran SSCIV or approved equal, or it may be an integrated modular component of the Constant Warning Time system such as the GCP4000 or Approved Equal.

Foundations

Provide foundations for wayside equipment cases, highway grade crossing gates, flashers, and cantilevers as specified herein.

Precast or cast-in-place reinforced concrete foundations shall be monolithic or sectional construction and shall conform to the requirements for concrete work as specified in Special Provision, Cast-in-Place Concrete, and Special Provision, Precast Concrete.

Provide precast concrete foundations complete with anchor bolts, nuts, and washers in accordance with the AREMA C&S Manual, Part 14.4.

galvanized steel foundations to be furnished and installed shall be complete with Special Provision, Signal Systems Miscellaneous Products, and AREMA C&S Manual, Part 15.3.1.

Galvanized steel foundations shall be constructed of steel angle and plate welded together. Foundations shall be constructed of 2-1/2 inch by 2-1/2 inch by 1/4-inch steel angle and 1/4 inch steel plate.

Bolts, nuts, and washers shall be galvanized. Nuts and threads shall be in accordance with AREMA Specifications for Bolts, Nuts, and Threads, C&S Manual, Part 14.6.20. Plain washers shall be in accordance with AREMA Specifications for Plain and Spring Lock Washers, C&S Manual, Part 14.6.21. Steel shall be in accordance with AREMA Specifications for Various Types of Steel, C&S Manual, Part 15.1.4, Section 1. Bolts shall be of sufficient length to provide for leveling of the device.

Place a conduit with a minimum 3-inch inside diameter in cast-in-place cantilever structure foundations for routing of cables to the cantilever junction box. The conduit shall protrude from the foundation sufficiently to enter cantilever structure ensuring cable is not exposed.

Hardware

Furnish hardware in accordance with Special Provision, Signal Systems Miscellaneous Products.

Conduit

Conduit shall conform to the specifications in Special Provision, Signal Systems Miscellaneous Products.

Delivery, Handling, and Storage

Package printed circuit cards separate from the constant warning time (CWT) units and all other electronic components with removable cards for shipment to the field. Protect each CWT unit and printed circuit card from damage or loss during handling and shipment.

Protect precast concrete foundation units during handling to avoid damage in transit and at storage locations. Support, cushion, and stack to protect the edges of the units. Replace chipped, cracked, or damaged units.

Spare Parts and Special Tools

Refer to Special Provision, Temporary Facilities and Controls, for general requirements for spare parts. Furnish for spare parts:

- A. A constant warning type (CWT) crossing train detection equipment cabinet complete with modules for a - track operation, associated surge panels, and programming keypad.
- B. A Solid State Vital Processing System including a vital modular processor assembly for loop detection for management of the exit gates.

CONSTRUCTION

General

Install and adjust equipment and materials in accordance with the appropriate requirements and recommendations of the equipment manufacturer, in conformance with the recommendations of the applicable parts of the AREMA C&S Manual; as required by CFR 49, Parts 234 and 236; applicable CPUC regulations; or as otherwise specified herein.

Where existing Grade Crossing Warning System Shelters and gate assemblies are indicated to be relocated, remove, protect, transport, store, disassemble, re-configure where necessary, reassemble and reinstall as shown in the railroad plans.

Insulated Joints

Install insulated joints as specified in Special Provision, Track Work (Appurtenances and Other Track Materials). Test each insulated joint in accordance with the requirements of the AREMA C&S Manual, Part 8.6.35, and per bonded joint and insulated joint section.

Rail Bonding

Install new, or maintain existing, and test rail bonding for electrical continuity as required for continuous train detection within the approach limits of the crossings.

Double bond frog assemblies, switch points, and rail joints as specified in Special Provision, Rail Bonding, with the type of bonds specified in Special Provision, Rail Bonding.

Make signal connection to rails using weld type track circuit connectors per Metrolink Design Standards.

Crossing Warning System

Install, connect, and test new equipment and cabling to the greatest extent practicable without disruption of the existing highway grade crossing or signal systems.

Track Circuits

Install and adjust track circuits in accordance with the requirements of AREMA C&S Manual, Parts 8.6.1, CFR 49, Parts 234 and 236, and as specified herein.

Make track circuit rail connections using weld type connectors.

Adjust each track circuit for a detection sensitivity of 0.06 ohm throughout the length of the track circuit, including within the shunt fouling limits of turnouts.

Record voltage and current measurements at both feed and receive ends of each track circuit in a format approved by the Engineer.

Highway Grade Crossing Equipment

Install grade crossing warning equipment in conformance with CFR, Title 49 Part 234; CPUC G.O. 75D; approved submittals; and as shown on the railroad plans.

The final voltage adjustment and alignment of the flashing light units and final balancing of the gate arms shall be made at the time of the functional test. Final adjustments and alignments shall be made in conformance with the requirements of the AREMA C&S Manual, Parts 3.3.1 and 3.3.5 and CFR 49 Part 234.

Provide new cabling between the wayside gate/flasher and the crossing control shelter except where the railroad plans specifically specify the re-use of the existing cabling.

Furnish and install pedestrian gates in accordance with the railroad plans and installation instructions furnished by the Engineer.

Foundations

Excavate, backfill, compact, and clean-up excavation as specified in Division 31- Earthwork.

Install each foundation in accordance with the approved installation detail for each type of foundation and as specified herein. The absence of a specific task listing herein does not relieve the Contractor of the responsibility for providing a complete and functional installation. The installation tasks that must be completed by the Contractor are included herein.

Prior to placing precast foundation or constructing cast-in-place foundations, excavate completely to the lines and grades required and install crushed stone base in accordance with the requirements specified.

Install foundations to the lines, grades, and dimensions required as determined by the Contractor and approved by the Engineer. Install mounting bolts of sufficient length to accommodate use of leveling nuts between the base of the mechanism and the top of the foundation.

When placing foundations, ensure that anchor bolts have not been bent and that the threads are undamaged. Protect anchor bolt thread, washers, and nuts by applying friction tape, or other method approved by the Engineer, until such time as the wayside equipment is installed. Bring damaged anchor bolts to the immediate attention of the Engineer. Do not use damaged anchor bolts. Remove and replace damaged anchor bolts and completely or partially remove and replace foundation as determined by the Engineer.

Refer to Special Provision, Exposed Finished Concrete, for requirements for finishing formed surfaces, smooth rubbed finish. Exposed poured concrete foundations shall be rubbed to obtain a uniformly smooth, clean surface of even texture and appearance.

Provide nonconductive material between the foundations and the mounted apparatus to prevent direct contact between the concrete and metal surfaces.

Conduit

Install conduit where shown on the railroad plans and as specified herein.

After conductors have been installed, seal ends of conduits terminating in instrument shelters, junction boxes, and equipment cases with an approved type of sealing compound.

Bore or jack conduit under the existing trackbed at any traverse, except that conduit may be placed under the track prior to the track renewal.

Place conduit to a minimum depth of 36 inches below finished grade except where specifically noted otherwise.

Removing, Reinstalling and Salvaging Equipment

Relocate, reuse, modify, and salvage existing equipment as shown on the railroad plans. Refer to Special Provision, Demolition, Cutting and Patching, for salvage requirements. Inventory existing relays and controlling equipment prior to delivering to the Engineer's designated storage location.

Newly re-wire any existing equipment designated to be reused except where noted on the railroad plans.

Removed equipment and materials not designated for reuse or salvage shall become the property of the Contractor and disposed of. Refer to Special Provision, Site Clearing, for disposal requirements.

Change existing crossing warning systems over to the new systems as expeditiously as practicable. Remove retired equipment immediately and keep work site kept free of debris and packaging materials.

Field Quality Control

Perform testing in accordance with Special Provision, Signal Systems Testing, including documentation requirements.

Prepare test procedures and perform and document tests on the highway grade crossing components and systems as follows:

1. Include tests herein specified, as specified in the appropriate sections of the AREMA C&S Manual, and the FRA Rules, Standards, Instructions for railroad Signal Systems, CFR 49 Part 234 and 236.
2. Perform pretests on procedures in advance of actual testing.
3. Perform applicable tests to each interim signal system, if any, before placing in service.
4. Actual testing shall be witnessed by the Engineer.

Make measurements at each piece of wayside equipment and record on the as-built record drawings verifying that the equipment is located where shown on the railroad plans and as approved by the Engineer. Verify, by measurement, that the equipment does not violate the train dynamic clearance envelope.

Test each grade crossing warning installation in accordance with Section 34 42 58, Signal Systems Testing, and the AREMA C&S Manual, Parts 3.3.1 and 3.3.5. In addition, perform applicable tests as described in the SCRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems, all manufacturer's recommended test and adjustment procedures, and any tests required by regulation.

Disconnect and ground associated signal equipment not under test. Disconnect or unplug electronic devices or signal equipment prior to any testing.

Follow manufacturer's instructions for testing of operation and electronic equipment.

Submit test data and results to the Engineer's information and approval within 24 hours of placing the apparatus or system in operation.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.25 WAYSIDE SIGNAL ASSEMBLIES

GENERAL

Summary

The Section includes the requirements for furnishing and installing wayside signal assemblies.

Wayside signal assemblies shall consist of ground-mounted masts, color-light signal heads with LED lamps, backgrounds, visors, number plates (for automatic signals), ladders, platforms, foundations, and mounting hardware required to construct absolute (interlocking) and automatic signals.

Contractor shall furnish and install signals as specified herein and as shown on the railroad plans.

Definitions

Not Used

Submittals

Contractor shall submit shop drawings for each type of signal unit and each type of signal layout to the Resident Engineer for approval. Show ladders, masts, bases, arms and required mounting hardware. Show location and method of mounting the signals to the structure.

Provide necessary dimensions, hardware, method of mounting signals, and material specifications for items to be furnished.

Submit shop drawings for structure foundations.

Submit Installation procedure for approval by the Engineer. The procedure shall include a detailed description of installation activity and sufficient detail to allow the Engineer to determine the validity of the installation procedure.

Quality Control and Assurance

Wayside signal assemblies shall meet the requirements of AREMA C&S Manual part 7 and applicable portions of Manual Part 3.2.5, where requirements of the AREMA Specifications do not conflict with requirements specified herein.

Inspect each signal assembly after it has been installed in the field. This inspection shall conform to the Contractor's Installation Procedure as accepted by the Engineer.

L.E.D. Lamp Units shall meet the requirements of AREMA C&S Manual Part 7.1.5.

Signal aspect shall be distinct and unmistakable when viewed from a height of 7 to 12 feet above top of rail at a distance of 1,000 feet. Nominal sighting distance shall be 2000 feet. Where unobstructed sighting distance for a standard signal arrangement is less than 2000 feet, provide to the Resident Engineer written notifications of sighting problems and locations.

Foundations shall meet requirements of AREMA Signal Manual Part 14.1.1.A through 14.4.36 inclusive, where requirements of the AREMA Specifications do not conflict with requirements specified herein.

The Engineer reserves the right to make inspections and tests, as necessary, to determine if the equipment meets the requirements of these Specifications.

MATERIALS

Delivery, Storage, and Handling

Ship lamp units separately from the signal head in which they will be used.

Contractor shall ensure that wayside signal assemblies and signal lamp units are safely stored and protected from damage during storage, handling and transporting.

Warranty

Contractor shall provide warranty from defects arising from defective parts, workmanship, and lightning damage for 2 years from the first date of service.

Materials

Contractor shall furnish color-light signal heads as manufactured by Safetran, as specified herein, and as shown on SCRRA ES8525-01

Contractor shall furnish ground signal assemblies in accordance with these Specifications, and SCRRA ES8500-01 and ES8505-01, as appropriate for site-specific requirements.

Signal Heads

Signal head shall be furnished with L.E.D. lamp units, blank out cover plates (if applicable), hoods, background, mounting brackets, and U-bolts to fit 5-inch mast assemblies that Contractor proposes to furnish.

Signal head shall include mounting bracket for 5-inch mast and stainless steel fasteners.

Color-light signal units shall be capable of displaying three aspects: green, yellow and red as shown on SCRRA ES 8525-01

Install blank-out cover plates in unused lamp units.

Signal head shall be designed to allow removal of lamp units from the rear.

Doors shall be provided with a means of securing in closed position.

Ground Signal Assemblies

Contractor shall furnish ground signal assemblies in accordance with SCRRA ES 8500-01, as appropriate for site-specific requirements.

Ground signal assemblies shall consist of an aluminum 5-inch mast structure, junction box, liquid-tight flex conduit, platforms, ladder, ladder foundation, grounding pigtail welded to the mast structure, and shall be equipped with mounting hardware to accommodate the required arrangement of signal heads.

Each ground signal assembly must be fully compliant with the latest OSHA and CAL-OSHA fall protection requirements in effect at the advertisement of this Contract. Where a conflict exists between the requirements, the most stringent shall apply.

Signal Masts

Signal masts shall be predrilled for the placement of signal units by the manufacturer at the factory. Nominal signal mast height is between 21 feet and 21 feet 7 inches. A 5-inch cap for top of mast shall also be provided with each mast unit.

The base section shall be designed to accommodate a 5-inch mast. The dimensions of the foundation bolt hold centers in the base shall be as specified on SCRRA ES8500-01 and SCRRA ES8505-01.

Signal mast shall be fitted with one 48-inch long No. 2 ground wire cad-welded to the mast as shown on SCRRA ES8500-01 and ES8505-01. The pigtail shall be coiled and secured in a manner that prevents during construction and while in transit.

Grounding for signal mast shall be as specified in Special Provision, Signal Grounding.

Ladders and Platforms

Platforms and ladder mounting brackets shall be constructed of galvanized steel, and shall be in accordance with AREMA Signal Manual Part 7.2 and SCRRA ES8500-01 and ES8505-01.

Ladders shall be constructed of aluminum having non-slip rungs and capable of supporting the weight of two people. Two hinged flat plates shall be fitted to the ladder to prevent unauthorized access to both sides of the ladder. The covers shall be locked in place by a signal padlock and hasp arrangement intended for this purpose.

Ladder platform cages shall extend a minimum of 42 inches above the top of landing.

Junction Boxes

Junction box shall be in accordance with SCRRA ES8530-01

Junction box shall be mounted as shown in SCRRA ES8500-01 and ES8505-01. Junction box shall be securely fastened to the mast using 5-inch u-bolts. Junction box shall be furnished with a minimum of 28 AAR test (multi-unit) terminals in accordance SCRRA ES8330, and a 4-inch liquid tight flex conduit 8feet. length with liquid-tight flex conduit 8feet. in length with liquid-tight fitting.

Foundations

Furnish foundations for ground signals in accordance with SCRRA ES8255.

Furnish galvanized steel foundations complete with galvanized bolts, washers, nuts and associated hardware. Galvanizing shall conform to Specifications in Special Provision, Signal Systems Miscellaneous Products, and AREMA Signal Manual, Part 15.3.1.

Construct galvanized steel foundations of steel angle and plate welded together. Foundations shall be constructed of 2 ½ inch by 2 ½ inch by ¼ inch steel angle and ¼ inch steel plate.

CONSTRUCTION

Installation - Signals

Contractor shall furnish and install signal layouts in locations as indicated on the railroad plans and as shown on the accepted shop drawings. No part of any signal layout shall conflict with SCRRA Design Standards, Code of Federal Regulations, Part 49, nor installed within the clearance envelope as defined in CPUC G.O. 26-D.

Locate signals centered between insulated joint, except where physically not possible. In such instances, submit a recommendation to the Resident Engineer for approval.

Center line of signal mast shall be 15 feet from centerline of track unless a deviation from this is approved by the Resident Engineer, as shown on the railroad plans or required to meet CPUC clearance requirements.

Install signal units level and plumb on their foundations. Leveling nuts shall be used as shown on SCRRA Engineering Standards.

Install signal layouts in accordance with the applicable requirements of AREMA Signal Manual, Part 7.4.1 and SCRRA Engineering Standards.

Install platforms for each signal unit level.

Align signals for maximum viewing distance before placing in service.

Refer to Design Requirements herein regarding signal aspect and sighting distances. Install signals and verify sighting distances. Provide the Resident Engineer with written notification with any sighting problems.

Mount signal heads on an offset arm as shown in the SCRRA Engineering Standards. Signal heads shall also be able to swivel on the offset arm and be adjustable.

Signal nomenclature shall be as shown on the railroad plans.

The underground cable shall be dressed, pot-headed, tagged and terminated in the signal junction box as specified in Special Provision, Signal Systems Miscellaneous Products. The number of conductors and conductor size of the underground cables shall be as shown in the railroad plans.

Wiring from the junction box base to the signal heads shall be No. 10 AWG copper stranded wire as shown on the railroad plans.

Install identification tags on each wire. These tags shall bear the nomenclature shown on the accepted Shop Drawings.

Set lamp voltage between 8.8 volts and 9.2 volts measured at the signal lamp.

Installation – Junction Boxes and Cabling

The junction box shall have two terminals with insulated test links for each cable conductor, as specified in Special Provision, Signal Systems Miscellaneous Products.

Junction box placement and cable entry to the junction box shall be as shown on SCRRA ES8500-01 and ES8505-01.

The method of routing #10 flex wire from the junction box to each signal mounted on the structure shall be to route the wire within the tubular members of the structure. Pull wires entirely through the structure members, mast and signal mounting brackets, unless otherwise approved by the Resident Engineer.

Provide pull boxes located a maximum of 5 feet from each signal. Edges shall be smooth and rounded to accommodate cable installation.

Installation - Foundations

Install each foundation in accordance with the approved Contractor's Installation Procedure for each type of foundation, as herein specified, and as shown on SCRRA ES8215-01. The absence of a specific task listing herein does not relieve the Contractor of the responsibility for providing a complete and functional installation.

Refer to Special Provision, Coordination with Utility Owners, for requirements for locating and protecting existing utilities. Advise the Resident Engineer immediately if any utility or cable interferes with foundation work. After locating interference, allow 72 hours for the Resident Engineer to relocate or mitigate the interference.

Prior to placing steel foundations in the excavations, place and compact a crushed stone base in accordance with Special Provision, Earthwork.

When placing foundations, exercise care and ensure that anchor bolts are not bent or threads damaged. Protect anchor bolt threads, washers, and nuts by applying friction tape or other accepted method satisfactory to the Resident Engineer, until the unit to be supported is installed.

After back filling excavation, the Contractor shall ensure that the foundation is plumb and level. Where ground signal foundations are installed, the top of the foundation shall be no higher than the nearest rail and no lower than the top of nearest tie. Under no circumstance shall the top of the foundation be more than 24 inches above final grade.

Foundations shall be installed to the lines, grades and dimensions required as determined by the Contractor and accepted by the Resident Engineer. Mounting bolts shall be of sufficient length to accommodate use of leveling nuts between the base of the equipment to be supported and the top of the foundation.

Painting

Touch up any damaged painted finish.

Field Tests

Make tests for proper operation and setting of lamp operating voltages in accordance with Special Provision, Signal Systems Testing.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.26 TRACK SHIFTING, RELOCATION, AND RESURFACING

GENERAL

Summary

Furnish supervision, labor, materials, equipment, transportation and incidentals necessary to shift, relocate or resurface railroad track as shown on the railroad plans and specified herein. Railroad track as used herein is defined as "an assembly of rails, ties and fastenings over which cars, locomotives and trains are moved." This "track" assembly includes, the rail, ties, special trackwork, other track material (OTM), ballast, and walkways although not an exclusive listing. Special provision for TRACKWORK will govern track construction work associated with this Section.

Perform track shifting, relocation and resurfacing work as shown on the railroad plans, and in accordance with this Section.

Prior to shifting or relocating track, drainage structures and grading, including placement of Sub-Ballast shall be completed and accepted by the Engineer.

Shifted, relocated, and resurfaced track shall be stabilized using a Ballast Stabilizer.

Following shifting, relocating, resurfacing and stabilizing of track, rail shall be distressed in accordance with SCRRRA Track Maintenance and Engineering Instructions Section 8.3.

Track shifting shall include work to shift existing track more than 1 foot and less than 10 feet and providing Ballast per the special provision BALLAST, resurfacing and regulating track in its new location.

Track relocation shall include all work to relocate existing track a distance greater than 10 feet including installation of Ballast per the special provision BALLAST, resurfacing and regulating track in its new location.

Resurfacing, shall include shifting of existing track up to 1 foot, and involves resurfacing indicated track and special trackwork, including lining, raising, tamping, and regulating track in conformance with SCRRRA engineering standards, provisions of this specification, and to the lines and grades shown on the railroad plans. The Ballast per the special provision BALLAST required to fill cribs and provide adequate shoulders must be provided by the Contractor.

Rough and final surfacing of the entire track section shall be performed to provide minimal profile smoothing and adjustment. This surfacing may include providing and placing Ballast per the special provision BALLAST, tamping, stabilizing and regulating ballast.

The Contractor must submit a SSWP for each track segment that requires shifting, relocating, or resurfacing the active track and specification for COORDINATION WITH SCRRRA.

Submittals

Refer to the special provision for COORDINATION WITH SCRRRA, for submittal of applicable SSWP.

Quality Control and Assurance

Contractor must perform track shifting, relocating, and surfacing under supervision of a qualified railroad Construction Project Manager, railroad Track Construction Manager, and Track Foreman. Work shall be performed by personnel experienced in similar railroad track work. The surfacing crew shall include a ground man, with a minimum of six months experience, qualified to check profile and alignment behind the tamper.

Project Conditions

This work may occur on an active railroad track.

The Contractor must coordinate the Work to prevent undue interference with the SCRRRA daily operations, or with other phases of the Project, whether performed by SCRRRA forces or another contractor's forces.

MATERIALS

Products

Materials to be installed under this Contract must be provided by the Contractor unless indicated otherwise in the Contract Documents.

Materials damaged or broken prior to or during installation must be replaced at the Contractor's expense with no cost to SCRRRA.

Labor, material not furnished by SCRRRA, or equipment required for track resurfacing but not expressly shown on the railroad plans shall be as if shown on the Drawings and included in the Contractor's bid price.

Material must be new, except as otherwise indicated herein, and meet the requirements stated herein and of the AREMA and SCRRRA Standards.

CONSTRUCTION

Contractor personnel and equipment shall meet the requirements set forth in these contract documents.

Contractor must exercise care in his progression of work under this Contract to avoid and prevent damage to the track being shifted, relocated, or resurfaced, adjacent tracks, and structures and facilities, such as existing pavements, pavement bases, drainage structures, light poles, fire hydrants, signal facilities (track wires, bootlegs, signal masts, guy wires, signals, cables, conduits) utilities, signage and buildings. Contractor must repair or replace damaged structures or facilities to satisfaction of the owner at no cost to SCRRA, except that SCRRA will repair and test signal facilities at the Contractor's expense. Track wires, bootlegs, signal masts, guy wires, signals, cables, conduits and other signal facilities identified for removal in the SSWP will not be removed by the Contractor but will be removed by SCRRA. The Contractor must be responsible to coordinate his work with SCRRA to arrange for the timely and orderly removals or relocations of this signal equipment and facilities. Failure of the Contractor to provide reasonable and adequate coordination for timely removal and relocation of signal facilities will not allow for an extension of time or provide grounds for extra cost to SCRRA.

Contractor must perform Work under this Section in accordance with these Specifications and consistent with track resurfacing standard industry practice.

Contractor must periodically review the supply of materials, labor and equipment to ensure a uniform flow of work. Contractor must keep the Engineer informed regarding material shortages or developing problems that require corrective action.

Shifted, relocated, and resurfaced track shall meet the following tolerances as well as the standards for FRA 49CFR213 class 5 track.

Except for pre-existing rail gauge corner rail wear,

Deviation from correct gage of 56-1/2 inch shall not exceed + or - 1/4 inch at any point.

Deviation measured in any section of 20 consecutive crossties shall not exceed 1/8 inches at 75 percent of the crossties, and 1/4 inch at the remaining 25 percent.

Newly installed or re-installed ties will be spiked not to exceed + or - 1/8" irrespective of pre-existing rail gauge corner wear.

TRACK SURFACE	TOLERANCE
Runoff in any 31 FEET of rail at the end of a raise may not be more than	1/4 inch
Deviation from uniform profile on either rail at the mid-ordinate of a 62 FEET chord may not be more than	3/8 inch
Deviation from designated elevation on spirals may not be more than	1/4 inch
Variations in cross levels on spirals in any 31 FEET may not be more than	5/8 inch
Deviation from zero cross level at point on tangent or from designated elevation on curves between spirals may not be more than	3/16 inch
Difference in cross level between two points less than 62 FEET apart on tangents and curves between spirals may not be more than	3/8 inch

Alignment - maximum deviation from uniformity measured in conformance FRA Safety Standards Section, 213.55.

Tangent Track 1/4 inch - at mid-ordinate on a 62 feet chord.

Curved Track 1/4 inch - from correct mid-ordinate on a 62 FEET chord.

Elastic clips, rail anchors, and spikes shall be loosened prior to shifting track to prevent skewed ties. Rail, fasteners, or crossties damaged during track shifting must be replaced by the Contractor at Contractor's expense. Rail anchors are not to be slid longitudinally along the base of the rail. They must be removed prior to shifting track and reapplied in the correct location after track is shifted to its final location.

Contractor must perform shifting and resurfacing within the stated project limit station areas as specified to bring the line and surface into compliance within the track geometry tolerances specified.

Contractor must resurface the track to zero crosslevel on tangent track and to the proper crosslevel elevation, with spirals, for the curves as shown on Contract Documents.

Ballast shall be spread and track raised in a series of lifts. No single lift shall be higher than 2 inches except in crossings and turnouts. In raising the track, jacks or equipment shall be regulated to avoid bending of angle bars or straining of joints. When jacks are used they shall be simultaneously used and properly spaced at not more than quarter points of the rail to avoid breaks or bends in the rail when the track is raised. Both rails shall be raised simultaneously and to proper crosslevel by utilizing automatic tampers or standard track level boards with each set of track raising jacks. Each tie shall be tamped from 15 IN inside the rail to the end of the tie. Tamping shall not be permitted at the middle of a tie. Both ends of a tie shall be tamped simultaneously and tamping inside and outside the rail shall be done at the same time.

Ties that become loose during track raise shall be placed in proper position, tie-plates properly placed, holes plugged with "Tight Spike" or approved tie plugs and spiked before tamping. During each track raise, track shall be uniformly tamped.

After ballasting is completed and the track is resurfaced and lined, according to the tolerances, ballast shall be mechanically stabilized using a track stabilizer and ballast shall be trimmed neatly and surplus material shall be spread evenly along the ballast shoulder.

After stabilizing is completed, rail shall be distressed in accordance with SCRRRA Track Maintenance and Engineering Instructions Section 8.3.

Contractor must perform the necessary operations to ensure that ties are at right angles to the track as practical with standard railroad procedures. Cribs between ties shall be fully ballasted and dressed.

Contractor must perform 2 tamping squeezes per tie up to 2 inch of raise with one additional insertion and squeeze for each additional 1 inch of raise. Joint ties shall be given one additional squeeze more than other ties. The Contractor must not cause a center-bound track condition.

Where squeeze tampers cannot fill and compact ballast, such as but not limited at frogs, guard rails, switch portions of turnouts and headblocks, mechanically tamp with approved hand-held air tools or other power tamping tools. Hand tamping shall be done simultaneously from both sides of the tie.

On curves, the high rail shall be used as the line rail and the low rail shall be used as the grade rail.

When surfacing turnouts, the straight side of the turnout shall be used as the line rail.

After ballast regulating in turnouts, cribs for switch points, switch rods, and guardrails shall be pocketed 3 inches and cleared of ballast to permit free operation of the switch and signal rods.

After the ballast is regulated, dressed and consolidated using a track stabilizer, Contractor must ensure that track bolts and rail anchors, or elastic track fasteners are tight and in proper alignment.

For track resurfacing the total track raise will be the minimum amount necessary to smooth the track profile. It shall be the responsibility of the Contractor to provide smooth transitions that meet the required surfacing tolerances as listed above to grade crossings and turnouts, using the ballast stockpiled near the worksite. In addition, the Contractor must maintain vertical overhead clearances under structures by limiting the amount of track raise. Adjustment of turnouts and connecting tracks to match profile and alignment adjustments on adjacent track must be provided by Contractor at no additional expense.

Any temporary surfacing runoffs made to accommodate interim rail traffic prior to completion of track surfacing must meet FRA Track Class 5 Standards.

Walkways shall conform to SCRRRA Engineering Standards ES 2105 and General Order No.118-Public Utilities Commission of the State of California.

MEASUREMENT AND PAYMENT

Work of shifting, relocating and resurfacing existing track will include furnishing all labor, materials, tools, equipment, supplies, supervision, installation of Contractor provided ballast and walkway rock, laser aligned tamping, resurfacing, regulating, stabilizing and de-stressing to SCRRRA standard cross section and any other incidental work necessary for shifting, relocating and resurfacing existing track as described in the Contract Documents.

Full compensation for conforming to the requirements of this section is considered as included in the contract price paid per track foot for running rail, by the unit for concrete and wood ties, linear foot for construct concrete grade crossing panels, lump sum for cutover track from mainline to shoofly and reverse, track foot for install ballasted track, lump sum for construct ballasted turn out, track foot for construct track on bridge and no separate payment will be made therefor.

SECTION 15-1. CITY OF BURBANK

15-1.00 EMPIRE CENTER RESTORATION COST BREAK-DOWN

Submit to the Engineer a cost break-down for Empire Center restoration work for review after the working drawings for the walkway and landscape area have been reviewed. Allow 15 days for review of each submittal or re-submittal.

Furnish the completed cost break-down in the format shown in the sample of the cost break-down included in this section. Line item descriptions of work shown in the sample are the minimum. The Contractor may designate additional line item descriptions of work. If the Contractors designate additional line item descriptions of work, the quantity, value, and amount for those line items must be completed in the same manner as for the line item descriptions shown in the sample.

The sum of the amounts for the line items of work listed in the cost break-down for Empire Center restoration work must be equal to or less than the contract lump sum price bid for Empire Center restoration. Include overhead and profit in each individual line item of work listed in the cost break-down table.

No adjustment in compensation is made in the contract lump sum price paid for Empire Center restoration work due to differences between the quantities shown in the cost break-down for Empire Center restoration work and the quantities required to complete the work.

The Engineer approves in writing the cost break-down for Empire Center restoration work before any progress payments are made for the item.

EMPIRE CENTER RESTORATION COST BREAK-DOWN

Contract No. **07-1218W4**

WORK DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
Remove Decorated Wall	LF	38		
Remove Walkway and Railing	LS	Lump Sum		
Remove Tree	EA	1		
Remove and Replace Trash Can	EA	1		
Remove Decorated Pavement	SQFT	349		
Replace Planting	LS	Lump Sum		
Construct Decorated Wall	LF	38		
Construct Decorated Pavement	SQFT	349		

TOTAL _____

15-1.01 TEMPORARY SIGNAL SYSTEM

The temporary signal system (TSS) shall consist of installing and maintaining temporary traffic signal and lighting for traffic control in conformance with the details shown on the plan entitled "RR -Temporary Traffic Signal Modification Plan," the provisions in "Maintaining Traffic" of these special provisions, the provisions in Section 86, "Electrical Systems," of the Standard Specifications, and these special provisions.

The provisions in this section shall not relieve the Contractor from the responsibility to provide the additional devices or take the measures as may be necessary to conform to the provisions in Section 7-1.09, "Public Safety," of the Standard Specifications.

Other materials and equipment for a temporary signal system including, but not limited to, signal heads, mast arms, luminaires, wood poles, conductors, and hardware shall be furnished by the Contractor.

Materials and equipment to be used in the temporary signal system shall be either new or used suitable for the intended use.

Each signal face shall be oriented to be clearly visible to traffic approaching from the direction which the signal is intended to control.

OPERATION

Temporary signal system shall operate at nominal 120 V (ac). Lighting shall operate at 120 V (ac) or 240 V (ac).

Unless otherwise directed by the Engineer, the system shall be operated on a continuous 24-hour basis except for the periods when it is necessary to control traffic by flaggers.

Timing of a temporary signal system will be performed by City forces.

MAINTAINING TEMPORARY SIGNAL SYSTEM

Maintaining a temporary signal system, except the controller assembly, shall be the responsibility of the Contractor.

If components in the temporary signal system are damaged, displaced or cease to operate or function as specified, from any cause during the progress of the work, the Contractor shall immediately repair the components to the original condition or replace the components and shall restore the components to the original location. Components shall include signs, flashing beacons, and signal equipment.

In the event the temporary signal system is out of operation, for any reason, the Contractor shall provide flaggers, at the Contractor's expense, to maintain traffic control until the traffic signals are returned to service.

CONDUIT

At those locations where conduit is to be installed under pavement, if delay to vehicles will not exceed 5 minutes, conduit may be installed by the trenching in pavement method in conformance with the provisions for "Trenching in Pavement Method" in Section 86-2.05C, "Installation," of the Standard Specifications and these special provisions.

CONDUCTORS AND WIRING

Conductors shall be the types specified in Section 86-2.08, "Conductors and Cables," of the Standard Specifications or shall be Type UF cable of the size and number of conductors shown on the plans. Minimum conductor size shall be No. 12.

Where conductors are to be placed across paved areas, the conductors shall be placed in conduit or in slots cut in the pavement as specified for inductive loop detectors in Section 86-5.01A(4), "Installation Details," of the Standard Specifications, including placing sealant over the conductors, or the conductors shall be suspended at least 25 feet above the roadway.

Conductors to be placed outside of paved areas shall be placed by one of the following methods:

1. Direct burial method with Type UF cable installed at a minimum depth of 24 inches below grade.
2. Placed in new or existing conduit. If Type 1 or Type 2 new conduit is used, the minimum depth shall be 12 inches. If Type 3 new conduit is used, the minimum depth shall be 18 inches.
3. Suspended from wood poles with a minimum clearance at any point of 10 feet. Conductors on the pole within 10 feet above ground shall be enclosed in a Type 3 or Type 4 conduit.

Conductors to be placed across structures shall be placed in a Type 1, Type 2 or Type 3 conduit. The conduit shall be installed on the outside face of the railing and secured by a method determined by the Engineer.

Conductors to a terminal compartment or signal head on a pole may be spliced to through conductors of the same phase in a pull box adjacent to the pole. Conductors or cables shall not be spliced except in pull boxes or in NEMA Type 3R enclosures.

BONDING AND GROUNDING

Flashing beacons, signal heads, standards with metal bases and the controller cabinet shall be mechanically and electrically secure to form a continuous system effectively grounded by the grounding conductor.

SERVICE

The following method shall be used to provide power for the TSS:

1. Obtain commercial power from an existing utility company.

COMMERCIAL POWER

Commercial power shall be 120 V (ac) or 120/240 V (ac). Power sources shall be protected in locked enclosures. The City shall be provided with keys to all locks.

Power shall not be obtained from private parties, other than a direct connection to a utility company service point.

Electrical power shall not be used from existing highway facilities, except when approved in writing by the Engineer.

The Contractor shall make arrangements with the utility company for providing service.

STATE-FURNISHED CONTROLLER ASSEMBLY

State or local forces will maintain all controller assemblies.

DETECTORS

Loop detector sensor units will be State-furnished as part of the controller assembly.

Loop detector lead-in cable shall be Type B.

SALVAGING SIGNAL SYSTEM

Upon completion of the work requiring traffic signals, as determined by the Engineer, State-furnished components of the temporary signal system shall be salvaged and delivered to the City of Burbank Yard at 124 South Lake Street, Burbank, CA 91502.

Other materials and equipment shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way," of the Standard Specifications. Pole holes shall be backfilled.

Conductors placed in slots across paved areas as specified herein, when no longer required, shall be abandoned in place when determined by the Engineer. Direct buried conductors, installed 12 inches or more below the ground surface, and conduit may be abandoned in place.

PAYMENT

The contract lump sum price paid for temporary signal system shall include full compensation for furnishing all labor, materials tools, equipment, and incidentals, and for doing all the work involved in installing, maintaining, and removing the temporary traffic signal, lighting, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

15-1.02 TRAFFIC SIGNALS, SIGNING AND STRIPING WORK (CITY OF BURBANK)

GENERAL

Summary

Portland Cement Concrete sidewalk shall be constructed in accordance with applicable Standard Drawings and per Subsection 303-5 entitled "Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps and Driveways" of the Standard Specifications for Public Works Construction (SSPWC), except as specified herein.

Forming shall include A.C. removal, replacement, grading and sawcutting necessary to build forms for concrete construction.

Sidewalks shall be 3-1/2 inch minimum thickness. On grades of 6% or less, they shall be given a rotary sweat finish with a steel trowel. Score lines shall be spaced at approximately 2 feet 6 inch, and shall match existing score lines.

SALVAGING EQUIPMENT

Existing Traffic Signal, Street Lighting equipment, and Foundation shall be removed unless otherwise specified. Removed equipment shall be salvaged and delivered to City Yard at 124 South Lake Street, Burbank, CA 91502. Existing conduits not to be reused shall be abandoned. Contractor shall dispose of foundations, and conductors.

ENVIRONMENTAL COMPLIANCE

Contractor shall not discharge or permit to be discharged to a street, channel, river, storm drain, or appurtenances thereof, a non-rain water or other fluid substance from the project or from operations pertaining to the project site without first securing a valid National Pollutant Discharge Elimination System (NPDES) permit unless the discharge is specifically listed as exempt or conditionally exempt in the most current list issued by the Regional Water Quality Control Board, Los Angeles Region.

Contractor shall implement necessary Best Management Practices (BMPs) to ensure that any conditionally exempt discharge meets current requirements of the Regional Water Quality Control Board and the city.

The city may prohibit or restrict any discharge if, in its discretion, the discharge is polluting, unsafe, or causes a nuisance condition to be created.

Contractor shall reduce the discharge of pollutants in storm water runoff to the maximum extent practicable by the effective implementation of appropriate BMPs. The following are the minimum requirements:

1. Sediments from areas disturbed by construction shall be retained on site and stockpiles of soil shall be properly contained to minimize sediment transport from the site to streets, drainage facilities, or adjacent properties via runoff, vehicle tracking, or wind.
2. Construction-related materials, wastes, spills, or residues shall be retained at the construction site to minimize transport from the work area to streets, drainage facilities or adjoining properties via vehicle tracking, runoff, or wind.

Non-stormwater runoff from equipment and vehicle washing shall be contained at project sites.

Erosion form slopes and channels shall be controlled by implementing an effective combination of BMPs, such as limiting grading scheduled during the wet season; inspecting graded areas during rain events; planting and maintenance of vegetation on slopes; and covering erosion susceptible slopes.

The selection, submittal, and adherence to BMPs are the responsibility of the Contractor. The selected BMPs must be submitted to and approved by the city prior to performing any operation under this contract which will disturb or expose soil, including, but not limited to: excavation, grading, demolition, clearing and grubbing, pavement removal, etc.

Construction activity that results in soil disturbances of less than one acre is subject to the General Permit for Storm Water Discharges Associated with Construction Activity (General Permit) if the construction activity is part of a larger common plan of development that encompasses one or more acres of soil disturbance or if there is significant water quality impairment resulting from the activity.

If it is determined that the entire site consists of one acre or greater, the Contractor must file a Notice of Intent (NOI) with the State to comply with the terms of the General Permit, and must provide proof of a Waste Discharge Identification (WDID) Number to the city prior to the issuance of a grading permit. The preparation, submittal and adherence to NOIs, Storm Water Pollution Prevention Plans (SWPPPs), Wet Weather Erosion Control Plans (WWECPs), and Contractor Self-Inspection Forms are the responsibility of Contractor.

The city may restrict the continuation of work if it is determined that the Contractor has not met the NPDES requirements.

TRAFFIC SIGNALS

Equipment, materials, and components for traffic signal and communication systems, and the installation thereof, shall conform to Section 86, "Signals and Lighting," of the Standard Specifications, except as noted in the Special Provisions and on the Plans.

MAINTAINING EXISTING SYSTEMS

Maintenance of existing traffic signal and safety lighting systems shall be in accordance with Section 86-1.06, "Maintaining Existing and Temporary Electrical Systems," of the Standard Specifications, except as modified or supplemented herein.

Temporary mast arm signal standards shall be installed whenever the existing mast arm indication will be inoperative for more than eight hours. Where there are no existing mast arm standards, temporary Type 1 standards may be used. Temporary standards shall be as shown in the Standard Plans.

Prior to initial turn-on of new or modified signal systems, equipment, signal displays, and loop detectors as shown on the Plans and called for in the Special Provisions, shall be installed and operable. The initial turn-on shall be made between 9:00 a.m. and 2:00 p.m. on a day not followed by a Saturday, Sunday, or legal holiday, unless otherwise approved by the Engineer. Notification shall be given to the Engineer 48 hours preceding the turn-on day.

Full compensation for temporary signal operation shall be considered as included in the contract lump sum price paid for temporary signal system and no additional compensation will be allowed therefore.

MATERIAL AND EQUIPMENT STORAGE

The Contractor shall comply with the requirements of Section 6-1.03, "Storage of Materials," of the Standard Specifications, except as modified or supplemented herein.

Spoils from foundation excavation shall be immediately removed from the project site. Traffic signal standards and mast arms shall not be delivered to the project site prior to the day of erection. Overnight storage of materials removed or to be incorporated into the construction, shall not be permitted on the traveled roadway surface.

EXCAVATION AND BACKFILL

Excavation and backfill shall be in accordance with Section 86-2.01, "Excavating and Backfilling," of the State Standard Specifications, except as modified or supplemented herein.

At any intersection, standards shall be erected, foundations capped and surfaces restored within 6 weeks of commencing excavation or breaking concrete. Foundations for controllers are exempt from the above.

FOUNDATIONS

Foundations shall be in accordance with Section 86-2.03, "Foundations" of the Standard Specifications, except as modified or supplemented herein.

Contractor shall locate substructures prior to construction. Hand-dig foundation until clear of obstruction. Coordinate pole installations with overhead Utility or Substructures owners.

Fly ash substitutes and/or admixtures shall not be permitted.

When existing foundations are removed, the entire foundation shall be completely removed.

STANDARDS, STEEL PEDESTALS AND POSTS

Standards, Steel Pedestals and Posts shall be in accordance with Section 86-2.04, "Standards, Steel Pedestals and Posts" of the Standard Specifications, except as modified or supplemented herein.

The base plate shall be of steel conforming to the requirements of American Society for Testing and Materials (ASTM) A36.

Signal Poles, Controller Cabinet and Service Cabinet locations shall be identified by the Engineer in the field. Contractor shall perform preliminary striping layout prior to loop detector layout.

The contract lump sum price paid for furnish and install traffic signal system complete includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in furnish and install traffic signal system complete, including furnishing and installing traffic signal poles and foundations, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

TRAFFIC SIGNAL CONDUITS

Conduit shall be in accordance with Section 86-2.05, "Conduit," of the Standard Specifications, except as modified or supplemented herein.

Conduit and fittings shall be hot-dipped galvanized rigid steel type in accordance with Section 86-2.05A, "Conduit," of the Standard Specifications.

The minimum diameter of conduit: From a signal standard to the adjacent pull box shall be 2 inch.

Conduit runs shall be 3 inch diameter hot-dipped galvanized rigid steel, unless otherwise noted on the Plans.

Conduit shall be placed to a depth of not less than 30 inches nor more than 60 inches below the flow line grade, except that conduit placed behind a curb shall not be less than 18 inches nor more than 36 inches below top of curb, and conduit placed under railroad tracks shall not be less than 60 inches below bottom of ties. Series street lighting conduit behind a curb shall be placed to a depth of not less than 24 inches.

Conduit ends terminating in the controller cabinets, pull boxes and standards shall be securely packed with an approved sealant after conductors are installed to prevent moisture intrusion.

Conduits shall be installed by jacking or drilling method unless otherwise called out on the Plans or directed by the Engineer. No Rock wheel allowed.

Polyethylene conduit shall be Schedule 80 and manufactured from high density, extra high molecular weight polyethylene. The material shall meet the requirements of National Electrical Manufacturers Association (NEMA) TC 7 and shall be listed in Plastic Pipe Institutes PPI TR 4. The conduit shall be manufactured in accordance with the dimensional requirements of ASTM D3035, ASTM F714, or NEMA TC 7.

Rigid steel conduit shall be hot-dipped galvanized rigid steel type meeting the requirements of Section 86-2.05A "Conduit," of the Standard Specifications.

The material used to fabricate bends for fiber optic conduit runs shall meet the burn-through and friction requirements identified in the Testing section of this section.

Conduit runs across streets or greater than 50 feet in length may be High Density Polyethylene HDPE and installed using the directional boring method. Conduit runs of less than 50 feet in length, except for runs across streets, shall be rigid steel and installed via trenching unless otherwise approved by Engineer

During shipping and while on the job site, the open ends of runs of conduit shall be sealed with removable caps to prevent the entry of rodents, dirt, sand, water, and other foreign materials. These caps shall be removed only when the Contractor is in the act of joining sections together, testing, or pulling cable. The open ends shall be immediately recapped after completion of these activities. For the conduits that are to remain empty, pull rope shall be attached to the removable caps without compromising the seal, and the caps shall be left in place.

Conduits installed in parkway areas shall be routed beneath sidewalk when possible.

Occupied conduit ends terminating in controller cabinets, splice vaults, pull boxes and standards shall be securely packed with an approved sealant after conductors are installed.

FIBER OPTIC CONDUIT

When obstructions are encountered during installation and fiber optic conduit cannot be economically located elsewhere, the obstruction shall be bypassed by deflecting the conduit at a rate of at least 10:1. Minimum 3 feet radius, maximum 90° bends may be used to avoid obstructions at locations where 10:1 deflection is not possible, provided the least degree bend needed to clear the obstruction is used. Flexible bends may be utilized when needed to facilitate proper location of the fiber optic conduit, only at locations approved by the ENGINEER. Fiber optic conduit runs between any two pull boxes/splice vaults shall not employ more than 4 bends, or exceed an angular sum of 270°.

Fiber optic conduit shall enter through the bottom of pull boxes and splice vaults with a minimum 3 feet radius sweep and at an angle of 45° or less measured along natural grade. The conduit ends shall protrude a minimum of 2 inch above the bottom of the pull box or splice vault.

Fiber optic warning tape shall be installed above fiber optic conduit installed in open trenches. The message side shall face up. Fiber optic conduit warning tape shall bear the words "FIBER OPTIC CABLE BURIED BELOW" or approved equivalent in black letters on an orange background, or approved equivalent.

Locator wire shall be installed in fiber optic conduit to facilitate locating underground fiber optic cables. Only one locator wire is needed in each trench or for multiple conduits grouped close together. Locator wire is not required when the trench contains metallic conduit or bond wire. Connect locator wires at pull boxes and splice vaults. Locator wire shall be #18 or larger and may be bare or jacketed, solid or stranded. If bare wire is used, then only solid wiring shall be used.

DIRECTIONAL BORING

The drilling system shall utilize small-diameter fluid jets to fracture, and mechanical cutters to cut and excavate the soil as the drill head advances forward. The drill head shall be sized to produce an average hole diameter of 4 inch or less. If boring fluids are used to lubricate the drilling head, the fluids shall consist of a mixture of bentonite and water or polymers and additives unless otherwise approved by the Engineer.

Minimum pressures and flow rates shall be used during drilling operation so as not to fracture the subgrade material around and/or above the bore. Uncontrolled jetting (where the primary purpose is to use fluid force to erode soil for creation of the final bore hole diameter) is prohibited.

Locate, record, and correct the path of the drill head a minimum of every 10 feet.

Use a backreamer sized no larger than one half inch greater than the outside diameter of the conduit to install the conduit.

The backreamer shall inject bentonite slurry (or approved equivalent) to fill any voids in the hole while pulling conduit through. The bentonite slurry shall be designed and certified by the manufacturer specifically for preserving the integrity of the soil and preventing collapse during and following directional boring

The entire length of directional bored conduit shall be installed without coupling, splices, or joints (i.e. it shall be one continuous piece from pull box/splice vault to pull box/splice vault) unless otherwise permitted by the Engineer.

The depth of conduit requirements specified in the thirteenth paragraph of Subsection 86-2.05C shall be deleted and substituted with the following:

"Except for rises at the beginning and end of a run, conduit that is installed by directional boring shall be placed to a depth of not less than 96 inch nor more than 144 inch below the flow line grade or top of curb unless otherwise approved by the Engineer. Conduit placed under railroad tracks shall not be less than 144 inch below bottom of ties.

TRENCHING

Trenched conduit shall be placed to a depth of not less than 30 inch nor more than 60 inch below the flow line grade, except that conduit placed behind a curb shall not be less than 18 inch nor more than 36 inch below top of curb, and conduit placed under railroad tracks shall not be less than 60 inch below bottom of ties. Series street lighting conduit behind a curb shall be placed to a depth of not less than 24 inches.

TESTING

Conduit and bends used for conduit runs that are identified on the plans to contain fiber optic cables shall be certified to meet the following requirement for burn resistance and friction:

- A. Burn resistance. Perform the burn resistance test on a 90°, 3 feet radius conduit or bend wrapped around and secured to a rigid form. Thread an appropriate length of 0.25 inch diameter braided polyethylene rope through the conduit and sew the ends together to create a continuous loop. The loop of rope shall be wrapped around a powered capstan and drawn away from the conduit at a rate of 100 feet per minute. The sample shall not burn through within 90 minutes.
- B. Friction. Fiber optic conduit and bends shall have a coefficient of friction of 0.09 or less when tested in accordance with Bellcore GR-356.

PEDESTRIAN PUSH BUTTONS

Pedestrian Push Button Assemblies shall be in accordance with Section 86-5.02, "Pedestrian Push Button Assemblies", of the Standard Specifications, except as modified or supplemented herein.

Pedestrian push buttons shall be Type "B".

Pedestrian push button actuator shall be the Polara Engineering's "Bulldog-Momentary", Model BDLM-G or City approved equal.

Pedestrian push button signs shall conform to the details shown on the plans. The message and symbol shall conform to State Standard Plan ES-5C.

Full compensation for furnishing and installing pedestrian push button assemblies shall be considered as included in the contract lump sum price paid for furnish and install traffic signal equipment complete and no additional compensation will be allowed therefore.

PULL BOXES AND SPLICE VAULTS

Pull boxes, splice vaults, covers and extensions shall be in accordance with Section 86-2.06, "Pull Boxes," of the Standard Specifications and these special provisions.

Pull boxes, covers and extensions shall be precast reinforced Portland Cement Concrete (PCC) except when noted otherwise. Plastic pull boxes shall not be used.

Pull box and splice vault covers shall be marked "Traffic Signal". The marking shall be clearly defined and uniform in depth and may be placed parallel to either the long or short side of the cover. Covers shall be marked in accordance with Section 86-2.06B, "Cover Marking," of the Standard Specifications.

Pull boxes or splice vaults shall not be installed in any part of a driveway, curb ramp or other traveled way unless authorized by the Engineer.

Pull boxes and splice vaults shall be installed in sidewalk areas where possible.

Unless otherwise specified or provided herein, pull boxes shall be Size No. 6 with extension (6E).

Reinforcement for concrete pull boxes shall be bar reinforcement or 3/4-inch mesh, No. 20 U.S. gage minimum, hardware cloth.

Covers shall be provided with at least one recessed lifting bolt or bar as shown in the Standard Plans. The lifting bolts or bars shall be designed so as not to provide a path for electrical current to follow through the lid.

Delete grout requirement in bottoms of pull boxes and splice vaults. Pull boxes and splice vaults shall be installed in accordance with APWA Standard Plan No. 460-0.

New Pull boxes located in roadways, driveways or anywhere within 50 feet of a railroad track centerline shall be traffic-rated pull boxes with steel covers and special concrete footings in accordance with Standard Plan ES-8

regardless of any designation otherwise on railroad plans. Steel cover shall have embossed non-skid pattern. Other pull box requirements are as indicated on the railroad plans and other contract documents.

Conductors and wiring shall be in accordance with Subsections 2.08, "Conductors," and 2.09, "Wiring," of the Standard Specifications, except as modified or supplemented herein.

Stranded and braided conductors shall be terminated with approved terminal lugs that shall then be soldered to the conductors.

The insulation for multiple circuit conductors shall be Type THW.

The Contractor shall install signal cable in lieu of individual conductors.

Twisted pair signals interconnect cable (SIC) shall meet the requirements of the Rural Utilities Service (RUS) Specification PE-22. Two turns of SIC shall be provided in intermediate pull boxes; 50 feet of SIC shall be provided in fiber optic pull boxes and splice cabinets.

Splicing is allowed only in pull boxes for the signal cables. The cable shall feed directly from one conduit to the next without any extra cable coiled in pull box, except where pull box is next to the controller, a minimum of three feet of slack shall be provided unless otherwise called out on the plans.

The splices between the stranded and solid wire shall be made by careful cleaning of the bare conductors, twisting the wires together for a good mechanical bond, applying a non-corrosive paste flux to the conductors and then applying heat to the conductors so that when solder is applied to the conductors, it will completely melt and flow into voids. A wire nut shall then be encapsulated within an epoxy pack to form a complete waterproof connection.

For signal standard with luminaries, a fused disconnect spliced connector shall be installed in each pull box adjacent to the standard and shall be readily accessible in the pull box regardless of whether the ballast is remote, or is integral with the luminaire. The connector shall have no exposed metal parts.

Fused splice connectors shall not be used in series circuits. Fuses shall be standard midget, ferrule type and shall be rated as follows:"

- 5 amperes for 150-watt lamps
- 5 amperes for 200-watt lamps
- 10 amperes for 250-watt lamps
- 10 amperes for 310-watt lamps
- 10 amperes for 400-watt lamps

28 conductor signal cable shall be 14/28-SBX 87526 the Standard Type. Interconnect cable shall be PE22, AWG 19, 25 pairs

Prior to splicing new twisted cable to existing twisted cable, the Contractor shall test of the continuity of the existing cable and identify any anomalies to the Engineer. Following installation, splicing, and installation of connectors to the twisted pair cable, the Contractor shall measure and record the loop resistance and insulation integrity of the circuit. The measured values shall not deviate from the calculated values by more than ten percent.

Bonding and grounding shall be in accordance with Section 86-2.10, "Bonding and Grounding," of the Standard Specifications and these special provisions.

A separate equipment grounding conductor shall be installed to connect the equipment grounding terminal/buss of the traffic signal controller cabinet to the terminal/buss to which the grounded service conductor is connected in the traffic signal service.

The equipment grounding conductor shall be a Type "THWN", No. 8 AWG or larger, stranded copper wire continuously GREEN in color and shall be unspliced and continuous from the service to the traffic signal cabinet.

Bonding in the pull box shall have #8 AWG solid copper bare wire.

TESTING

Section 86-2.14, "Testing," of the Standard Specifications and these special provisions.

New signal controllers and cabinets shall be delivered to the City of Burbank, Traffic Signal Lab, 124 South Lake Street, Burbank, California, 91502, 14 days prior to installation for shop testing. Contact City of Burbank , Traffic Signal Manager at (818) 238-3974 to schedule the delivery.

Delete Subsection 86-2.14B(3) "Insulation Resistance," and substitute with the following paragraph:

A megger test at 500 volts DC shall be made on each circuit between the circuit and a ground. The insulation resistance shall not be less than 10 megaohms on circuits, except for inductive loop detector circuits which will be tested for continuity, circuit resistance and insulation resistance at the pull box before filling slots. After splicing, test each loop circuit for continuity, circuit resistance and insulation resistance at the controller cabinet location. The loop circuit resistance shall not exceed 0.5 ohms plus 0.35 ohms per 100 feet of lead-in cable. The insulation resistance shall be performed between each circuit conductor and ground. The insulation resistance shall not be less than 100 megaohms.

PAVEMENT DELINEATION

Signing and striping shall conform to the California Manual on Uniform Traffic Control Devices (MUTCD) latest edition.

Conflicting striping and pavement marking shall be removed per Cal/OSHA Standards Rules.

Pavement Striping and Markings shall be 2-coat paint, unless otherwise noted. All White and Yellow longitudinal pavement stripes/markings shall be done with Long Line Ribbon Striper.

PAINTING

Painting of electrical equipment and materials shall be in accordance with Section 86-2.16, "Painting," of the Standard Specifications except as modified and supplemented herein.

Painted equipment which has been relocated shall be repainted. Pedestrian Signals and Vehicle Signal Heads except backplates are to be painted gloss black, unless otherwise specified.

Full compensation for repainting relocated equipment will be considered as included in the contract unit price paid for furnish and install traffic signal system complete and no additional compensation will be allowed therefore.

CONTROLLER ASSEMBLIES

Controller Assemblies shall be in accordance with Section 86-3.01, "Controller Assemblies," of the Standard Specifications, except as modified or supplemented herein.

Conform to City of Burbank, Traffic Signal Controller Specification, State 170E or equivalent.

The Contractor shall furnish and install inductive loop detector sensor units and switch packs necessary to complete the traffic signal modifications as shown on the railroad Plans.

Input and output devices shall conform to the requirements for Model 200, Model 204, Model 222, Model 242 and Model 252 in said "Traffic Signal Control equipment Specifications", issued by the State of California, Department of Transportation, and latest addendum thereto.

New loop detector sensor units shall be Reno A&E's Vehicle Detector Model C-170 or equivalent as approved by the Engineer. Detector assignments shall be coordinated with the Engineer.

The minimum warranty for the traffic signal controller, equipment and/or materials shall be for a period of one year from the date of installation and primary operation of equipment, but not to exceed 2 years from date of receipt of final shipment of the equipment specified in the contract. Agency inventory and use records shall be accepted for determination involving vendor's liability within specified warranty period.

Repair under the warranty, turn around time, shall not be more that 30 calendar days after receipt of failed item.

Full compensation for furnishing and installing controller assemblies and equipment shall be considered as included in the contract lump sum price paid for furnish and install traffic signal system complete and no additional compensation will be allowed therefore.

CONTROLLER CABINETS

Controller Cabinets shall be in accordance with Section 86-3.04 "Controller Cabinets," of the Standard Specifications, except as modified or supplemented herein.

Controller Cabinet shall be Model 332 Cabinet.

The cabinet and doors shall be fabricated from 0.125-inch minimum thickness sheet aluminum. Exterior seams for the cabinet and doors shall be continuously welded. The color shall be anodized aluminum.

The cabinet shall be equipped with one fluorescent lighting fixture mounted inside the back top portion of the cabinet. A door actuated switch shall be installed to turn the cabinet light on when door is opened.

Cabinets shall be equipped with Corbin #2 locks.

Each cabinet shall equipped with an envelope between the controller and input file for plans and record drawings.

Each cabinet shall be equipment with a red monitoring kit.

Full compensation for furnishing and installing controller assemblies and equipment shall be considered as included in the contract lump sum price paid for furnish and install traffic signal equipment complete and no additional compensation will be allowed therefore.

Circular inductive loop detector installation shall conform to Section 86-5 of the Standard Specifications and these special provisions.

The loop wire shall be of a double-insulated type, and shall comply to specifications for the Standard Type 2 traffic loop wire. The tubing shall have an outside diameter of 0.27 inch. It shall be of a continuous and unspliced conductor, and shall be wound 3 turns in a clockwise direction into the saw cut by hand when the saw cut width is approximately 0.375 inch, or shall be preformed and stacked for insertion into the saw cut when the saw cut width is approximately 0.500 inch. The preformed loop shall consist of 3 turns of loop wire stacked in a circle 6 feet in

diameter. Each turn shall be laid on top of another and be secured so when it is placed in the saw cut it will remain in place and not drop in the slots. Loop wires in the home run slot shall be twisted in one direction only with at least 2 turns per foot.

Loop detector lead-in cable shall be Type B. Shields shall be connected to ground on the input panel in the 332 cabinet.

Inductive loop detector expansion joint shall be installed where a loop wire saw cut crosses a pavement type change or where vertical pavement fracture may occur as determined by the Engineer.

INSTALLATION

ILD installation shall be in accordance with Section 86-5.01A(5), "Installation Details," of the Standard Specifications, and APWA Standard Plan No. 435-0, except as modified or supplemented herein. Slots for round traffic signal loop detectors shall be six (6) feet in diameter and .375 inch to a maximum of .500 inch in width, and 4.0 inches in depth. The slots shall be either core drilled or cut by the use of "Circular Loop Cutter" machine. This machine must be so configured that, once started, it will continue to cut a circle without any overlap, and able to circumscribe a six-foot-diameter round loop without being raised or repositioned. This method of installation shall not cause any additional holes to be placed in the pavement for the purpose of anchoring the installing machine.

Home runs shall be saw cut to the appropriate pull box, and shall be .5 inch in width by 5.0 inches in depth. In addition, home runs shall be routed along the lane lines, limit lines, and crosswalk lines when applicable.

Loop shall be installed on the same day in which the loop slots are cut, including placement of the loop conductors and sealant. Slot shall be completely dried before the loop conductors are installed. Loop sealant shall be Asphaltic Emulsion Sealant in accordance with the Standard Specification. Pouring sealant into the saw cut will only be permitted if the loop saw cut is .5 inch wide.

Residue resulting from slot cutting operations shall not be permitted to flow across shoulders or lanes occupied by public traffic, and shall be removed from the pavement surface. Water and slurry shall be vacuumed out, leaving a clean and dry loop area. This vacuumed water shall be dumped in a private dumpsite, and it will not be allowed in catch basins and storm drains.

Contractor shall obtain approval of exact loop location prior to final placement. The locations of the loops and beginning loop wires shall be pre-marked for inspection before cutting and installation.

Stub out conduits for loop detectors shall be inserted next to the gutter edge in the street, be a minimum of 1.5 inches in diameter, and installed at a minimum depth of eight (8) inches from the top of the pavement. Dust seal shall be used at the end of the conduit during loop installation. Loop sealant is not allowed in the conduit. The end of future loop stub out shall be exposed for inspection and backfill with sand and cold patch.

The exact location of each stub out shall be marked with a concrete nail driven into the top of the curb. The concrete nail shall have red top.

Contractor shall obtain approval of exact loop location prior to final placement. The locations of the loops and home runs shall be pre-marked for inspection before cutting.

The job site shall be cleaned and debris removed from City property daily, leaving the City premises clean. Debris shall be disposed of in accordance with applicable laws, rules, and regulations covering disposal of material.

WARRANTY

Materials and workmanship to be guaranteed for 12 months after acceptance.

MEASUREMENT AND PAYMENT

Full compensation for compliance with environmental requirements shall be considered as included in the contract prices paid for the various items of work requiring environmental compliance, unless the cost of compliance is listed as a separate pay item, and no additional compensation will be allowed therefore.

TRAFFIC CONTROL, PUBLIC CONVENIENCE AND SAFETY (BURBANK)

General

Unless otherwise permitted by the Engineer, the Contractor shall conform to the requirements specified herein for movement of traffic through the construction areas of this project. The Contractor shall provide advance warning signs, flashing arrow boards for detours and lane closures, temporary construction signs, flagmen, channelizing devices (temporary striping tape or delineators), barricades, pavement markings, temporary traffic striping, lighting devices, work zone upkeep and maintenance, etc., in accordance with the California Manual of Uniform Traffic Control Devices (MUTCD), 2006 Edition, as directed by the Engineer.

The Contractor shall conduct operations to offer the least possible obstruction and inconvenience to the public, and shall have under construction, no greater length or amount of work than can be prosecuted properly with due regard to the rights of the public.

Work area traffic control shall conform to methods and devices described in the Standard Specifications; California Manual of Uniform Traffic Control Devices (MUTCD), 2006 Edition, and the California Administrative Code Title 8 (Safety Orders); except as modified and supplemented herein.

If the Contractor fails to provide and install signs or traffic control devices required hereby or ordered by the Engineer, the Engineer may cause such signs or traffic control devices to be placed by others. Related costs will be charged against the Contractor, and deducted from the next progress payment.

The Contractor shall submit a traffic control plan for approval prior to start of work for conditions not covered by the California Manual on Uniform Traffic Control Devices Manual. Revisions to the traffic control plans or requirements shall be approved by the Engineer.

The Contractor shall provide 3 Changeable Message Sign (CMS) boards one week prior to the start of construction and throughout the project.

Flashing arrow boards are mandatory for lane closures on major streets. They shall operate until traffic control is removed.

Travel lanes shall be open between 5:00 a.m. and 8:30 a.m. and between 3:30 p.m. and 9:00 p.m. One travel lane in each direction shall be open at between 8:30 a.m. and 3:30 p.m. Traffic lanes shall be open before and after work hours. Work areas shall be left in a safe and secure condition before and after work hours.

Barricades shall be equipped with flashing/steady burn warning lamps at night. Cones, delineators, barricades, and "temporary railing (Type K) shall be reflectorized.

Traffic control shall be maintained in their proper position and shall be repaired, replaced, or cleaned as necessary to preserve their appearance and continuity. Devices not part of the required traffic control or detours shall be removed from the view of the traveling public immediately.

The Contractor shall notify MTA Stops and Zones Dispatcher and other affected transit services (Adam Emmer @ (818)238-5359) at least 3 working days prior to construction.

Where necessary, properly post City-issued and approved "TEMPORARY NO PARKING ANYTIME" signs at least 48 hours before start of work. The Contractor shall notify the Burbank Police Department at 818-238-3100 immediately upon posting signs. These signs must clearly state the dates and time restrictions, and if restrictions apply to weekends.

Vehicular and Pedestrian access to adjacent properties shall be provided. Closed sidewalks shall be posted with "SIDEWALK CLOSED" signs at each approach to the closure and an approved alternate route provided. A minimum walkway width of 36 inches must be maintained at all times for safe pedestrian passage on pedestrian routes.

Vehicle detectors damaged by the work shall be replaced to the standards of the City Public Works Department.

The Contractor shall notify adjacent residents and businesses at least 5 days in advance of start of excavation and prior to driveway closures that will affect their property or access to property.

The Contractor shall cover conflicting parking control signs in the vicinity of the project, as directed by the Engineer. Covers shall be provided by the Contractor, and shall be removed by the Contractor at the direction of the Engineer. The use of tape to cover existing parking control signs will not be allowed.

The Contractor shall provide, install, and maintain warning, regulatory, and construction signs. Cross streets to be affected shall have "DETOUR" signs posted at the last intersection prior to entering the work area. "NO PARKING" signs shall be installed at the work site intersection to permit turn-around in the event vehicles enter the restricted area.

The Contractor shall be required to backfill open trenches before the end of each working day and/or set up barricades along the excavation edges as directed by the Engineer. Open trenches will require approval of the Engineer and shall be fenced or steel-plated in a manner approved by the Engineer.

The Contractor shall provide temporary painted striping and markings in areas where full width cold planning has been specified on the plans. Existing Striping within the rubberized hot mix asphalt (gap graded) overlay limits as shown on the plans may be painted over with Black paint per City requirements for temporary striping, in lieu of removal per City and CalOsha Standards.

The Contractor is required to schedule his work so that all concrete work areas (sidewalks, driveways and pedestrian curb ramps) are poured and finished, including repair of damages, prior to the end of work on each Friday.

Work shown on plans within the SCRRA/MTA Right-of-Ways, shall meet requirements from SCRRA/MTA; Rules and Requirements for Construction on Railway Property, General Safety Regulations for Contractors, and:

- A. SCRRA Design Criteria Manual
- B. SCRRA Form 4 Agreement for Moving Oversized Loads

- C. SCRRA Form 5 Indemnification and Assumption of Liability Agreement
- D. SCRRA Form 6 Temporary Right of Entry Agreement
- E. SCRRA Form 36 Right of Way Encroachment Approval Procedures
- F. SCRRA Form 37 Rules and Requirements for Construction on Railway Property
- G. Schedule of Fees
- H. SCRRA General Safety Regulations for Contractors
- I. SCRRA Right of Way Encroachment Application
- J. SCRRA Train Traffic Information
- K. UPRC Contractor's Right of Entry Agreement (Exhibit B)
- L. UPRC Contractor's Insurance Requirements (Exhibit C)
- M. UPRC Minimum Safety Requirements (Exhibit D)

Payment for railroad flagging will be paid directly to SCRRA by the Contractor.

During working hours, if construction operations require parking restrictions, the Contractor shall post City of Burbank "NO PARKING" signs no earlier than 96 hours and no later than 48 hours in advance of commencing work on each street, and they shall be placed at regular intervals. "NO PARKING" signs shall be supplied by the City to the Contractor.

The following information shall appear on each posted "No Parking" sign:

- A. Dates sign is in effect.
- B. Time period sign is in effect
- C. Reason for posting (such as paving, excavation, construction, etc.).
- D. Date and time the sign was posted.

The following shall apply to each "No Parking" sign:

- A. Signs shall not be posted more than 50 feet apart.
- B. Signs shall not be posted on private property.
- C. Signs shall be posted within the parkway area or as close to the roadway as practical.
- D. Signs may be posted (no staples or nails) on standard or tree within the parkway, except that, in the absence of such items, signs may be attached to traffic barricades.
- E. Immediately upon posting signs, the Contractor shall notify Burbank Police Department at (818) 238-3100.
- F. Signs shall not be revised for subsequent streets or dates.
- G. Signs shall only be posted on one side of a block at a time.

Time or dates on the sign shall include only the period during which the operations occur. Unnecessary parking restrictions will not be allowed. Contractor shall obtain the City Inspector's approval of information on the signs prior to posting.

Full compensation for "No Parking" signs shall be considered as included in the contract lump sum price paid for construction area signs and no additional compensation will be allowed therefore.

**AMENDMENTS TO THE STANDARD SPECIFICATIONS
DATED MAY 2006**

AMENDMENTS ISSUE DATE: 07-20-12

SECTION 0 GLOBAL REVISIONS

(Issued 01-20-12)

Global revisions are changes to contract documents not specific to a section of the Standard Specifications. In each contract document at each occurrence, interpret the following terms as shown:

Term	Interpretation	Conditions
AC	HMA	1. Where AC means asphalt concrete 2. Except where existing AC is described
Asphalt concrete	Hot mix asphalt	Except where existing asphalt concrete is described
Class 1 concrete	Concrete containing not less than 675 pounds of cementitious material per cubic yard	--
Class 2 concrete	Concrete containing not less than 590 pounds of cementitious material per cubic yard	--
Class 3 concrete	Concrete containing not less than 505 pounds of cementitious material per cubic yard	--
Class 4 concrete	Concrete containing not less than 420 pounds of cementitious material per cubic yard	--
Clause providing an option to use either a class concrete or minor concrete	Use minor concrete	--
Clause referring to a delay as a right-of-way delay	Delay under Section 8-1.09, "Delays"	--
Contact joint	Construction joint	--
Controlling operation	Controlling activity	--
Engineer's Estimate	Verified Bid Item List	--
Engineering fabrics	Geosynthetics	--
Notice to Contractors	Notice to Bidders	--
Partial payments	Progress payments	Except in Section 9-1.07D, "Mobilization"
PCC pavement	Concrete pavement	Except where existing PCC pavement is described
Portland cement concrete pavement	Concrete pavement	Except where existing portland cement concrete pavement is described
Project information	Supplemental project information	Except in "Contract Project Information Signs"
Reference to a working day or non-working day under Section 8-1.06, "Time of Completion"	Working day as defined in Section 1-4.02, "Glossary"	--
Section 9-1.015	Section 9-1.01C	--
Section 86, "Signal, Lighting and Electrical Systems"	Section 86, "Electrical Systems"	--
Section 86-2.08, "Conductors"	Section 86-2.08, "Conductors and Cables"	--
Section 86-5.01A(5), "Installation Details"	Section 86-5.01A(4),	--

Headings are included for the purposes of organization and referencing. Inclusion of a heading with no related content, "Reserved," or "Not Used" does not indicate that no specification exists for that subject; applicable specifications may be covered in a general or referenced specification.

1-2 REFERENCES

1-2.01 REFERENCES

Where Standard Specifications refer to the special provisions to describe the work, interpret the reference as a reference to the Bid Item List, the special provisions, or both.

Interpret a reference to a section of the Standard Specifications as a reference to the Standard Specifications as revised by any amendment, special provision, or both.

A reference within parentheses to a law or regulation is included in the contract for convenience only and is not a comprehensive listing of related laws and regulations. Lack of a reference does not indicate no related laws or regulations exist.

Where the version of a referenced document is not specified, use the current version in effect on the date of Notice to Bidders.

A reference to a subsection includes the section's general specifications of which the subsection is a part.

A code not specified as a Federal code is a California code.

1-3 ABBREVIATIONS AND MEASUREMENT UNITS

1-3.01 ABBREVIATIONS

Abbreviations

Abbreviation	Meaning
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMA	archaeological monitoring area
ANSI	American National Standards Institute
APHA	American Public Health Association
API	American Petroleum Institute
AREMA	American Railway Engineering and Maintenance-of-Way Association
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CIH	Certified Industrial Hygienist
DBE	Disadvantaged Business Enterprise
DVBE	Disabled Veteran Business Enterprise
EIA	Electronic Industries Alliance
ESA	environmentally sensitive area
ETL	Electrical Testing Laboratories
(F)	final pay item
FHWA	Federal Highway Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NEC	National Electrical Code
NETA	National Electrical Testing Association, Inc.
NEMA	National Electrical Manufacturers Association
PLAC	permit, license, agreement, certification, or any combination of these
RFI	request for information
SSPC	The Society for Protective Coatings
TIA	time impact analysis
UL	Underwriters' Laboratories Inc.

1-3.02 MEASUREMENT UNITS

Measurement Units		
Symbols as used in the specifications	Symbols as used in the Bid Item List	Meaning
A	—	amperes
	ACRE	acre
	CF	cubic foot
	CY	cubic yard
--	EA	each
g	--	gram
ksi	--	kips per square inch
	GAL	gallon
h	H	hour
	LB	pound
--	LS	lump sum
	LF	linear foot
	LNMI	lane mile
	MFBM	thousand foot board measure
	MI	mile
	MSYD	thousand station yard
Ω	--	ohm
pcf	--	pounds per cubic foot
s	--	second
	STA	100 feet
	SQFT	square foot
	SQYD	square yard
	TAB	tablet
ton	TON	2,000 pounds
V	--	volt
W	--	watt
--	WDAY	working day

1-4 DEFINITIONS

1-4.01 GENERAL

Interpret terms as defined in the contract documents. A construction-industry term not defined in the contract documents has the meaning defined in Means Illustrated Construction Dictionary, Condensed Version, Second Edition.

1-4.02 GLOSSARY

aerially deposited lead: Lead primarily from vehicle emissions deposited within unpaved areas or formerly unpaved areas.

archaeological monitoring area: Area within, near, or straddling the project limits where access is allowed, but work is subject to archaeological monitoring.

archaeological resources: Remains of past human activity, including historic and prehistoric material (e.g., tools and tool fragments, hearth and food remains, structural remains, and human remains).

acceptance: Formal written acceptance by the Director of an entire contract that has been completed in all respects in accordance with the plans and specifications and any modifications to them previously approved.

base: Layer of specified material of planned thickness placed immediately below the pavement or surfacing.

basement material: Material in excavation or embankments underlying the lowest layer of subbase, base, pavement, surfacing, or other specified layer to be placed.

bid item: Specific work unit for which the bidder provides a price.

Bid Item List: List of bid items and the associated quantities.

Bid Item List, verified: Bid Item List with verified prices. The Contract Proposal of Low Bidder at the Department's Web site is the verified Bid Item List.

bridge: Structure, with a bridge number, that carries a utility facility, or railroad, highway, pedestrian or other traffic, over a water course or over or under or around any obstruction.

building-construction contract: Contract that has "building construction" on the cover of the Notice to Bidders and Special Provisions.

business day: Day on the calendar except Saturday or holiday.

California Manual on Uniform Traffic Control Devices: The California Manual on Uniform Traffic Control Devices for Streets and Highways (California MUTCD) is issued by the Department of Transportation and is the Federal Highway Administration's MUTCD 2003 Edition, as amended for use in California.

Certified Industrial Hygienist: Industrial hygienist certified in comprehensive practice by the American Board of Industrial Hygiene.

conduit: Pipe or tube in which smaller pipes, tubes, or electrical conductors are inserted or are to be inserted.

contract: Written and executed contract between the Department and the Contractor.

contract bonds: Security for the payment of workers and suppliers furnishing materials, labor, and services and for guaranteeing the Contractor's work performance.

contract item: Bid item.

Contractor: Person or business or its legal representative entering into a contract with the Department for performance of the work.

culvert: Structure, other than a bridge, that provides an opening under a roadway for drainage or other purposes.

day: 24 consecutive hours running from midnight to midnight; calendar day.

deduction: Amount of money permanently taken from progress payment and final payment. Deductions are not retentions under Pub Cont Code § 7107.

Department: Department of Transportation as defined in St & Hwy Code § 20 and authorized in St & Hwy Code § 90; its authorized representatives.

detour: Temporary route for traffic around a closed road part. A passageway through a job site is not a detour.

Director: Department's Director.

Disabled Veteran Business Enterprise: Business certified as a DVBE by the Office of Small Business and DVBE Services, Department of General Services.

Disadvantaged Business Enterprise: Disadvantaged Business Enterprise as defined in 49 CFR 26.5.

divided highway: Highway with separated traveled ways for traffic, generally in opposite directions.

Engineer: Department's Chief Engineer acting either directly or through properly authorized agents; the agents acting within the scope of the particular duties delegated to them.

environmentally sensitive area: Area within, near, or straddling the project limits where access is prohibited or limited to protect environmental resources.

Federal-aid contract: Contract that has a Federal-aid project number on the cover of the Notice to Bidders and Special Provisions.

fixed costs: Labor, material, or equipment cost directly incurred by the Contractor as a result of performing or supplying a particular bid item that remains constant regardless of the item's quantity.

frontage road: Local street or road auxiliary to and located generally on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.

grading plane: Basement material surface on which the lowest layer of subbase, base, pavement, surfacing, or other specified layer is placed.

highway: Whole right of way or area that is reserved for and secured for use in constructing the roadway and its appurtenances.

holiday:

1. Every Sunday
2. January 1st, New Year's Day
3. 3rd Monday in January, Birthday of Martin Luther King, Jr.
4. February 12th, Lincoln's Birthday
5. 3rd Monday in February, Washington's Birthday
6. March 31st, Cesar Chavez Day
7. Last Monday in May, Memorial Day
8. July 4th, Independence Day
9. 1st Monday in September, Labor Day
10. 2nd Monday in October, Columbus Day
11. November 11th, Veterans Day
12. 4th Thursday in November, Thanksgiving Day
13. Day after Thanksgiving Day
14. December 25th, Christmas Day

If January 1st, February 12th, March 31st, July 4th, November 11th, or December 25th falls on a Sunday, the Monday following is a holiday. If November 11th falls on a Saturday, the preceding Friday is a holiday. Interpret "legal holiday" as "holiday."

idle equipment: Equipment:

1. On the job site at the start of a delay
2. Idled because of the delay
3. Not operated during the delay

informal-bid contract: Contract that has "Informal Bid Authorized by Pub Cont Code §10122" on the cover of the Notice to Bidders and Special Provisions.

Information Handout: Supplemental project information furnished to bidders as a handout.

laboratory: Laboratory authorized by the Department to test materials.

liquidated damages: Amount prescribed in the specifications, pursuant to the authority of Pub Cont Code § 10226, to be paid to the State or to be deducted for each day's delay in completing the whole or any specified portion of the work beyond the time allowed in the specifications.

listed species: Any species listed as threatened or endangered under (1) Federal Endangered Species Act of 1973, 16 USC §1531 et seq., (2) California Endangered Species Act, Fish & Game Code §§ 2050–2115.5, (3) or both.

material shortage: Shortage of raw or produced material that is area-wide and caused by an unusual market condition, except if any of the following occurs:

1. Shortage relates to a produced, nonstandard material
2. Supplier's and the Contractor's priority for filling an order differs
3. Event outside the U.S. for a material produced outside the U.S.

median: Portion of a divided highway separating the traveled ways for traffic in opposite directions including inside shoulders.

mobilization: Preparatory work that must be performed or costs incurred before starting work on the various items on the job site (Pub Cont Code § 10104).

Notice to Bidders: Document that provides a general work description, bidder and bid specifications, and the time and location the Department receives bids.

paleontological resources: Fossils and the deposits they are found in. Fossils are evidence of ancient life preserved in sediments and rock. Examples of paleontological resources are remains of (1) animals, (2) animal tracks, (3) plants, and (4) other organisms. Archaeological resources are not paleontological and fossils found within an archaeological resource are generally considered archaeological resources, not paleontological resources.

pavement: Uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with surfacing.

permitted biological activities: Monitoring, surveying, or other practices that require a take permit and project specific permission from U.S. Fish and Wildlife Service or NOAA Fisheries or a take permit or Memorandum of Understanding with Department of Fish and Game.

plans: Official project plans and Standard Plans, profiles, typical cross sections, working drawings and supplemental drawings, or reproductions thereof, approved by the Engineer, which show the location, character, dimensions and details of the work to be performed. These documents are to be considered as a part of the plans.

In the above definition, the following terms are defined as follows:

Standard Plans: Standard Plans issued by the Department.

project plans: Specific details and dimensions peculiar to the work supplemented by the Standard Plans insofar as the same may apply.

protective radius: Minimum distance between construction activities and regulated species.

regulated species: Any species protected by one or any combination of the following:

1. Federal Endangered Species Act of 1973, 16 USC §1531 et seq.
2. California Endangered Species Act, Fish & Game Code §§2050–2115.5
3. Fish & Game Code §§1600–1616
4. National Environmental Policy Act, 42 USC §4321 et seq.
5. California Environmental Quality Act, Pub Res Code § 21000 et.seq.
6. Other law or regulation that governs activities that affect species or their habitats.

- roadbed:** Area between the intersection of the upper surface of the roadway and the side slopes or curb lines. The roadbed rises in elevation as each increment or layer of subbase, base, surfacing or pavement is placed. Where the medians are so wide as to include areas of undisturbed land, a divided highway is considered as including 2 separate roadbeds.
- roadway:** Highway portion included between the outside lines of sidewalks, or curbs, slopes, ditches, channels, waterways, and including all the appertaining structures, and other features necessary to proper drainage and protection.
- routine biological activities:** Biological monitoring, surveying, or other activity that does not require a take permit from the U.S. Fish and Wildlife Service or NOAA Fisheries or a take permit or Memorandum of Understanding with Department of Fish and Game.
- service-approved biologist:** Biologist whose activities must be approved by a state or federal agency as provided in PLACs.
- shoulder:** Roadway portion contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.
- small tool:** Tool or piece of equipment not listed in Labor Surcharge and Equipment Rental Rates that has a replacement value of \$500 or less.
- special provisions:** Specific clauses setting forth conditions or requirements peculiar to the work and supplementary to these Standard Specifications. The Department's publication titled "Labor Surcharge And Equipment Rental Rates" is part of the special provisions.
- specifications:** Directions, provisions, and requirements contained in these Standard Specifications, Amendments to the Standard Specifications, and the special provisions. Where the term "these specifications" or "these Standard Specifications" is used in this book, it means the provisions set forth in this book.
- State:** State of California, including its agencies, departments, or divisions, whose conduct or action is related to the work.
- Structure Design:** Offices of Structure Design of the Department.
- subbase:** Layer of specified material of planned thickness between a base and the basement material.
- subgrade:** Roadbed portion on which pavement, surfacing, base, subbase, or a layer of any other material is placed.
- substructure:** Bridge portions below the bridge seats, tops of piers, haunches of rigid frames, or below the spring lines of arches. Backwalls and parapets of abutments and wingwalls of bridges are portions of the substructure.
- superstructure:** Bridge portion except the bridge substructure.
- supplemental project information:** Information relevant to the project, specified as supplemental project information, and made available to bidders.
- surfacing:** Uppermost layer of material placed on the traveled way, or shoulders. This term is used interchangeably with pavement.
- take:** Legal definition regarding harm to listed species as defined in 16 USC §1532 and Fish & Game Code § 86.
- take permit:** Permit granted by the US Fish and Wildlife Service or by the NOAA Fisheries that allows take of federal listed species under 16 USC §1539 or by the Department of Fish & Game that allows take of state listed species under to Fish & Game Code § 2081.
- traffic lane:** Portion of a traveled way for the movement of a single line of vehicles.
- traveled way:** Portion of the roadway for the movement of vehicles, exclusive of shoulders.
- total bid:** Sum of the item totals as verified by the Department; original contract price.
- withhold:** Money temporarily or permanently taken from progress payment. Withholds are not retentions under Pub Cont Code § 7107.
- work:** All the work specified, indicated, shown or contemplated in the contract to construct the improvement, including all alterations, amendments, or extensions to it made by contract change order or other written orders of the Engineer.
- working day:** Time measure unit for work progress. A working day is any day except:
1. Saturdays and holidays
 2. A day when you cannot perform work on the controlling activity for at least 50 percent of the day with at least 50 percent of the normal labor and equipment due to any of the following:
 - 2.1. Adverse weather-related conditions that cause you to dismiss the crew
 - 2.2. Maintaining traffic under the contract

- 2.3. The Engineer's direction to suspend the controlling activities for reasons unrelated to your performance
- 2.4. An unanticipated event not caused by either party such as:
 - 2.4.1. Act of God (Pub Cont Code § 7105)
 - 2.4.2. Act of a public enemy
 - 2.4.3. Epidemic
 - 2.4.4. Fire
 - 2.4.5. Flood
 - 2.4.6. Governor-declared state of emergency
 - 2.4.7. Landslide
 - 2.4.8. Quarantine restriction
- 2.5. An issue involving a third-party, including:
 - 2.5.1. Industry or area-wide labor strike
 - 2.5.2. Material shortage
 - 2.5.3. Freight embargo
 - 2.5.4. Jurisdictional requirement of a law enforcement agency
 - 2.5.5. Workforce labor dispute of a utility or non-highway facility owner resulting in a utility or non-highway facility reconstruction not described and not solely for the Contractor's convenience

1-5 DISTRICTS

District Composition and Office Addresses

District	Counties	Location Address	Mailing Address
1	Del Norte (DN), Humboldt (Hum), Lake (Lak), Mendocino (Men)	1656 UNION ST EUREKA, CA	PO BOX 3700 EUREKA CA 95502
2	Lassen (Las), Modoc (Mod), Plumas (Plu), Shasta (Sha), Siskiyou (Sis), Tehama (Teh), Trinity (Tri)	1657 RIVERSIDE DR REDDING, CA	PO BOX 496073 REDDING CA 96049-6073
3	Butte (But), Colusa (Col), El Dorado (ED), Glenn (Gle), Nevada (Nev), Placer (Pla), Sacramento (Sac), Sierra (Sie), Sutter (Sut), Yolo (Yol), Yuba (Yub)	703 B ST MARYSVILLE, CA	703 B ST MARYSVILLE CA 95901
4	Alameda (Ala), Contra Costa (CC), Marin (Mrn), Napa (Nap), San Francisco (SF), San Mateo (SM), Santa Clara (SCI), Solano (Sol), Sonoma (Son)	111 GRAND AVE OAKLAND, CA	PO BOX 23660 OAKLAND CA 94623-0660
5	Monterey (Mon), San Benito (SBt), San Luis Obispo (SLO), Santa Barbara (SB), Santa Cruz (SCr)	50 HIGUERA ST SAN LUIS OBISPO, CA	50 HIGUERA ST SAN LUIS OBISPO CA 93401-5415
6	Fresno (Fre), Kern (Ker), Kings (Kin), Madera (Mad), Tulare (Tul)	1352 W. OLIVE AVE FRESNO, CA	PO BOX 12616 FRESNO CA 93728-2616
7	Los Angeles (LA), Ventura (Ven)	100 S. MAIN ST LOS ANGELES	100 S MAIN ST LOS ANGELES CA 90012
8	Riverside (Riv), San Bernardino (SBd)	464 W 4TH ST SAN BERNARDINO, CA	464 W 4TH ST SAN BERNARDINO CA 92401-1400
9	Inyo (Iny), Mono (Mno)	500 S MAIN ST BISHOP, CA	500 S MAIN ST BISHOP CA 93514-3423
10	Alpine (Alp), Amador (Ama), Calaveras (Cal), Mariposa (Mpa), Merced (Mer), San Joaquin (SJ), Stanislaus (Sta), Tuolumne (Tuo)	1976 E CHARTER WAY STOCKTON, CA	PO BOX 2048 STOCKTON CA 95201
11	Imperial (Imp), San Diego (SD)	4050 TAYLOR ST SAN DIEGO, CA	4050 TAYLOR ST SAN DIEGO CA 92110-2737
12	Orange (Ora)	3347 MICHELSON DR STE 100 IRVINE, CA	3347 MICHELSON DR STE 100 IRVINE CA 92612-0661

A project with work in District 1, 2, or 3 is a North Region project. For Districts 1, 2, and 3, interpret each reference to the district office as the North Region office. The North Region office address is the District 3 address.

1-6 WEB SITES, ADDRESSES, AND TELEPHONE NUMBERS

Web Sites, Addresses, and Telephone Numbers

Agency, Department Unit, or Reference	Web Site	Address	Telephone No.
Bidders' Exchange	www.dot.ca.gov/hq/esc/oe/bidex	MSC 26 BIDDERS' EXCHANGE DEPARTMENT OF TRANSPORTATION 1727 30TH ST SACRAMENTO CA 95816-7005	(916) 227-6259
Department	www.dot.ca.gov		
Department of General Services, Office of Small Business and DVBE Services	www.pd.dgs.ca.gov/smbus/default.htm	OFFICE OF SMALL BUSINESS AND DVBE SERVICES DEPARTMENT OF GENERAL SERVICES 707 3RD ST WEST SACRAMENTO CA 95605- 2811	(800) 559-5529 (916) 375-4940
Department of Industrial Relations	www.dir.ca.gov		
Department of Industrial Relations, Division of Apprenticeship Standards		455 GOLDEN GATE AVENUE SAN FRANCISCO, CA 94102	
Division of Accounting, Office of External Accounts Payable	http://www.dot.ca.gov/hq/asc/oap/payments/contact.htm#compets1	MAJOR CONSTRUCTION PAYMENT AND INFORMATION UNIT OFFICE OF EXTERNAL ACCOUNTS PAYABLE DIVISION OF ACCOUNTING DEPARTMENT OF TRANSPORTATION P.O. BOX 168043 SACRAMENTO, CA 95816-8043	(916) 227-9013
Office Engineer		MSC 43 OFFICE ENGINEER DEPARTMENT OF TRANSPORTATION 1727 30TH ST SACRAMENTO CA 95816-7005	
Office Engineer--All Projects Currently Advertised	http://www.dot.ca.gov/hq/esc/oe/weekly_ads/all_advertised.php		
Offices of Structure Design, Documents Unit		MSC 9-4/4I DOCUMENTS UNIT OFFICES OF STRUCTURE DESIGN DEPARTMENT OF TRANSPORTATION 1801 30TH ST SACRAMENTO CA 95816-7006	(916) 227-0716
Publication Distribution Unit		PUBLICATION UNIT DEPARTMENT OF TRANSPORTATION 1900 ROYAL OAKS DRIVE SACRAMENTO CA 95815-3800	

For rock cores, also include the bridge number in your request.
If bridge as-built drawings are available:

1. For a project in District 1 through 6 or 10, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357
2. For a project in District 7, 8, 9, 11, or 12, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357, and they are available at the Office of Structure Maintenance and Investigations, Los Angeles, CA, telephone (213) 897-0877

As-built drawings may not show existing dimensions and conditions. Where new construction dimensions are dependent on existing bridge dimensions, verify the field dimensions and adjust dimensions of the work to fit existing conditions.

2-1.04–2-1.10 RESERVED

2-1.11 JOB SITE AND DOCUMENT EXAMINATION

Examine the job site and bid documents.

Bid submission is your acknowledgment that you have examined the job site and bid documents and are satisfied with:

1. General and local conditions to be encountered
2. Character, quality, and scope of work to be performed
3. Quantities of materials to be furnished
4. Character, quality, and quantity of surface and subsurface materials or obstacles
5. Requirements of the contract

2-1.12 BID DOCUMENT COMPLETION

2-1.12A General

Complete forms in the Bid book.

Except for the bid item number and the percentage of each item subcontracted, do not fax submittals.

2-1.12B Bid Item List and Bid Comparison

Submit a bid based on the work item quantities the Department shows in the Bid Item List.

For a lump sum based bid, the Department compares bids based on the total price.

For a unit price based bid, the Department compares bids based on the sum of the item totals.

For a cost plus time based bid, the Department compares bids based on the sum of the item totals and the total bid for time. If your bid for time exceeds the number of working days described in the Notice to Bidders, your bid is nonresponsive.

2-1.12C Subcontractor List

In the Subcontractor List, list each subcontractor to perform work in an amount in excess of 1/2 of 1 percent of the total bid or \$10,000, whichever is greater (Pub Cont Code § 4100 et seq.)

The Subcontractor List must show the name, address, and work portions to be performed by each subcontractor listed. Show work portion by bid item number, description, and percentage of each bid item subcontracted.

On the Subcontractor List you may either submit each subcontracted bid item number and corresponding percentage with your bid or fax these numbers and percentages to (916) 227-6282 within 24 hours after bid opening. Failure to do so results in a nonresponsive bid.

2-1.13 BIDDER'S SECURITY

Submit your bid with one of the following forms of bidder's security equal to at least 10 percent of the bid:

1. Cash
2. Cashier's check
3. Certified check
4. Bidder's bond signed by a surety insurer who is licensed in California

Replace Section 3 with:

SECTION 3 CONTRACT AWARD AND EXECUTION

3-1.01 SCOPE

Section 3, "Contract Award and Execution," includes specifications related to contract award and execution.

3-1.02 CONTRACT AWARD

Submit any bid protest to the Office Engineer.

If the Department awards the contract, the award is made to the lowest responsible bidder within the number of days shown in the following table:

Contract Award Period	
Days (after bid opening)	Project Estimated Cost shown in the Notice to Bidders
30	< \$200 million
60	≥ \$200 million

The Department may extend the specified award period if the bidder agrees.

3-1.03 CONTRACT BONDS (PUB CONT CODE §§ 10221 AND 10222)

The successful bidder must furnish:

1. Payment bond to secure the claim payments of laborers, workers, mechanics, or materialmen providing goods, labor, or services under the contract. This bond must be equal to at least 100 percent of the total bid.
2. Performance bond to guarantee the faithful performance of the contract. This bond must be equal to at least 50 percent of the total bid.

The Department furnishes the successful bidder with the bond forms.

3-1.04 CONTRACTOR LICENSE

For a Federal-aid contract, the Bidder must be properly licensed (Pub Cont Code § 10164) from contract award through contract acceptance.

For a non-Federal-aid contract:

1. The Bidder must be properly licensed from bid opening through contract acceptance (Bus & Prof Code § 7028.15)
2. Joint venture bidders must obtain a joint venture license before contract award (Bus & Prof Code § 7029.1)

3-1.05 INSURANCE POLICIES

The successful bidder must submit:

1. Copy of its commercial general liability policy and its excess policy or binder until such time as a policy is available, including the declarations page, applicable endorsements, riders, and other modifications in effect at the time of contract execution. Standard ISO form No. CG 0001 or similar exclusions are allowed if not inconsistent with Section 7-1.12, "Indemnification and Insurance." Allowance of additional exclusions is at the discretion of the Department.
2. Certificate of insurance showing all other required coverages. Certificates of insurance, as evidence of required insurance for the auto liability and any other required policy, shall set forth deductible amounts applicable to each policy and all exclusions that are added by endorsement to each policy. The evidence of insurance shall provide that no cancellation, lapse, or reduction of coverage will occur without 10 days prior written notice to the Department.
3. A declaration under the penalty of perjury by a CPA certifying the accountant has applied GAAP guidelines confirming the successful bidder has sufficient funds and resources to cover any self-insured retentions if the self-insured retention is over \$50,000.

If the successful bidder uses any form of self-insurance for workers compensation in lieu of an insurance policy, it shall submit a certificate of consent to self-insure under Labor Code § 3700.

3-1.06–3-1.08 RESERVED

3-1.09 CONTRACT EXECUTION

The successful bidder must sign the contract and return it to the Office Engineer along with:

1. Contract bonds
2. Documents identified in Section 3-1.05, "Insurance Policies"

For an informal-bid contract, the Office Engineer must receive these documents before the 5th business day after the bidder receives the contract. For all other contracts, the Office Engineer must receive these documents before the 10th business day after the bidder receives the contract.

The bidder's security may be forfeited for failure to execute the contract within the time specified (Pub Cont Code §§ 10181, 10182, and 10183).

The following is a copy of the Contract form:



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
CONTRACT NO. _____

This contract is entered into between the State of California's Department of Transportation and the Contractor named below:

CONTRACTOR'S NAME

The parties agree to comply with the terms of the following exhibits that are by this reference made a part of this contract.

- Exhibit A - Bid book dated _____
- Exhibit B - Notice to Bidders and Special Provisions dated _____
- Exhibit C - Project Plans approved _____
- Exhibit D - Standard Specifications dated _____
- Exhibit E - Standard Plans dated _____
- Exhibit F - Addenda _____

Exhibits A, B, C, and F are those exhibits identified with the same contract number as this contract.

This contract has been executed by the following parties:

CONTRACTOR	
CONTRACTOR'S NAME <i>(if other than an individual, state whether a corporation, partnership, etc.)</i>	
BY <i>(Authorized Signature)</i>	DATE SIGNED <i>(Do not type)</i>
PRINTED NAME AND TITLE OF PERSON SIGNING	
FEDERAL EMPLOYER IDENTIFICATION NUMBER	LICENSE NUMBER

DEPARTMENT OF TRANSPORTATION	
BY <i>(Authorized Signature)</i>	DATE SIGNED <i>(Do not type)</i>
PRINTED NAME AND TITLE OF PERSON SIGNING	

This contract has been certified as complying with the State Contract Act:

BY <i>(Authorized Signature)</i>	DATE SIGNED <i>(Do not type)</i>
PRINTED NAME AND TITLE OF PERSON SIGNING	

ADA Notice For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

remaining portion of the work will be classed as extra work. Extra work also includes work specifically designated as extra work in the plans or specifications.

Add:

4-1.035 VALUE ENGINEERING

4-1.035A General

Reserved

4-1.035B Value Engineering Change Proposal

You may submit a VECP to reduce any of the following:

1. Total cost of construction
2. Construction activity duration
3. Traffic congestion

Before preparing a VECP, meet with the Engineer to discuss:

1. Proposal concept
2. Permit issues
3. Impact on other projects
4. Project impacts, including traffic, schedule, and later stages
5. Peer reviews
6. Overall proposal merits
7. Review times required by the Department and other agencies

The VECP must not impair the project's essential functions or characteristics, such as:

1. Service life
2. Operation economy
3. Maintenance ease
4. Desired appearance
5. Design and safety

The VECP must include:

1. Description of the contract specifications and drawing details for performing the work and the proposed changes.
2. Itemization of contract specifications and drawing details that would be changed.
3. Detailed cost estimate for performing the work under the existing contract and under the proposed change. Determine the estimates under Section 9-1.03, "Force Account Payment."
4. Deadline for the Engineer to decide on the changes.
5. Bid items affected and resulting quantity changes.

The Department is not required to consider a VECP. If a VECP is similar to a change in the plans or specifications being considered by the Department at the time the proposal is submitted or if the proposal is based on or similar to drawings or specifications adopted by the Department before Contract award, the Department does not accept the VECP and may make these changes without VECP payments.

Until the Department approves a change order incorporating the VECP or parts of it, continue to perform the work under the contract. If the Department does not approve a change order before the deadline stated in the VECP or other date you subsequently stated in writing, the VECP is rejected. The Department does not adjust time or payment for a rejected VECP.

The Department decides whether to accept a VECP and the estimated net construction-cost savings from adopting the VECP or parts of it.

The Department may require you to accept a share of the investigation cost as a condition of reviewing a VECP. After written acceptance, the Department considers the VECP and deducts the agreed cost.

If the Department accepts the VECP or parts of it, the Department issues a change order that:

Add:

5-1.005 GENERAL

Failure to comply with any specification part is a waiver of your right to an adjustment of time and payment related to that part.

After contract approval, submit documents and direct questions to the Engineer. Orders, approvals, authorizations, and requests to the Contractor are by the Engineer.

The Engineer furnishes the following in writing:

1. Approvals
2. Authorizations
3. Certifications
4. Decisions
5. Notifications
6. Orders
7. Responses

The Contractor must furnish the following in writing:

1. Assignments
2. Notifications
3. Proposals
4. Reports
5. Requests, including RFIs, sequentially numbered
6. Subcontracts
7. Test results

The Department rejects a form if it has any error or any omission.

Convert foreign language documents to English.

Use contract administration forms available at the Department's Web site.

If the last day for submitting a document falls on a Saturday or holiday, it may be submitted on the next business day with the same effect as if it had been submitted on the day specified.

Add to 5-1.01:

Failure to enforce a contract provision does not waive enforcement of any contract provision.

Add:

5-1.011 PROTESTS

You may protest an Engineer's decision by submitting an RFI under Section 5-1.145, "Requests for Information."

Add:

5-1.012 PARTNERING

5-1.012A General

The Department strives to work cooperatively with all contractors; partnering is our way of doing business. The Department encourages project partnering among the project team, made up of significant contributors from the Department and the Contractor, and their invited stakeholders.

For a project with a total bid greater than \$1 million, professionally facilitated project partnering is encouraged.

For a project with a total bid greater than \$10 million, professionally facilitated project partnering is required.

In implementing project partnering, you and the Engineer manage the contract by:

1. Using early and regular communication with involved parties
2. Establishing and maintaining a relationship of shared trust, equity, and commitment
3. Identifying, quantifying, and supporting attainment of mutual goals
4. Developing strategies for using risk management concepts

5. Implementing timely communication and decision making
6. Resolving potential problems at the lowest possible level to avoid negative impacts
7. Holding periodic partnering meetings and workshops as appropriate to maintain partnering relationships and benefits throughout the life of the project
8. Establishing periodic joint evaluations of the partnering process and attainment of mutual goals

Partnering does not void any contract part.

The Department's "Field Guide to Partnering on Caltrans Construction Projects" current at the time of bid is available to the project team as reference. This guide provides structure, context, and clarity to the partnering process requirements. This guide is available at the Department's Partnering Program website:

<http://www.dot.ca.gov/hq/construc/partnering.html>

In implementing project partnering, the project team must:

1. Create a partnering charter that includes:
 - 1.1. Mutual goals, including core project goals and may also include project-specific goals and mutually supported individual goals.
 - 1.2. Partnering maintenance and close-out plan.
 - 1.3. Dispute resolution plan that includes a dispute resolution ladder and may also include use of facilitated dispute resolution sessions.
 - 1.4. Team commitment statement and signatures.
2. Participate in monthly partnering evaluation surveys to measure progress on mutual goals and may also measure short-term key issues as they arise.
3. Evaluate the partnering facilitator on Forms CEM-5501 and CEM-5502. The Engineer provides the evaluation forms to the project team and collects the results. The Department makes evaluation results available upon request. Facilitator evaluations must be completed:
 - 3.1. At the end of the initial partnering workshop on Form CEM-5501.
 - 3.2. At the end of the project close-out partnering workshop on Form CEM-5502.
4. Conduct a project close-out partnering workshop.
5. Document lessons learned before contract acceptance.

5-1.012B Partnering Facilitator, Workshops, and Monthly Evaluation Surveys

The Engineer sends you a written invitation to enter into a partnering relationship after contract approval. Respond within 15 days to accept the invitation and request the initial and additional partnering workshops. After the Engineer receives the request, you and the Engineer cooperatively:

1. Select a partnering facilitator that offers the service of a monthly partnering evaluation survey with a 5-point rating and agrees to follow the Department's "Partnering Facilitator Standards and Expectations" available at the Department's Partnering Program website
2. Schedule initial partnering workshop
3. Determine initial workshop site and duration
4. Agree to other workshop administrative details

Additional partnering workshops and sessions are encouraged throughout the life of the project as determined necessary by you and the Engineer, recommended quarterly.

5-1.012C Training in Partnering Skills Development

For a project with a total bid of \$25 million or greater, training in partnering skills development is required.

For a project with a total bid between \$10 million and \$25 million, training in partnering skills is optional.

You and the Engineer cooperatively schedule the training session and select a professional trainer, training site, and 1 to 4 topics from the following list to be covered in the training:

1. Active Listening
2. Building Teams
3. Change Management
4. Communication
5. Conflict Resolution
6. Cultural Diversity
7. Dealing with Difficult People
8. Decision Making
9. Effective Escalation Ladders
10. Emotional Intelligence
11. Empathy
12. Ethics
13. Facilitation Skills
14. Leadership
15. Partnering Process and Concepts
16. Project Management
17. Project Organization
18. Problem Solving
19. Running Effective Meetings
20. Time Management
21. Win-Win Negotiation

Before the initial partnering workshop, the trainer conducts a 1-day training session in partnering skills development for the Contractor's and the Engineer's representatives. This training session must be a separate session from the initial partnering workshop and must be conducted locally. The training session must be consistent with the partnering principles under the Department's "Field Guide to Partnering on Caltrans Construction Projects."

Send at least 2 representatives to the training session. One of these must be your assigned representative as specified in Section 5-1.06, "Superintendence," of the Standard Specifications.

5-1.012D Payment

The Department pays you for:

1. 1/2 of partnering workshops and sessions based on facilitator and workshop site cost
2. 1/2 of monthly partnering evaluation survey service cost
3. Partnering skills development trainer and training site cost

The Department determines the costs based on invoice prices minus any available or offered discounts. The Department does not pay markups on these costs.

The Department does not pay for wages, travel expenses, or other costs associated with the partnering workshops and sessions, monthly partnering evaluation surveys, and training in partnering skills development.

Add:

5-1.015 RECORDS

5-1.015A General

Reserved

5-1.015B Record Retention

Retain project records from bid preparation through:

1. Final payment
2. Resolution of claims, if any

For at least 3 years after the later of these, retain cost records, including records of:

1. Bid preparation
2. Overhead
3. Payrolls

4. Payments to suppliers and subcontractors
5. Cost accounting

Maintain the records in an organized way in the original format, electronic and hard copy, conducive to professional review and audit.

5-1.015C Record Inspection, Copying, and Auditing

Make your records available for inspection, copying, and auditing by State representatives for the same time frame specified under Section 5-1.015B, "Record Retention." The records of subcontractors and suppliers must be made available for inspection, copying, and auditing by State representatives for the same period. Before contract acceptance, the State representative notifies the Contractor, subcontractor, or supplier 5 business days before inspection, copying, or auditing.

If an audit is to start more than 30 days after contract acceptance, the State representative notifies the Contractor, subcontractor, or supplier when the audit is to start.

5-1.015D Cost Accounting Records

Maintain cost accounting records for the project distinguishing between the following work cost categories:

1. Work performed based on bid item prices
2. Work performed by change order other than extra work. Distinguish this work by:
 - 2.1. Bid item prices
 - 2.2. Force account
 - 2.3. Agreed price
3. Extra work. Distinguish extra work by:
 - 3.1. Bid item prices
 - 3.2. Force account
 - 3.3. Agreed price
 - 3.4. Specialist billing
4. Work performed under potential claim records
5. Overhead
6. Subcontractors, suppliers, owner-operators, and professional services

Cost accounting records must include:

1. Final cost code lists and definitions
2. Itemization of the materials used and corresponding vendor's invoice copies
3. Direct cost of labor
4. Equipment rental charges
5. Workers' certified payrolls
6. Equipment:
 - 6.1. Size
 - 6.2. Type
 - 6.3. Identification number
 - 6.4. Hours operated

5-1.015E Extra Work Bills

Maintain separate records for costs of work performed by change order.

Within 7 days after performing the work, submit extra work bills using the Department's Internet extra work billing system.

The Contractor submitting and the Engineer approving an extra work bill using the Internet force account work billing system is the same as each party signing the bill.

The Department provides billing system:

1. Training within 30 days of your written request
2. Accounts and user identification to your assigned representatives after a representative has received training

Each representative must maintain a unique password.

Replace Section 5-1.04 with:

5-1.04 CONTRACT COMPONENTS

A component in one contract part applies as if appearing in each. The parts are complementary and describe and provide for a complete work.

If a discrepancy exists:

1. The governing ranking of contract parts in descending order is:
 - 1.1. Special provisions
 - 1.2. Project plans
 - 1.3. Revised Standard Plans
 - 1.4. Standard Plans
 - 1.5. Amendments to the Standard Specifications
 - 1.6. Standard Specifications
 - 1.7. Supplemental project information
2. Written numbers and notes on a drawing govern over graphics
3. A detail drawing governs over a general drawing
4. A detail specification governs over a general specification
5. A specification in a section governs over a specification referenced by that section

If a discrepancy is found or confusion arises, request correction or clarification.

Add:

5-1.055 SUBCONTRACTING

5-1.055A General

No subcontract releases you from the contract or relieves you of your responsibility for a subcontractor's work.

If you violate Pub Cont Code § 4100 et seq., the Department may exercise the remedies provided under Pub Cont Code § 4110. The Department may refer the violation to the Contractors State License Board as provided under Pub Cont Code § 4111.

Except for a building-construction non-federal-aid contract, perform work equaling at least 30 percent of the value of the original total bid with your employees and with equipment owned or rented by you, with or without operators.

Each subcontract must comply with the contract.

The Department encourages you to include a dispute resolution process in each subcontract.

Each subcontractor must have an active and valid State contractor's license with a classification appropriate for the work to be performed (Bus & Prof Code, § 7000 et seq.).

Submit copies of subcontracts upon request.

Before subcontracted work starts, submit a Subcontracting Request form.

Do not use a debarred contractor; a current list of debarred contractors is available at the Department of Industrial Relations' Web site.

Upon request, immediately remove and not again use a subcontractor who fails to prosecute the work satisfactorily.

Replace Section 5-1.07 with:

5-1.07 LINES AND GRADES

The Engineer places stakes and marks under Chapter 12, "Construction Surveys," of the Department's Surveys Manual.

Submit your request for Department-furnished stakes:

1. On a Request for Construction Stakes form. Ensure:
 - 1.1. Requested staking area is ready for stakes
 - 1.2. You use the stakes in a reasonable time
2. A reasonable time before starting an activity using the stakes

Establish priorities for stakes and note priorities on the request.

Preserve stakes and marks placed by the Engineer. If the stakes or marks are destroyed, the Engineer replaces them at the Engineer's earliest convenience and deducts the cost.

Replace Section 5-1.10 with:

5-1.10 EQUIPMENT

Clearly stencil or stamp at a clearly visible location on each piece of equipment except hand tools an identifying number and:

1. On compacting equipment, its make, model number, and empty gross weight that is either the producer's rated weight or the scale weight
2. On meters and on the load-receiving element and indicators of each scale, the make, model, serial number, and producer's rated capacity

Submit a list:

1. Describing each piece of equipment
2. Showing its identifying number

Upon request, submit producer's information that designates portable vehicle scale capacities.

For proportioning materials, use measuring devices, material plant controllers, and undersupports complying with Section 9-1.01B, "Weighing Equipment and Procedures."

Measuring devices must be tested and approved under California Test 109 in the Department's presence by any of the following:

1. County Sealer of Weights and Measures
2. Scale Service Agency
3. Division of Measurement Standards Official

The indicator over-travel must be at least 1/3 of the loading travel. The indicators must be enclosed against moisture and dust.

Group measuring system dials such that the smallest increment for each indicator can be read from the location at which proportioning is controlled.

Replace Section 5-1.116 with:

5-1.116 DIFFERING SITE CONDITIONS (23 CFR 635.109)

5-1.116A Contractor's Notification

Promptly notify the Engineer if you find either of the following:

1. Physical conditions differing materially from either of the following:
 - 1.1. Contract documents
 - 1.2. Job site examination
2. Physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract

Include details explaining the information you relied on and the material differences you discovered.
If you fail to notify the Engineer promptly, you waive the differing site condition claim for the period between your discovery of the differing site condition and your notification to the Engineer.

If you disturb the site after discovery and before the Engineer's investigation, you waive the differing site condition claim.

5-1.116B Engineer's Investigation and Decision

Upon your notification, the Engineer investigates job site conditions and:

1. Notifies you whether to resume affected work
2. Decides whether the condition differs materially and is cause for an adjustment of time, payment, or both

You may protest the Engineer's decision.

Replace Section 5-1.14 with:

5-1.14 COST REDUCTION INCENTIVE

Comply with Section 4-1.035B, "Value Engineering Change Proposal."

Add:

5-1.145 REQUESTS FOR INFORMATION

Submit an RFI upon recognition of any event or question of fact arising under the Contract.

The Engineer responds to the RFI within 5 days. Proceed with the work unless otherwise ordered. You may protest the Engineer's response by:

1. Submitting an Initial Potential Claim Record within 5 days after receipt of the Engineer's response
2. Complying with Section 5-1.146, "Potential Claims and Dispute Resolution"

Add:

5-1.146 POTENTIAL CLAIMS AND DISPUTE RESOLUTION

5-1.146A General

Minimize and mitigate impacts of potentially claimed work or event.

For each potential claim, assign an identification number determined by chronological sequencing and the 1st date of the potential claim.

Use the identification number for each potential claim on the:

1. Initial Potential Claim Record
2. Supplemental Potential Claim Record
3. Full and Final Potential Claim Record

Failure to comply with this procedure is:

1. Waiver of the potential claim and a waiver of the right to a corresponding claim for the disputed work in the administrative claim procedure
2. Bar to arbitration (Pub Cont Code § 10240.2)

5-1.146B Initial Potential Claim Record

Submit an Initial Potential Claim Record within 5 days of the Engineer's response to the RFI or within 5 days from the date when a dispute arises due to an act or failure to act by the Engineer. The Initial Potential Claim Record establishes the claim nature and circumstances. The claim nature and circumstances must remain consistent.

The Engineer responds within 5 days of the date of the Initial Potential Claim Record. Proceed with the potentially claimed work unless ordered.

Within 20 days of a request, provide access to the project records determined necessary by the Engineer to evaluate the potential claim.

5-1.146C Supplemental Potential Claim Record

Within 15 days of submitting the Initial Potential Claim Record, submit a Supplemental Potential Claim Record including:

1. Complete nature and circumstances causing the potential claim or event
2. Contract specifications supporting the basis of a claim
3. Estimated claim cost and an itemized breakdown of individual costs stating how the estimate was determined
4. TIA

The Engineer evaluates the Supplemental Potential Claim Record and furnishes you a response within 20 days of submittal. If the estimated cost or effect on the scheduled completion date changes, update the Supplemental Potential Claim Record information as soon as the change is recognized and submit this information.

5-1.146D Full and Final Potential Claim Record

Notify the Engineer within 10 days of the completion date of the potentially claimed work. The Engineer approves this completion date or notifies you of a revised date.

Within 30 days of the completion of the potentially claimed work, submit a Full and Final Potential Claim Record including:

1. A detailed factual account of the events causing the potential claim, including:
 - 1.1. Necessary dates
 - 1.2. Locations
 - 1.3. Work items affected by the potential claim
2. The Contract documents supporting the potential claim and a statement of the reasons these parts support entitlement
3. If a payment adjustment is requested, an itemized cost breakdown. Segregate costs into the following categories:
 - 3.1. Labor, including:
 - 3.1.1. Individuals
 - 3.1.2. Classifications
 - 3.1.3. Regular and overtime hours worked
 - 3.1.4. Dates worked
 - 3.2. Materials, including:
 - 3.2.1. Invoices
 - 3.2.2. Purchase orders
 - 3.2.3. Location of materials either stored or incorporated into the work
 - 3.2.4. Dates materials were transported to the job site or incorporated into the work
 - 3.3. Equipment, including:
 - 3.3.1. Detailed descriptions, including make, model, and serial number
 - 3.3.2. Hours of use
 - 3.3.3. Dates of use
 - 3.3.4. Equipment rates at the rental rate listed in Labor Surcharge and Equipment Rental Rates in effect when the affected work related to the claim was performed
4. If a time adjustment is requested:
 - 4.1. Dates for the requested time.
 - 4.2. Reasons for a time adjustment.
 - 4.3. Contract documentation supporting the requested time adjustment.

- 4.4. TIA. The TIA must demonstrate entitlement to a time adjustment.
5. Identification and copies of your documents and copies of communications supporting the potential claim, including certified payrolls, bills, cancelled checks, job cost reports, payment records, and rental agreements
6. Relevant information, references, and arguments that support the potential claim

The Department does not consider a Full and Final Potential Claim Record that does not have the same nature, circumstances, and basis of claim as those specified on the Initial Potential Claim Record and Supplemental Potential Claim Record.

The Engineer evaluates the information presented in the Full and Final Potential Claim Record and furnishes you a response within 30 days of its receipt unless the Full and Final Potential Claim Record is submitted after Contract acceptance; in which case, a response may not be furnished. The Engineer's receipt of the Full and Final Potential Claim Record must be evidenced by postal return receipt or the Engineer's written receipt if delivered by hand.

5-1.146E Dispute Resolution

Comply with Section 5-1.15, "Dispute Resolution."

Add:

5-1.15 DISPUTE RESOLUTION

5-1.15A General

Section 5-1.15, "Dispute Resolution," applies to a contract with 100 or more working days.

The dispute resolution process is not a substitute for the submitting an RFI or a potential claim record.

5-1.15B Dispute Resolution Advisor

Section 5-1.15B, "Dispute Resolution Advisor," applies to a contract with a total bid from \$3 million to \$10 million.

A dispute resolution advisor, hereinafter referred to as "DRA," is chosen by the Department and the Contractor to assist in the resolution of disputes.

The DRA shall be established by the Department and the Contractor within 30 days of contract approval.

The Department and the Contractor shall each propose 3 potential DRA candidates. Each potential candidate shall provide the Department and the Contractor with their disclosure statement. The disclosure statement shall include a resume of the potential candidate's experience and a declaration statement describing past, present, anticipated, and planned relationships with all parties involved in this contract.

The Department and the Contractor shall select one of the 6 nominees to be the DRA. If the Department and the Contractor cannot agree on one candidate, the Department and the Contractor shall each choose one of the 3 nominated by the other. The final selection of the DRA will be decided by a coin toss between the two candidates.

The Department and the Contractor shall complete and adhere to the Dispute Resolution Advisor Agreement. No DRA meeting shall take place until the Dispute Resolution Advisor Agreement has been signed by all parties, unless all parties agree to sign it at the first meeting.

If DRA needs outside technical services, technical services shall be preapproved by both the Department and the Contractor.

DRA recommendations are nonbinding.

The Contractor shall not use the DRA for disputes between subcontractors or suppliers that have no grounds for a lawsuit against the Department.

DRA replacement is selected in the same manner as the original selection. The appointment of a replacement DRA will begin promptly upon determination of the need for replacement. The Dispute Resolution Advisor Agreement shall be amended to reflect the change of the DRA.

Failure of the Contractor to participate in selecting DRA will result in the withhold of 25 percent of the estimated value of all work performed during each estimate period that the Contractor fails to comply. DRA withholds will be released for payment on the next monthly progress payment following the date that the Contractor has provided assistance in choosing the DRA and no interest will be due the Contractor.

The State and the Contractor shall bear the costs and expenses of the DRA equally.

The DRA shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting either at the start of the project or for a dispute. A member serving on more than one State DRA or Dispute Resolution Board, regardless the number of meetings per day shall not be paid more than the agreed rate per day. The agreed rate shall

be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel, and incidentals for each day or portion thereof that the DRA is at an authorized DRA meeting.

No additional compensation will be made for time spent by the DRA to review and research activities outside the official DRA meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRA, has been specifically agreed to in advance by the State and Contractor. Time away from the project that has been specifically agreed to in advance by the Department and the Contractor will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services.

The State will provide conference facilities for DRA meetings at no cost to the Contractor.

The Contractor shall make direct payments to the DRA for participation in authorized meetings and approved hourly rate charges from invoices submitted.

The State will reimburse the Contractor for the State's share of the costs.

There will be no markups applied to expenses associated with the DRA, either by the DRA or by the Contractor when requesting payment of the State's share of DRA expenses. Regardless of the DRA recommendation, neither party will be entitled to reimbursement of DRA costs from the other party.

The Contractor shall submit extra work bills and include invoices with original supporting documents for reimbursement of the State's share.

The cost of technical services will be borne equally by the State and Contractor. There will be no markups for these costs.

A copy of the "Dispute Resolution Advisor Agreement" to be executed by the Contractor, State and the DRA is as follows:

DISPUTE RESOLUTION ADVISOR AGREEMENT

(Contract Identification)

Contract No. _____

THIS DISPUTE RESOLUTION ADVISOR AGREEMENT, hereinafter called "AGREEMENT", made and entered into this _____ day of _____, _____, between the State of California, acting through the California Department of Transportation and the Director of Transportation, hereinafter called the "STATE," _____ hereinafter called the "CONTRACTOR," and _____, the Dispute Resolution Advisor, hereinafter called the "DRA."

WITNESSETH, that

WHEREAS, the STATE and the CONTRACTOR, hereinafter called the "parties," are now engaged in the construction on the State Highway project referenced above; and

WHEREAS, the Standard Specifications for the above referenced contract provides for the establishment and operation of the DRA to assist in resolving disputes; and

WHEREAS, the DRA is composed of one person, chosen by the CONTRACTOR and the STATE;

NOW THEREFORE, in consideration of the terms, conditions, covenants, and performance contained herein, or attached and incorporated and made a part hereof, the STATE, the CONTRACTOR, and the DRA hereto agree as follows:

SECTION I DESCRIPTION OF WORK

To assist in the timely resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRA. The DRA is to fairly and impartially consider disputes placed before it and provide recommendations for resolution of these disputes to the parties. The DRA shall provide recommendations based on the facts related to the dispute, the contract and applicable laws and regulations. The DRA shall perform the services necessary to participate in the DRA's actions as designated in Section III, Scope of Work.

SECTION II DRA QUALIFICATIONS

The DRA shall be knowledgeable in the type of construction and contract documents anticipated by the contract and shall have completed training through the Dispute Review Board Foundation. In addition, it is desirable for the DRA to have served on several State Dispute Resolution Boards (DRB).

No DRA shall have prior direct involvement in this contract. No DRA shall have a financial interest in this contract or parties thereto, including but not limited to the CONTRACTOR, subcontractors, suppliers, consultants, and legal and business services, within a period 6 months prior to award and during this contract. Exceptions to above are compensation for services on this or other DRAs and DRBs or retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.

The DRA shall fully disclose all direct or indirect professional or personal relationships with all key members of the contract.

SECTION III SCOPE OF WORK

The Scope of Work of the DRA includes, but is not limited to, the following:

A. PROCEDURES

The DRA shall meet with the parties at the start of the project to establish procedures that will govern the conduct of its business and reporting procedures in conformance with the requirements of the contract and the terms of this AGREEMENT. The DRA established procedures shall only be implemented upon approval by the parties. Subsequent meetings shall be held only to hear disputes between the parties.

The DRA shall not meet with, or discuss contract issues with individual parties.

The State shall provide the DRA with the contract and all written correspondence regarding the dispute between the parties and, if available, the Contractor's supplemental potential claim record, and the Engineer's response to the supplemental potential claim record.

The parties shall not call the DRA who served on this contract as a witness in arbitration proceedings, which may arise from this contract.

The DRA shall have no claim against the STATE or the CONTRACTOR, or both, from claimed harm arising out of the parties' evaluations of the DRA's opinions.

B. DISPUTE MEETING

The term "dispute meeting" as used in this subsection shall refer to both the informal and traditional dispute meeting processes, unless otherwise noted.

If the CONTRACTOR requests a dispute meeting with the DRA, the Contractor must simultaneously notify the STATE. Upon being notified of the need for a dispute meeting, the DRA shall review and consider the dispute. The DRA shall determine the time and location of the dispute meeting with due consideration for the needs and preferences of the parties, while recognizing the importance of a speedy resolution to the dispute.

Dispute meetings shall be conducted at any location that would be convenient and provide required facilities and access to necessary documentation.

Only the STATE's Area Construction Engineer, Resident Engineer, and Structure Representative and the CONTRACTOR's or subcontractor's, Superintendent or Project Manager may present information at a dispute meeting. There shall be no participation of persons who are not directly involved in the contract or who do not have direct knowledge of the dispute. The exception to this is technical services, as described below:

The DRA, with approval of the parties, may obtain technical services necessary to adequately review the disputes presented, including audit, geotechnical, schedule analysis and other services. The parties' technical staff may supply those services as appropriate. The cost of technical services, as agreed to by the parties, shall be borne equally by the two parties as specified in an approved contract change order. The CONTRACTOR shall not be entitled to markups for the payments made for these services.

At the dispute meeting the DRA may ask questions, seek clarification, and request further clarification of data presented by either of the parties as may be necessary to assist in making a fully informed recommendation. However, the DRA shall refrain from expressing opinions on the merits of statements on matters under dispute during the parties' presentations. Each party will be given ample time to fully present its position, make rebuttals, provide relevant documents, and respond to DRA questions and requests.

There shall be no testimony under oath or cross-examination, during DRA dispute meetings. There shall be no reporting of the procedures by a shorthand reporter or by electronic means. Documents and verbal statements shall be received by the DRA in conformance with the rules and regulations established at the first meeting between the DRA and parties. These established rules and regulations need not comply with prescribed legal laws of evidence.

Failure to attend a dispute meeting by either of the parties shall be conclusively considered by the DRA as indication that the non-attending party considers all written documents and correspondence submitted as their entire and complete argument. The claimant shall discuss the dispute, followed by the other party. Each party shall then be allowed one or more rebuttals at the meeting until all aspects of the dispute are thoroughly covered.

1. TRADITIONAL DISPUTE MEETING:

The following procedure shall be used for the traditional dispute meeting:

- a. Within 5 days after receiving the STATE's written response to the CONTRACTOR's supplemental potential claim record, the CONTRACTOR shall refer the dispute to the DRA, if the CONTRACTOR wishes to further pursue the dispute. The CONTRACTOR shall make the referral in writing to the DRA, simultaneously copied to the STATE. The written dispute referral shall describe the disputed matter in individual discrete segments, so that it will be clear to both parties and the DRA what discrete elements of the dispute have been resolved, and which remain unresolved, and shall include an estimate of the cost of the affected work and impacts, if any, on project completion.
- b. The parties shall each be afforded an opportunity to be present and to be heard by the DRA, and to offer evidence. Either party furnishing written evidence or documentation to the DRA must furnish copies of such information to the other party a minimum of 10 days prior to the date the DRA is scheduled to convene the meeting for the dispute. Either party shall produce such additional evidence as the DRA may deem necessary to reach an understanding and a determination of the dispute. The party furnishing additional evidence shall furnish copies of such additional evidence to the other party

- at the same time the evidence is provided to the DRA. The DRA shall not consider evidence not furnished in conformance with the terms specified herein.
- c. Upon receipt by the DRA of a written referral of a dispute, the DRA shall convene to review and consider the dispute. The dispute meeting shall be held no later than 25 days after receipt of the written referral unless otherwise agreed to by all parties.
 - d. The DRA shall furnish a written report to both parties. The DRA may request clarifying information of either party within 5 days after the DRA dispute meeting. Requested information shall be submitted to the DRA within 5 days of the DRA request. The DRA shall complete its report and submit it to the parties within 10 days of the DRA dispute meeting, except that time extensions may be granted at the request of the DRA with the written concurrence of both parties. The report shall summarize the facts considered, the contract language, law or regulation viewed by the DRA as pertinent to the dispute, and the DRA's interpretation and philosophy in arriving at its conclusions and recommendations and, if appropriate, recommends guidelines for determining compensation. The DRA's written opinion shall stand on its own, without attachments or appendices.
 - e. Within 10 days after receiving the DRA's report, both parties shall respond to the DRA in writing signifying that the dispute is either resolved or remains unresolved. Failure to provide the written response within the time specified, or a written rejection of the DRA's recommendation or response to a request for reconsideration presented in the report by either party, shall conclusively indicate that the party(s) failing to respond accepts the DRA recommendation. Immediately after responses have been received from both parties, the DRA shall provide copies of both responses to the parties simultaneously. Either party may request clarification of elements of the DRA's report from the DRA prior to responding to the report. The DRA shall consider any clarification request only if submitted within 5 days of receipt of the DRA's report, and if submitted simultaneously in writing to both the DRA and the other party. Each party may submit only one request for clarification for any individual DRA report. The DRA shall respond, in writing, to requests for clarification within 5 days of receipt of such requests.
 - f. Either party may seek a reconsideration of the DRA's recommendation. The DRA shall only grant reconsideration based upon submission of new evidence and if the request is submitted within the 10 day time limit specified for response to the DRA's written report. Each party may submit only one request for reconsideration regarding an individual DRA recommendation.
 - g. If the parties are able to settle their dispute with the aid of the DRA's report, the STATE and CONTRACTOR shall promptly accept and implement the settlement of the parties. If the parties cannot agree on compensation within 30 days of the acceptance by both parties of the settlement, either party may request the DRA to make a recommendation regarding compensation.

2. INFORMAL DISPUTE MEETING

An informal dispute meeting shall be convened, only if, the parties and the DRA agree that this dispute resolution process is appropriate to settle the dispute.

The following procedure shall be used for the informal dispute meeting:

- a. The parties shall furnish the DRA with one copy of pertinent documents requested by the DRA that are or may become necessary for the DRA to perform its function. The party furnishing documents shall furnish such documents to the other party at the same time the document is provided to the DRA.
- b. After the dispute meeting has concluded, the DRA shall deliberate in private the same day, until a response to the parties is reached or as otherwise agreed to by the parties.
- c. The DRA then verbally delivers its recommendation with findings to the parties.
- d. After the recommendation is presented, the parties may ask for clarifications.
- e. Occasionally the DRA, on complex issues, may be unable to formulate a recommendation based on the information given at a dispute meeting. However, the DRA may provide the parties with advice on strengths and weaknesses of their prospective positions, in the hope of the parties reaching settlement.
- f. If the parties are able to settle their dispute with the aid of the DRA's opinion, the STATE and CONTRACTOR shall promptly accept and implement the settlement of the parties.
- g. The DRA will not be bound by its oral recommendation in the event that a dispute is later heard by the DRA in a traditional dispute meeting.

Unless the dispute is settled, use of the informal dispute meeting does not relieve the parties of their responsibilities under Section 5-1.15B, "Dispute Resolution Advisor," of the Standard Specifications or Subsection, "Traditional Dispute Meeting," of this AGREEMENT. There will be no extension of time allowed for the process to permit the use of the informal dispute meeting, unless otherwise agreed to by the parties.

SECTION IV TIME FOR BEGINNING AND COMPLETION

Once established, the DRA shall be in operation until the day the Director accepts the contract. The DRA shall not begin work under the terms of this AGREEMENT until authorized in writing by the STATE or as agreed to by the parties.

SECTION V PAYMENT

The DRA shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting, either at the start of the project or for a dispute. A member serving on more than one State DRA or DRB, regardless the number of meetings per day, shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for onsite time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof that the DRA is at an authorized DRA meeting. No additional compensation will be made for time spent by the DRA to review and research activities outside the official DRA meetings unless that time, (such as time spent evaluating and preparing recommendations on specific issues presented to the DRA), has been specifically agreed to in advance by the parties. Time away from the project, which has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services. The State will provide administrative services such as conference facilities to the DRA.

A. PAYMENT PROCESSING

The CONTRACTOR shall make direct payments to the DRA for their participation in authorized meetings and approved hourly rate charges, from invoices submitted by the DRA, and technical services.

The DRA may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their participation in authorized meetings not more often than once per month during the progress of the work. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that billing period. Payment for hourly fees, at the agreed rate, shall not be paid to the DRA until the amount and extent of those fees are approved by the STATE and CONTRACTOR.

B. INSPECTION OF COSTS RECORDS

The DRA and the CONTRACTOR shall keep available for inspection by representatives of the STATE and the United States, for a period of 3 years after final payment, the cost records and accounts pertaining to this AGREEMENT. If any litigation, claim, or audit arising out of, in connection with, or related to this contract is initiated before the expiration of the 3-year period, the cost records and accounts shall be retained until such litigation, claim, or audit involving the records is completed.

SECTION VI ASSIGNMENT OF TASKS OF WORK

The DRA shall not assign the work of this AGREEMENT.

SECTION VII TERMINATION OF DRA

The DRA may resign after providing not less than 15 days written notice of the resignation to the STATE and CONTRACTOR. The DRA may be terminated, by either party, for failing to fully comply at all times with all required employment or financial disclosure conditions of DRA membership in conformance with the terms of the contract and this AGREEMENT. Each party shall document the need for replacement and substantiate the replacement request in writing to the other party and the DRA.

SECTION VIII LEGAL RELATIONS

The parties hereto mutually understand and agree that the DRA in the performance of duties is acting in the capacity of an independent agent and not as an employee of either party.

No party to this AGREEMENT shall bear a greater responsibility for damages or personal injury than is normally provided by Federal or State of California Law.

Notwithstanding the provisions of this contract that require the CONTRACTOR to indemnify and hold harmless the STATE, the parties shall jointly indemnify and hold harmless the DRA from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRA.

SECTION IX CONFIDENTIALITY

The parties hereto mutually understand and agree that all documents and records provided by the parties in reference to issues brought before the DRA, which documents and records are marked "Confidential - for use by the DRA only," shall be kept in confidence and used only for the purpose of resolution of subject disputes, and for assisting in development of DRA findings and recommendations; that such documents and records will not be utilized or revealed to others, except to officials of the parties who are authorized to act on the subject disputes, for any purposes, during the life of this AGREEMENT. Upon termination of this AGREEMENT, said confidential documents and records, and all copies thereof, shall be returned to the parties who furnished them to the DRA. However, the parties understand that such documents may be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

SECTION X DISPUTES

Disputes between the parties arising out of the work or other terms of this AGREEMENT that cannot be resolved by negotiation and mutual concurrence between the parties or through the administrative process provided in the contract shall be resolved by arbitration as provided in Section 9-1.10, "Arbitration," of the Standard Specifications. Disputes between the DRA and the parties that cannot be resolved by negotiation and mutual concurrence shall be resolved in the appropriate forum.

SECTION XI VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION

In the event that any party, including the DRA, deems it necessary to institute arbitration proceedings to enforce any right or obligation under this AGREEMENT, the parties hereto agree that such action shall be initiated in the Office of Administrative Hearings of the State of California. The parties hereto agree that all questions shall be resolved by arbitration by application of California law and that the parties to such arbitration shall have the right of appeal from such decisions to the Superior Court in conformance with the laws of the State of California. Venue for the arbitration shall be Sacramento or any other location as agreed to by the parties.

SECTION XII FEDERAL REVIEW AND REQUIREMENTS

On Federal-Aid contracts, the Federal Highway Administration shall have the right to review the work of the DRA in progress, except for private meetings or deliberations of the DRA.

Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

SECTION XIII CERTIFICATION OF CONTRACTOR, DRA, AND STATE

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRA

By: _____

Title: _____

CONTRACTOR

CALIFORNIA DEPARTMENT
OF TRANSPORTATION

By: _____

By: _____

Title: _____

Title: _____

5-1.15C Dispute Resolution Board

Section 5-1.15C, "Dispute Resolution Board," applies to a contract with a total bid of over \$10 million.

The Dispute Resolution Board, hereinafter referred to as "DRB," is a three member board established by the Department and Contractor to assist in the resolution of disputes.

The DRB shall be established by the Department and the Contractor within 45 days after contract approval.

The DRB shall consist of one member selected by the Department and approved by the Contractor, one member selected by the Contractor and approved by the Department, and a third member selected by the first 2 members and approved by both the Department and the Contractor.

The Department and Contractor shall provide the other written notification for approval of the name of their DRB nominee along with the nominee's disclosure statement.

Disclosure statements shall include a resume of the nominee's experience and a declaration statement describing past, present, anticipated, and planned relationships with all parties involved in this contract. Objections to nominees shall be based on a specific breach or violation of nominee responsibilities or on nominee qualifications. The Department or the Contractor may, on a one-time basis, object to the other's nominee without specifying a reason and this person shall not be selected for the DRB. Another person shall then be nominated within 15 days.

The 2 DRB members shall proceed with the selection of the third DRB member immediately after receiving written notification from the Department of their selection. The 2 DRB members shall provide their recommendation simultaneously to the parties within 15 days. The third member shall provide disclosure statement to the first 2 DRB members, to the Department, and the Contractor. The professional experience of the third DRB member shall complement that of the first 2 DRB members. The third DRB member shall be subject to mutual approval of the Department and the Contractor. If the 2 DRB members cannot agree on the third nominee, they shall submit a list of nominees to the Department and the Contractor for final selection and approval.

If the Department and the Contractor cannot agree on the third DRB member, or if the first 2 DRB members are unable to agree upon a recommendation, the Department and the Contractor shall select 6 names from the current list of arbitrators certified by the Public Works Contract Arbitration Committee created by Article 7.2 of the State Contract Act. The 2 DRB members shall then select one of the 6 names by a blind draw.

The 3 DRB members shall appoint one member as a chairperson to provide leadership for the DRB's activities. The chairperson shall be approved by the Department and the Contractor. In the event of an impasse, the third DRB member shall become the chairperson.

The Department and Contractor shall complete and adhere to the Dispute Resolution Board Agreement. No DRB meeting shall take place until the Dispute Resolution Board Agreement has been signed by all parties, unless all parties agree to sign it at the first meeting.

If the DRB needs outside technical services, technical services shall be preapproved by both the Department and the Contractor.

DRB recommendations are nonbinding.

The Contractor shall not use the DRB for disputes between the subcontractors or suppliers that have no grounds for a lawsuit against the Department.

DRB member replacements are selected in the same manner as the original selection. The appointment of a replacement DRB member will begin promptly upon determination of the need for replacement. The Dispute Resolution Board Agreement shall be amended to reflect the change in the DRB.

Failure of the Contractor to participate in establishing the DRB will result in the withholding of 25 percent of the estimated value of all work performed during each estimate period that the Contractor fails to comply. DRB withholds will be released for payment on the next monthly progress payment following the date that the Contractor has provided assistance in establishing the DRB and no interest will be due the Contractor.

The Department and the Contractor shall bear the costs and expenses of the DRB equally.

Each DRB member shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting either at the start of the project, for scheduled progress, or dispute meetings. A member serving on more than one Department DRB or Dispute Resolution Advisor (DRA), regardless of the number of meetings per day shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel, and incidentals for each day or portion thereof that the DRB member is at an authorized DRB meeting.

No additional compensation will be made for time spent by DRB members in review and research activities outside the official DRB meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRB, has been specifically agreed to in advance by the Department and Contractor. Time away from the project, which has been specifically agreed to in advance by the Department and Contractor, will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services.

The Department will provide conference facilities for DRB meetings at no cost to the Contractor.

The Contractor shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges from invoices submitted by each DRB member.

The Department will reimburse the Contractor for the Department's share of the costs.

There will be no markups applied to expenses connected with the DRB, either by the DRB members or by the Contractor when requesting payment of the Department's share of DRB expenses. Regardless of the DRB recommendation, neither party shall be entitled to reimbursement of DRB costs from the other party.

The Contractor shall submit extra work bills and include evidence of every payment to each DRB member in the form of a cancelled check or bank statement within 30 days of payment.

The cost of technical services requested by the DRB will be borne equally by the State and Contractor. There will be no markups for these costs.

A copy of the "Dispute Resolution Board Agreement" to be executed by the Department, Contractor, and the 3 DRB members after approval of the contract follows:

DISPUTE RESOLUTION BOARD AGREEMENT

(Contract Identification)

Contract No. _____

THIS DISPUTE RESOLUTION BOARD AGREEMENT, hereinafter called "AGREEMENT", made and entered into this _____ day of _____, _____, between the State of California, acting through the California Department of Transportation and the Director of Transportation, hereinafter called the "STATE," _____ hereinafter called the "CONTRACTOR," and the Dispute Resolution Board, hereinafter called the "DRB" consisting of the following members:

_____,
(DRB Member) ,

_____,
(DRB Member) ,

and _____
(DRB Chairperson)

WITNESSETH, that

WHEREAS, the STATE and the CONTRACTOR, hereinafter called the "parties," are now engaged in the construction on the State Highway project referenced above; and

WHEREAS, the Standard Specifications for the above referenced contract provides for the establishment and operation of the DRB to assist in resolving disputes; and

WHEREAS, the DRB is composed of three members, one selected by the STATE, one selected by the CONTRACTOR, and the third member selected by the other two members and approved by the parties; and

NOW THEREFORE, in consideration of the terms, conditions, covenants, and performance contained herein, or attached and incorporated and made a part hereof, the STATE, the CONTRACTOR, and the DRB members hereto agree as follows:

SECTION I DESCRIPTION OF WORK

To assist in the timely resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRB. The DRB is to fairly and impartially consider disputes placed before it and provide recommendations for resolution of these disputes to the parties. The DRB shall provide recommendations based on the facts related to the dispute, the contract and applicable laws and regulations. The DRB shall perform the services necessary to participate in the DRB's actions as designated in Section III, Scope of Work.

SECTION II DRB QUALIFICATIONS

DRB members shall be knowledgeable in the type of construction and contract documents anticipated by the contract and shall have completed training through the Dispute Review Board Foundation.

No DRB member shall have prior direct involvement in this contract. No DRB member shall have a financial interest in this contract or parties thereto, including but not limited to the CONTRACTOR, subcontractors, suppliers, consultants, and legal and business services, within a period 6 months prior to award and during this contract. Exceptions to above are compensation for services on this or other DRBs and DRAs or retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.

DRB members shall fully disclose all direct or indirect professional or personal relationships with all key members of the contract.

SECTION III SCOPE OF WORK

The scope of work of the DRB includes, but is not limited to, the following:

A. PROCEDURES

The DRB shall establish procedures that will govern the conduct of its business and reporting procedures in conformance with the requirements of the contract and the terms of this AGREEMENT. The DRB established procedures shall only be implemented upon approval of the parties.

The DRB Chairperson shall schedule progress and dispute meetings and any other DRB activities.

The parties shall not call on any of the DRB members, who served on this contract, as a witness in arbitration proceedings, which may arise from this contract.

DRB members shall have no claim against the STATE or the CONTRACTOR, or both, from claimed harm arising out of the parties' evaluations of the DRB's opinions.

During progress or dispute meetings, DRB members shall refrain from expressing opinions on the merits of statements on matters under dispute or potential dispute. Opinions of DRB members expressed in private sessions shall be kept strictly confidential. Individual DRB members shall not meet with, or discuss contract issues with individual parties. Discussions regarding the project between the DRB members and the parties shall be in the presence of all three members and both parties. Individual DRB members shall not undertake independent investigations of any kind pertaining to disputes or potential disputes, except with the knowledge of both parties and as expressly directed by the DRB Chairperson.

B. PROGRESS MEETINGS

DRB members shall visit the project site and meet with representatives of the parties to keep abreast of construction activities and to develop familiarity with the work in progress. Scheduled progress meetings shall be held at or near the project site. The DRB shall meet at least once at the start of the project, and at least once every 4 months thereafter. The frequency, exact time, and duration of additional site visits and progress meetings shall be as recommended by the DRB and approved by the parties consistent with the construction activities or matters under consideration and dispute. Scheduled progress meetings may be waived, if the parties are in agreement, when the only work remaining is plant establishment work. Each meeting shall consist of a round table discussion and a field inspection of the work being performed on the contract, if necessary. Each meeting shall be attended by representatives of both parties. The agenda shall generally be as follows:

1. Meeting opened by the DRB Chairperson.
2. Remarks by the STATE's representative.
3. A description by the CONTRACTOR's representative of work accomplished since the last meeting; the current schedule status of the work; and a forecast for the coming period.
4. An outline by the STATE's representative of the status of the work as the STATE views it.
5. An outline by the CONTRACTOR's representative of potential problems and a description of proposed solutions.
6. A brief description by the CONTRACTOR's and the STATE's representative of potential claims and disputes that have surfaced since the last meeting.
7. A summary by the STATE's representative, the CONTRACTOR's representative, or the DRB of the status of past potential claims and disputes.

The STATE's representative will prepare minutes of all progress meetings and circulate them for revision and approval by all concerned within 10 days of the meeting.

C. DISPUTE MEETING

The term "dispute meeting" as used in this subsection shall refer to both the informal and traditional dispute meeting processes, unless otherwise noted.

Either the STATE or the CONTRACTOR may request a dispute meeting with the DRB. The requesting party shall simultaneously notify the other party of each dispute meeting request. Upon being notified of the need for a dispute meeting, the DRB shall review and consider the dispute. The DRB shall determine the time and location of the dispute meeting with due consideration for the needs and preferences of the parties, while recognizing the importance of a speedy resolution to the dispute.

Dispute meetings shall be conducted at any location that would be convenient and provide required facilities and access to necessary documentation.

No DRB dispute meeting shall take place later than 30 days prior to acceptance of the contract.

Only the STATE's Area Construction Engineer, Resident Engineer, and Structure Representative and the CONTRACTOR's or subcontractor's, Superintendent or Project Manager may present information at a dispute meeting. There shall be no participation of persons who are not directly involved in the contract or who do not have direct knowledge of the dispute. The exception to this is technical services, as described below:

The DRB, with approval of the parties, may obtain technical services necessary to adequately review the disputes presented, including audit, geotechnical, schedule analysis and other services. The parties' technical staff may supply those services as appropriate. The cost of technical services, as agreed to by the parties, shall be borne equally by the two parties as specified in an approved contract change order. The CONTRACTOR shall not be entitled to markups for the payments made for these services.

At the dispute meeting the DRB may ask questions, seek clarification, and request further clarification of data presented by either of the parties as may be necessary to assist in making a fully informed recommendation. However, the DRB shall refrain from expressing opinions on the merits of statements on matters under dispute during the parties' presentations. The claimant shall discuss the dispute, followed by the other party. Each party shall then be allowed one or more rebuttals at the meeting until all aspects of the dispute are thoroughly covered. Each party will be given ample time to fully present its position, make rebuttals, provide relevant documents, and respond to DRB questions and requests.

There shall be no testimony under oath or cross-examination, during DRB dispute meetings. There shall be no reporting of the procedures by a shorthand reporter or by electronic means. Documents and verbal statements shall be received by the DRB in conformance with the procedures established at the first meeting between the DRB and the parties. These established procedures need not comply with prescribed legal laws of evidence.

Failure to attend a dispute meeting by either of the parties shall be conclusively considered by the DRB as indication that the non-attending party considers all written documents and correspondence submitted as their entire and complete argument.

After dispute meetings are concluded, the DRB shall meet in private and reach a conclusion supported by two or more members. Private sessions of the DRB may be held at a location other than the job site or by electronic conferencing as deemed appropriate, in order to expedite the process.

The DRB shall make every effort to reach a unanimous decision.

1. TRADITIONAL DISPUTE MEETING:

The following procedure shall be used for the traditional dispute meeting:

- a. Within 21 days after receiving the STATE's written response to the CONTRACTOR's supplemental potential claim record, the CONTRACTOR shall refer the dispute to the DRB if the CONTRACTOR wishes to further pursue the dispute. The CONTRACTOR shall make the referral in writing to the DRB, simultaneously copied to the STATE. The written dispute referral shall describe the disputed matter in individual discrete segments, so that it will be clear to both parties and the DRB what discrete elements of the dispute have been resolved, and which remain unresolved, and shall include an estimate of the cost of the affected work and impacts, if any, on project completion.
- b. The parties shall each be afforded an opportunity to be present and to be heard by the DRB, and to offer evidence. Either party furnishing written evidence or documentation to the DRB must furnish copies of such information to the other party a minimum of 15 days prior to the date the DRB is scheduled to convene the meeting for the dispute. Either party shall produce such additional evidence as the DRB may deem necessary to reach an understanding and a determination of the dispute. The party furnishing additional evidence shall furnish copies of such additional evidence to the other party at the same time the evidence is provided to the DRB. The DRB shall not consider evidence not furnished in conformance with the terms specified herein.
- c. Upon receipt by the DRB of a written referral of a dispute, the DRB shall convene to review and consider the dispute. The dispute meeting shall be held no earlier than 30 days and no later than 60 days after receipt of the written referral unless otherwise agreed to by all parties.
- d. The DRB may request clarifying information of either party within 10 days after the dispute meeting. Requested information shall be submitted to the DRB within 10 days of the DRB request.
- e. The DRB shall furnish a written report to the parties with its conclusion(s) and recommendation(s). The DRB shall complete its report, including minority opinion, if any, and submit it to the parties within 30 days of the dispute meeting, except that time extensions may be granted at the request of the DRB with the written concurrence of the parties. The report shall summarize the facts considered, the contract language, law or regulation viewed by the DRB as pertinent to the dispute, and the DRB's interpretation and reasoning in arriving at its conclusion(s) and recommendation(s) and, if appropriate, recommends

guidelines for determining compensation. The DRB's written opinion shall stand on its own, without attachments or appendices. The DRB Chairperson shall furnish a copy of the written recommendation report to the DRB Coordinator, Division of Construction, MS 44, P.O. Box 942874, Sacramento, CA 94274.

- f. Within 30 days after receiving the DRB's report, the parties shall respond to the DRB in writing signifying that the dispute is either resolved or remains unresolved. Failure to provide the written response within the time specified, or a written rejection of the DRB's recommendation or a written response requesting the DRB reconsider their recommendation, shall conclusively indicate that the party(s) failing to respond accepts the DRB recommendation. Immediately after responses have been received from both parties, the DRB shall provide copies of both responses to the parties simultaneously. Either party may request clarification of elements of the DRB's report from the DRB prior to responding to the report. The DRB shall consider any clarification request only if submitted within 10 days of receipt of the DRB's report, and if submitted simultaneously in writing to both the DRB and the other party. Each party may submit only one request for clarification for any individual DRB report. The DRB shall respond, in writing, to requests for clarification within 10 days of receipt of such requests.
- g. Either party may seek a reconsideration of the DRB's recommendation. The DRB shall only grant reconsideration based upon submission of new evidence and if the request is submitted within the 30 day time limit specified for response to the DRB's written report. Each party may submit only one request for reconsideration regarding an individual DRB recommendation.
- h. If the parties are able to settle their dispute with the aid of the DRB's report, the STATE and the CONTRACTOR shall promptly accept and implement the settlement of the parties. If the parties cannot agree on compensation within 60 days of the acceptance by both parties of the settlement, either party may request the DRB to make a recommendation regarding compensation.

2. INFORMAL DISPUTE MEETING

An informal dispute meeting shall be convened, only if, the parties and the DRB agree that this dispute resolution process is appropriate to settle the dispute.

The following procedure shall be used for the informal dispute meeting:

- a. The parties shall furnish the DRB with one copy of pertinent documents requested by the DRB that are or may become necessary for the DRB to perform its function. The party furnishing documents shall furnish such documents to the other party at the same time the document is provided to the DRB.
- b. After the dispute meeting has concluded, the DRB members shall deliberate in private the same day until a response to the parties is reached or as otherwise agreed to by the parties.
- c. The DRB then verbally delivers its recommendation with findings, including minority opinion, if any, to the parties.
- d. After the recommendation is presented, the parties may ask for clarifications.
- e. Occasionally the DRB may be unable to formulate a recommendation based on the information given at a dispute meeting. However, the DRB may provide the parties with advice on strengths and weaknesses of their prospective positions, in the hope of the parties reaching settlement.
- f. If the parties are able to settle their dispute with the aid of the DRB's opinion, the STATE and the CONTRACTOR shall promptly accept and implement the settlement of the parties.
- g. The DRB will not be bound by its verbal recommendation in the event that a dispute is later heard by the DRB in a traditional dispute meeting.

Unless the dispute is settled, use of the informal dispute meeting does not relieve the parties of their responsibilities under Section 5-1.15C, "Dispute Resolution Board," of the Standard Specifications or subsection, "Traditional Dispute Meeting," of this AGREEMENT. There will be no extension of time allowed for the process to permit the use of the informal dispute meeting, unless otherwise agreed to by the parties.

SECTION IV TIME FOR BEGINNING AND COMPLETION

DRB members shall not begin work under the terms of this AGREEMENT, until authorized in writing by the STATE or as agreed to by the parties. Once established, the DRB shall be in operation until the Director accepts the contract. If the contract is terminated in accordance with Section 8-1.08, "Termination of Control," of the Standard Specifications, the DRB will be dissolved.

SECTION V PAYMENT

Each DRB member shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting, either at start of project, or a scheduled progress or a dispute meeting. A member serving on more than one State DRB or DRA, regardless of the number of meetings per day, shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on site time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof that the DRB member is at an authorized DRB meeting. No additional compensation will be made for time spent by DRB member to review and research activities outside the official DRB meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRB, has been specifically agreed to in advance by the parties. Time away from the project, which has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services. The State will provide administrative services such as conference facilities to the DRB.

A. PAYMENT PROCESSING

The CONTRACTOR shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges, from invoices submitted by each DRB member, and technical services.

DRB members may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their participation in authorized meetings not more often than once per month during the progress of the work. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that billing period. Payment for hourly fees, at the agreed rate, shall not be paid to a DRB member until the amount and extent of those fees are approved by the STATE and the CONTRACTOR.

B. INSPECTION OF COSTS RECORDS

DRB members and the CONTRACTOR shall keep available for inspection by representatives of the STATE and the United States federal government, for a period of 3 years after final payment, the cost records and accounts pertaining to this AGREEMENT. If any litigation, claim, or audit arising out of, in connection with, or related to this contract is initiated before the expiration of the 3-year period, the cost records and accounts shall be retained until such litigation, claim, or audit involving the records is completed.

SECTION VI ASSIGNMENT OF TASKS OF WORK

DRB members shall not assign the work of this AGREEMENT.

SECTION VII TERMINATION OF A DRB MEMBER

DRB members may resign after providing not less than 15 days written notice of their resignation to the STATE and the CONTRACTOR. A DRB member may be terminated, by either party, for failing to comply at all times with all required employment or financial disclosure conditions of DRB membership in conformance with the terms of the contract and this AGREEMENT.

Service of a DRB member may be terminated at any time with not less than 15 days notice as follows:

- A. The State may terminate service of the State appointed member.
- B. The Contractor may terminate service of the Contractor appointed member.
- C. Upon the written recommendation of the State and Contractor appointed members for the removal of the third member.
- D. Upon resignation of a member.

When a member of the DRB is replaced, the replacement member shall be appointed in the same manner as the replaced member was appointed. The appointment of a replacement DRB member will begin promptly upon determination of the need for replacement and shall be completed within 15 days. Changes in either of the DRB members chosen by the 2 parties will not require re-selection of the third member, unless both parties agree to such re-selection in writing. The Dispute Resolution Board Agreement shall be amended to reflect the change of a DRB member.

Each party shall document the need for replacement and substantiate the replacement request in writing to the other party and DRB members.

SECTION VIII LEGAL RELATIONS

The parties hereto mutually understand and agree that each DRB member in the performance of duties is acting in the capacity of an independent agent and not as an employee of either party.

No party to this AGREEMENT shall bear a greater responsibility for damages or personal injury than is normally provided by Federal or State of California Law.

Notwithstanding the provisions of this contract that require the CONTRACTOR to indemnify and hold harmless the STATE, the parties shall jointly indemnify and hold harmless the DRB members from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRB.

SECTION IX CONFIDENTIALITY

The parties hereto mutually understand and agree that all documents and records provided by the parties in reference to issues brought before the DRB, which documents and records are marked "Confidential - for use by the DRB only," shall be kept in confidence and used only for the purpose of resolution of subject disputes, and for assisting in development of DRB findings and recommendations; that such documents and records will not be utilized or revealed to others, except to officials of the parties who are authorized to act on the subject disputes, for any purposes, during the life of this AGREEMENT. Upon termination of this AGREEMENT, said confidential documents and records, and all copies thereof, shall be returned to the parties who furnished them to the DRB. However, the parties understand that such documents may be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

SECTION X DISPUTES

Disputes between the parties arising out of the work or other terms of this AGREEMENT, which cannot be resolved by negotiation and mutual concurrence between the parties, or through the administrative process provided in the contract, shall be resolved by arbitration as provided in Section 9-1.10, "Arbitration," of the Standard Specifications. Disputes between the DRB and either party, which cannot be resolved by negotiation and mutual concurrence, shall be resolved in the appropriate forum.

SECTION XI VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION

In the event that any party deems it necessary to institute arbitration proceedings to enforce any right or obligation under this AGREEMENT, the parties hereto agree that such action shall be initiated in the Office of Administrative Hearings of the State of California. The parties hereto agree that all questions shall be resolved by arbitration by application of California law and that the parties to such arbitration shall have the right of appeal from such decisions to the Superior Court in conformance with the laws of the State of California. Venue for the arbitration shall be Sacramento or any other location as agreed to by the parties.

SECTION XII FEDERAL REVIEW AND REQUIREMENTS

On Federal-Aid contracts, the Federal Highway Administration shall have the right to review the work of the DRB in progress, except for private meetings or deliberations of the DRB that do not become part of the project records.

Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

SECTION XIII CERTIFICATION OF CONTRACTOR, DRB, AND STATE

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRB MEMBER

DRB MEMBER

By: _____

By: _____

Title: _____

Title : _____

DRB CHAIRPERSON

By : _____

Title : _____

CONTRACTOR

CALIFORNIA DEPARTMENT
OF TRANSPORTATION

By: _____

By: _____

Title: _____

Title: _____

Add:

5-1.16–5-17 (BLANK)

Add:

5-1.18 PROPERTY AND FACILITY PRESERVATION

5-1.18A General

Preserve property and facilities, including:

1. Adjacent property
2. Department's instrumentation
3. ESAs
4. Lands administered by other agencies
5. Railroads and railroad equipment
6. Roadside vegetation not to be removed
7. Utilities
8. Waterways

Immediately report damage to the Engineer.

If you cause damage, you are responsible.

Install sheet piling, cribbing, bulkheads, shores, or other supports necessary to support existing facilities or support material carrying the facilities.

Dispose of temporary facilities when they are no longer needed.

If you damage plants not to be removed:

1. Dispose of them outside the right of way unless the Engineer allows you to reduce them to chips and spread the chips within the highway at locations designated by the Engineer
2. Replace them

Replace plants with plants of the same species.

Replace trees with 24-inch-box trees.

Replace shrubs with No. 15 container shrubs.

Replace ground cover plants with plants from flats. Replace *Carpobrotus* ground cover plants with plants from cuttings. Plant ground cover plants 1 foot on center.

If a plant establishment period is specified, replace plants before the start of the plant establishment period; otherwise, replace plants at least 30 days before Contract acceptance.

Water each plant immediately after planting and saturate the backfill soil around and below the roots or ball of earth around the roots of each plant. Water as necessary to maintain plants in a healthy condition until Contract acceptance.

The Department may make a temporary repair to restore service to a damaged facility.

If working on or adjacent to railroad property, do not interfere with railroad operations.

For an excavation on or affecting railroad property, submit work plans showing the system to be used to protect railroad facilities. Allow 65 days for the Engineer's review of the plans. Do not perform work based on the plans until the Engineer notifies you they are accepted.

5-1.18B Nonhighway Facilities (Including Utilities)

The Department may rearrange a nonhighway facility during the Contract. Rearrangement of a nonhighway facility includes installation, relocation, alteration, or removal of the facility. The Department may authorize facility owners and their agents to enter the highway to perform rearrangement work for their facilities or to make connections or repairs to their property. Coordinate activities to avoid delays.

Notify the Engineer at least 3 business days before you contact the regional notification center under Govt Code § 4216 et seq. Failure to contact the notification center prohibits excavation.

Before starting work that could damage or interfere with underground infrastructure, locate the infrastructure described in the Contract, including laterals and other appurtenances, and determine the presence of other underground infrastructure inferred from visible facilities such as buildings, meters, or junction boxes.

2. Improper operation
3. Insufficient maintenance
4. Abuse
5. Unauthorized change
6. Act of God

During the guarantee period, repair or replace each work portion having a substantial defect.

The Department does not pay for corrective work.

During corrective work activities, provide insurance coverage specified for coverage before contract acceptance.

The contract bonds must be in full force and effect until the later of:

1. Expiration of guarantee period
2. Completion of corrective work

If a warranty specification conflicts with Section 6-1.075, "Guarantee," comply with the warranty specification.

During the guarantee period, the Engineer monitors the completed work. If the Engineer finds work having a substantial defect, the Engineer lists work parts and furnishes you the list.

Within 10 days of receipt of the list, submit for authorization a detailed plan for correcting the work. Include a schedule that includes:

1. Start and completion dates
2. List of labor, equipment, materials, and any special services you plan to use
3. Work related to the corrective work, including traffic control and temporary and permanent pavement markings

The Engineer notifies you when the plan is authorized. Start corrective work and related work within 15 days of notice.

If the Engineer determines corrective work is urgently required to prevent injury or property damage:

1. The Engineer furnishes you a request to start emergency repair work and a list of parts requiring corrective work
2. Mobilize within 24 hours and start work
3. Submit a corrective work plan within 5 days of starting emergency repair work

If you fail to perform work as specified, the Department may perform the work and bill you.

In Section 6-1.08 delete the 2nd paragraph.

Add:

6-1.085 BUY AMERICA (23 CFR 635.410)

For a Federal-aid contract, furnish steel and iron materials to be incorporated into the work that are produced in the United States except:

1. Foreign pig iron and processed, pelletized, and reduced iron ore may be used in the domestic production of the steel and iron materials [60 Fed Reg 15478 (03/24/1995)]
2. If the total combined cost of the materials does not exceed the greater of 0.1 percent of the total bid or \$2,500, material produced outside the United States may be used

Production includes:

1. Processing steel and iron materials, including smelting or other processes that alter the physical form or shape (such as rolling, extruding, machining, bending, grinding, and drilling) or chemical composition
2. Coating application, including epoxy coating, galvanizing, and painting, that protects or enhances the value of steel and iron materials

Replace Section 7-1.01 with:

7-1.01 LAWS TO BE OBSERVED

Comply with laws, regulations, orders, decrees, and PLACs applicable to the project. Indemnify and defend the State against any claim or liability arising from the violation of a law, regulation, order, decree, or PLAC by you or your employees. Immediately report to the Engineer in writing a discrepancy or inconsistency between the contract and a law, regulation, order, decree, or PLAC.

In Section 7-1.01A replace the 1st clause with:

Work on the job site must comply with Labor Code §§ 1727 and 1770-1815 and 8 CA Code of Regs § 16000 et seq. Work includes roadside production and processing of materials.

In Section 7-1.01A(2) in the 1st paragraph, replace item 3 with:

3. Upon becoming aware of the subcontractor's failure to pay the specified prevailing rate of wages to the subcontractor's workers, the Contractor must diligently take corrective action to stop or rectify the failure, including withholding sufficient funds due the subcontractor for work performed on the public works project.

In Section 7-1.01A(2), replace the 2nd paragraph with:

Pursuant to Section 1775 of the Labor Code, the Division of Labor Standards Enforcement must notify the Contractor on a public works project within 15 days of the receipt by the Division of Labor Standards Enforcement of a complaint of the failure of a subcontractor on that public works project to pay workers the general prevailing rate of per diem wages. If the Division of Labor Standards Enforcement determines that employees of a subcontractor were not paid the general prevailing rate of per diem wages and if the Department did not withhold sufficient money under the contract to pay those employees the balance of wages owed under the general prevailing rate of per diem wages, the Contractor must withhold an amount of moneys due the subcontractor sufficient to pay those employees the general prevailing rate of per diem wages if requested by the Division of Labor Standards Enforcement. The Contractor must pay any money withheld from and owed to a subcontractor upon receipt of notification by the Division of Labor Standards Enforcement that the wage complaint has been resolved. If notice of the resolution of the wage complaint has not been received by the Contractor within 180 days of the filing of a valid notice of completion or acceptance of the public works project, whichever occurs later, the Contractor must pay all moneys withheld from the subcontractor to the Department. The Department withholds these moneys pending the final decision of an enforcement action.

In Section 7-1.01A(2) replace 7th paragraph with:

Changes in general prevailing wage determinations apply to the contract when the Director of Industrial Relations has issued them at least 10 days before advertisement (Labor Code § 1773.6 and 8 CA Code of Regs 16204).

In Section 7-1.01A(3) replace the 2nd paragraph with:

The Department withholds the penalties specified in subdivision (g) of Labor Code § 1776 for noncompliance with the requirements in Section 1776.

In Section 7-1.01A(3) replace the 4th paragraph with:

The Department withholds for delinquent or inadequate payroll records (Labor Code § 1771.5). If the Contractor has not submitted an adequate payroll record by the month's 15th day for the period ending on or before the 1st of that month, the Department withholds 10 percent of the monthly progress estimate, exclusive of mobilization. The Department does not withhold more than \$10,000 or less than \$1,000.

In Section 7-1.01A(3) delete the 5th paragraph.

Replace Section 7-1.01A(6) with:

7-1.01A(6) (Blank)

Replace Section 7-1.01A(7) with:

7-1.01A(7) (Blank)

Replace Section 7-1.01F with:

7-1.01F Environmental Stewardship

Comply with Section 14.

Replace Section 7-1.01I with:

7-1.01I (Blank)

In Section 7-1.02 in the 2nd paragraph, replace the 4th sentence with:

Trucks used to haul treated base, portland cement concrete, or hot mix asphalt shall enter onto the base to dump at the nearest practical entry point ahead of spreading equipment.

In Section 7-1.02 between the 4th and 5th paragraphs, add:

Loads imposed on existing, new, or partially completed structures shall not exceed the load carrying capacity of the structure or any portion of the structure as determined by AASHTO LRFD with interims and California Amendments, Design Strength Limit State II. The compressive strength of concrete (f'_c) to be used in computing the load carrying capacity shall be the smaller of the following:

1. Actual compressive strength at the time of loading
2. Value of f'_c shown on the plans for that portion of the structure or 2.5 times the value of f'_c (extreme fiber compressive stress in concrete at service loads) shown on the plans for portions of the structure where no f'_c is shown

Replace Section 7-1.04 with:

7-1.04 PERMITS, LICENSES, AGREEMENTS, AND CERTIFICATIONS

7-1.04A General

Comply with PLACs. The Department makes PLAC changes under Section 4-1.03, "Changes."

7-1.04B Before Award

To make a change to a PLAC made available to you before award, submit the proposed change. The Department sends the proposed change to the appropriate authority for consideration.

7-1.04C After Award

Confirm with the Engineer which after-award PLACs are obtained by the Department and which are obtained by the Contractor.

To make a change to an after-award PLAC obtained by the Department, submit the proposed change. The Department sends the proposed change to the appropriate authority for consideration.

Obtain those PLACs to be issued to you and pay fees and costs associated with obtaining them. Submit copies of Contractor-obtained after-award PLACs for review.

In Section 7-1.06 in the 1st paragraph, add:

The Contractor's Injury and Illness Prevention Program shall be submitted to the Engineer. The program shall address the use of personal and company issued electronic devices during work. The use of entertainment and personal communication devices in the work zone shall not be allowed. Workers may use a communication device for business purposes in the work area, at a location where their safety and the safety of other workers and the traveling public is not compromised.

Replace Section 7-1.07 with:

7-1.07 Lead Compliance Plan

Section 7-1.07 applies if a bid item for a lead compliance plan is included in the Contract.

Prepare a work plan to prevent or minimize worker exposure to lead while managing and handling earth materials, paint system debris, traffic stripe residue, and pavement marking residue containing lead. Regulations containing specific Cal/OSHA requirements when working with lead include 8 CA Code of Regs § 1532.1.

The plan must contain the items listed in 8 CA Code of Regs § 1532.1(e)(2)(B). Before submittal, a CIH must sign and seal the plan. Submit the plan at least 7 days before starting any activity that presents the potential for lead exposure. The Engineer notifies you of the acceptability of the plan within 4 business days of receipt.

Before starting any activity that presents the potential for lead exposure to employees who have no prior training, including State employees, provide a safety training program to these employees that complies with 8 CA Code of Regs § 1532.1 and your lead compliance program.

Submit copies of air monitoring or job site inspection reports made by or under the direction of the CIH under 8 CA Code of Regs § 1532.1 within 10 days after the date of monitoring or inspection.

Supply personal protective equipment, training, and washing facilities required by your lead compliance plan for 5 State employees.

The contract lump sum price paid for lead compliance plan includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in preparing and implementing the plan as specified in this section.

Replace Section 7-1.08 with:

7-1.08 PUBLIC CONVENIENCE

Compliance with the provisions of this section does not relieve you of your responsibility for public safety.

Construction activities must not inconvenience the public or abutting property owners. Schedule and conduct work to avoid unnecessary inconvenience to the public and abutting property owners. Avoid undue delay in construction activities to reduce the public's exposure to construction.

Where possible, route traffic on new or existing paved surfaces.

Maintain convenient access to driveways, houses, and buildings. When the abutting property owner's access across the right of way line is to be eliminated or replaced under the contract, the existing access must not be closed until the replacement access facilities are usable. Construct temporary approaches to crossings and intersecting highways.

Provide a reasonably smooth and even surface for use by traffic at all time during excavation of roadways and construction of embankments. Before other grading activities, place fill at culverts and bridges to allow traffic to cross. If ordered, excavate roadway cuts in layers and construct embankments in partial widths at a time alternating construction from one side to the other and routing traffic over the side opposite the one under construction. Install or construct culverts on only 1/2 the width of the traveled way at a time; keep the traveled way portion being used by traffic open and unobstructed until the opposite side of the traveled way is ready for use by traffic.

Upon completion of rough grading or placing any subsequent layer, bring the surface of the roadbed to a smooth and even condition, free of humps and depressions and satisfactory for the use of the public.

After subgrade preparation for a specified layer of material has been completed, repair any damage to the roadbed or completed subgrade, including damage due to use by the public.

While subgrade and paving activities are underway, allow the public to use the shoulders. If half-width paving methods are used, allow the public to use the side of the roadbed opposite the one under construction. If enough width is available, keep open a passageway wide enough to accommodate at least 2 lanes of traffic at locations where subgrade and paving activities are underway. Shape shoulders or reshape subgrade as necessary to accommodate traffic during subgrade preparation and paving activities.

Apply water or dust palliative for the prevention or alleviation of dust nuisance.

Install signs, lights, flares, temporary railing (Type K), barricades and other facilities to direct traffic. Furnish flaggers whenever necessary to direct the movement of the public through or around the work.

You will be required to pay the cost of replacing or repairing all facilities installed under extra work for the convenience or direction or warning of the public which are lost while in your custody, or are damaged by your operations to such an extent as to require replacement or repair.

The Engineer may order or consent to your request to open a completed section of surfacing, pavement, or structure roadway surface for public use. You will not be compensated for any delay to your construction activities caused by the public. This does not relieve you from any other contractual responsibility.

Replace Section 7-1.09 with:

7-1.09 PUBLIC SAFETY

You are responsible to provide for public safety.

Do not construct a temporary facility that interferes with the safe passage of traffic.

Control dust resulting from the work, inside and outside the right-of-way.

Move workers, equipment, and materials without endangering traffic.

Whenever your operations create a condition hazardous to the public, furnish, erect and maintain those fences, temporary railing, barricades, lights, signs, and other devices and take any other necessary protective measures to prevent damage or injury to the public.

Any fences, temporary railing, barricades, lights, signs, or other devices furnished, erected and maintained by you are in addition to those for which payment is provided elsewhere in the specifications.

Provide flaggers whenever necessary to ensure that the public is given safe guidance through the work zone. Except as ordered, at locations where traffic is being routed through construction under one-way controls, move your equipment in compliance with the one-way controls.

Use of signs, lights, flags, or other protective devices must conform with the California MUTCD and as ordered. Signs, lights, flags or other protective devices must not obscure the visibility of, nor conflict in intent, meaning and function of either existing signs, lights and traffic control devices or any construction area signs or traffic control devices.

Keep existing traffic signals and highway lighting in operation. Other entities perform routine maintenance of these facilities during the work.

Cover signs that direct traffic to a closed area. Providing, maintaining, and removing the covers on construction area signs is paid as extra work under Section 4-1.03D, "Extra Work."

Install temporary illumination in a manner which the illumination and the illumination equipment does not interfere with public safety. The installation of general roadway illumination does not relieve you from furnishing and maintaining any protective devices.

Equipment must enter and leave the highway via existing ramps and crossovers and must move in the direction of public traffic. All movements of workmen and construction equipment on or across lanes open to public traffic must be performed in a manner that will not endanger the public. Your vehicles or other mobile equipment leaving an open traffic lane to enter the construction area, must slow down gradually in advance of the location of the turnoff to give traffic following an opportunity to slow down. When leaving a work area and entering a roadway carrying public traffic, your vehicles and equipment must yield to public traffic.

Immediately remove hauling spillage from roadway lanes or shoulders open to traffic. When hauling on roadways, trim loads and remove material from shelf areas to minimize spillage.

Notify the Engineer not less than 25 days and not more than 125 days before the anticipated start of an activity that will change the vertical or horizontal clearance available to public traffic, including shoulders.

If vertical clearance is temporarily reduced to 15.5 feet or less, place low clearance warning signs in accordance with the California MUTCD and as ordered. Signs must comply with the dimensions, color, and legend requirements of the California MUTCD and these specifications except that the signs must have black letters and numbers on an orange retroreflective background. W12-2P signs must be illuminated so that the signs are clearly visible.

Pave or provide full width continuous and cleared wood walks for pedestrian openings through falsework. Protect pedestrians from falling objects and curing water for concrete. Extend overhead protection for pedestrians not less than 4 feet beyond the edge of the bridge deck. Illuminate all pedestrian openings through falsework. Temporary pedestrian facilities must comply with the American with Disabilities Act of 1990 (ADA).

Do not store vehicles, material, or equipment in a way that:

1. Creates a hazard to the public
2. Obstructs traffic control devices

Do not install or place temporary facilities used to perform the work which interfere with the free and safe passage of public traffic.

Temporary facilities which could be a hazard to public safety if improperly designed shall comply with design requirements specified in the contract for those facilities or, if none are specified, with standard design criteria or codes appropriate for the facility involved. Working drawings and design calculations for the temporary facilities shall be prepared and signed by an engineer who is registered as a Civil Engineer in the State of California and shall be submitted to the Engineer for approval pursuant to Section 5-1.02, "Plans and Working Drawings." The

submittals shall designate thereon the standard design criteria or codes used. Installation of the temporary facilities shall not start until the Engineer has reviewed and approved the drawings.

If you appear to be neglectful or negligent in furnishing warning devices and taking protective measures, the Engineer may direct your attention to the existence of a hazard and the necessary warning devices must be furnished and installed and protective measures taken by you. If the Engineer points out the inadequacy of warning devices and protective measures, that action on the part of the Engineer does not relieve you from your responsibility for public safety or abrogate the obligation to furnish and pay for these devices and measures.

Install temporary railing (Type K) or other approved protection system under the following conditions:

1. Excavations: Where the near edge of the excavation is within 15 feet from the edge of an open traffic lane
2. Temporarily Unprotected Permanent Obstacles: When the work includes the installation of a fixed obstacle together with a protective system, such as a sign structure together with protective railing, and you elect to install the obstacle before installing the protective system; or you, for your convenience and as authorized, remove a portion of an existing protective railing at an obstacle and do not replace such railing completely the same day
3. Storage Areas: When material or equipment is stored within 15 feet of the edge of an open traffic lane and the storage is not otherwise prohibited by the provisions of these Standard Specifications and the special provisions
4. Height Differentials: When construction operations create a height differential greater than 0.15 feet within 15 feet of the edge of traffic lane

Temporary railing (Type K) does not need to be installed where excavations within 15 feet from edge of an open traffic lane are:

1. Covered with steel plates or concrete covers of adequate thickness to prevent accidental entry by traffic or the public
2. In side slopes, where the downhill slope is 4:1 (horizontal:vertical) or less unless a naturally occurring condition
3. Protected by existing barrier or railing

Offset the approach end of temporary railing (Type K) a minimum of 15 feet from the edge of an open traffic lane. Install the temporary railing on a skew toward the edge of the traffic lane of not more than one foot transversely to 10 feet longitudinally with respect to the edge of the traffic lane. If the 15-foot minimum offset cannot be achieved, the temporary railing must be installed on the 10 to 1 skew to obtain the maximum available offset between the approach end of the railing and the edge of the traffic lane, and an array of temporary crash cushion modules must be installed at the approach end of the temporary railing.

Secure in place temporary railing (Type K) before starting work for which the temporary railing is required.

Where 2 or more lanes in the same direction are adjacent to the area where the work is being performed, including shoulders, the adjacent lane must be closed under any of the following conditions:

1. Work is off the traveled way but within 6 feet of the edge of traveled way, and approach speed is greater than 45 miles per hour
2. Work is off the traveled way but within 3 feet of the edge of traveled way, and approach speed is less than 45 miles per hour

Closure of the adjacent traffic lane is not required when:

1. Performing work behind a barrier
2. Paving, grinding, or grooving
3. Installing, maintaining, or removing traffic control devices except temporary railing (Type K)

Do not reduce an open traffic lane width to less than 10 feet. When traffic cones or delineators are used for temporary edge delineation, the line of cones or delineators is considered the edge of the traveled way.

If a traffic lane is closed with channelizers for excavation work, move the devices to the adjacent edge of the traveled way when not excavating. Space the devices the same as specified for the lane closure.

Do not move or temporarily suspend anything over a traffic lane open to the public unless the public is protected.

Replace Section 7-1.11 with:

7-1.11 PRESERVATION OF PROPERTY

Comply with Section 5-1.18, "Property and Facility Preservation."

Replace Section 7-1.12 with:

7-1.12 INDEMNIFICATION AND INSURANCE

The Contractor's obligations regarding indemnification of the State of California and the requirements for insurance shall conform to the provisions in Section 3-1.05, "Insurance Policies," and Sections 7-1.12A, "Indemnification," and 7-1.12B, "Insurance," of this Section 7-1.12.

7-1.12A Indemnification

The Contractor shall defend, indemnify, and save harmless the State, including its officers, employees, and agents (excluding agents who are design professionals) from any and all claims, demands, causes of action, damages, costs, expenses, actual attorneys' fees, losses or liabilities, in law or in equity (Section 7-1.12A Claims) arising out of or in connection with the Contractor's performance of this contract for:

1. Bodily injury including, but not limited to, bodily injury, sickness or disease, emotional injury or death to persons, including, but not limited to, the public, any employees or agents of the Contractor, the State, or any other contractor; and
2. Damage to property of anyone including loss of use thereof; caused or alleged to be caused in whole or in part by any negligent or otherwise legally actionable act or omission of the Contractor or anyone directly or indirectly employed by the Contractor or anyone for whose acts the Contractor may be liable.

Except as otherwise provided by law, these requirements apply regardless of the existence or degree of fault of the State. The Contractor is not obligated to indemnify the State for Claims arising from conduct delineated in Civil Code Section 2782 and to Claims arising from any defective or substandard condition of the highway that existed at or before the start of work, unless this condition has been changed by the work or the scope of the work requires the Contractor to maintain existing highway facilities and the Claim arises from the Contractor's failure to maintain. The Contractor's defense and indemnity obligation shall extend to Claims arising after the work is completed and accepted if the Claims are directly related to alleged acts or omissions by the Contractor that occurred during the course of the work. State inspection is not a waiver of full compliance with these requirements.

The Contractor's obligation to defend and indemnify shall not be excused because of the Contractor's inability to evaluate liability or because the Contractor evaluates liability and determine that the Contractor is not liable. The Contractor shall respond within 30 days to the tender of any Claim for defense and indemnity by the State, unless this time has been extended by the State. If the Contractor fails to accept or reject a tender of defense and indemnity within 30 days, in addition to any other remedy authorized by law, the Department may withhold such funds the State reasonably considers necessary for its defense and indemnity until disposition has been made of the Claim or until the Contractor accepts or rejects the tender of defense, whichever occurs first.

With respect to third-party claims against the Contractor, the Contractor waives all rights of any type to express or implied indemnity against the State, its officers, employees, or agents (excluding agents who are design professionals).

Nothing in the Contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of these indemnification specifications.

7-1.12B Insurance

7-1.12B(1) General

Nothing in the contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of these insurance specifications.

7-1.12B(2) Casualty Insurance

The Contractor shall procure and maintain insurance on all of its operations with companies acceptable to the State as follows:

1. The Contractor shall keep all insurance in full force and effect from the beginning of the work through contract acceptance.

2. All insurance shall be with an insurance company with a rating from A.M. Best Financial Strength Rating of A- or better and a Financial Size Category of VII or better.
3. The Contractor shall maintain completed operations coverage with a carrier acceptable to the State through the expiration of the patent deficiency in construction statute of repose set forth in Code of Civil Procedure Section 337.15.

7-1.12B(3) Workers' Compensation and Employer's Liability Insurance

In accordance with Labor Code Section 1860, the Contractor shall secure the payment of worker's compensation in accordance with Labor Code Section 3700.

In accordance with Labor Code Section 1861, the Contractor shall submit to the Department the following certification before performing the work:

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

Contract execution constitutes certification submittal.

The Contractor shall provide Employer's Liability Insurance in amounts not less than:

1. \$1,000,000 for each accident for bodily injury by accident
2. \$1,000,000 policy limit for bodily injury by disease
3. \$1,000,000 for each employee for bodily injury by disease

If there is an exposure of injury to the Contractor's employees under the U.S. Longshoremen's and Harbor Workers' Compensation Act, the Jones Act, or under laws, regulations, or statutes applicable to maritime employees, coverage shall be included for such injuries or claims.

7-1.12B(4) Liability Insurance

7-1.12B(4)(a) General

The Contractor shall carry General Liability and Umbrella or Excess Liability Insurance covering all operations by or on behalf of the Contractor providing insurance for bodily injury liability and property damage liability for the following limits and including coverage for:

1. Premises, operations, and mobile equipment
2. Products and completed operations
3. Broad form property damage (including completed operations)
4. Explosion, collapse, and underground hazards
5. Personal injury
6. Contractual liability

7-1.12B(4)(b) Liability Limits/Additional Insureds

The limits of liability shall be at least the amounts shown in the following table:

Total Bid	For Each Occurrence ¹	Aggregate for Products/Completed Operation	General Aggregate ²	Umbrella or Excess Liability ³
≤\$1,000,000	\$1,000,000	\$2,000,000	\$2,000,000	\$5,000,000
>\$1,000,000				
≤\$10,000,000	\$1,000,000	\$2,000,000	\$2,000,000	\$10,000,000
>\$10,000,000				
≤\$25,000,000	\$2,000,000	\$2,000,000	\$4,000,000	\$15,000,000
>\$25,000,000	\$2,000,000	\$2,000,000	\$4,000,000	\$25,000,000

1. Combined single limit for bodily injury and property damage.
2. This limit shall apply separately to the Contractor's work under this contract.
3. The umbrella or excess policy shall contain a clause stating that it takes effect (drops down) in the event the primary limits are impaired or exhausted.

The Contractor shall not require certified Small Business subcontractors to carry Liability Insurance that exceeds the limits in the table above. Notwithstanding the limits specified herein, at the option of the Contractor, the liability insurance limits for certified Small Business subcontractors of any tier may be less than those limits specified in the table. For Small Business subcontracts, "Total Bid" shall be interpreted as the amount of subcontracted work to a certified Small Business.

The State, including its officers, directors, agents (excluding agents who are design professionals), and employees, shall be named as additional insureds under the General Liability and Umbrella Liability Policies with respect to liability arising out of or connected with work or operations performed by or on behalf of the Contractor under this contract. Coverage for such additional insureds does not extend to liability:

1. Arising from any defective or substandard condition of the roadway which existed at or before the time the Contractor started work, unless such condition has been changed by the work or the scope of the work requires the Contractor to maintain existing roadway facilities and the claim arises from the Contractor's failure to maintain;
2. For claims occurring after the work is completed and accepted unless these claims are directly related to alleged acts or omissions of the Contractor that occurred during the course of the work; or
3. To the extent prohibited by Insurance Code Section 11580.04

Additional insured coverage shall be provided by a policy provision or by an endorsement providing coverage at least as broad as Additional Insured (Form B) endorsement form CG 2010, as published by the Insurance Services Office (ISO), or other form designated by the Department.

7-1.12B(4)(c) Contractor's Insurance Policy is Primary

The policy shall stipulate that the insurance afforded the additional insureds applies as primary insurance. Any other insurance or self-insurance maintained by the State is excess only and shall not be called upon to contribute with this insurance.

7-1.12B(5) Automobile Liability Insurance

The Contractor shall carry automobile liability insurance, including coverage for all owned, hired, and nonowned automobiles. The primary limits of liability shall be not less than \$1,000,000 combined single limit each accident for bodily injury and property damage. The umbrella or excess liability coverage required under Section 7-1.12B(4)(b) also applies to automobile liability.

7-1.12B(6) Policy Forms, Endorsements, and Certificates

The Contractor shall provide its General Liability Insurance under Commercial General Liability policy form No. CG0001 as published by the Insurance Services Office (ISO) or under a policy form at least as broad as policy form No. CG0001.

7-1.12B(7) Deductibles

The State may expressly allow deductible clauses, which it does not consider excessive, overly broad, or harmful to the interests of the State. Regardless of the allowance of exclusions or deductions by the State, the Contractor is responsible for any deductible amount and shall warrant that the coverage provided to the State is in accordance with Section 7-1.12B, "Insurance."

7-1.12B(8) Enforcement

The Department may assure the Contractor's compliance with its insurance obligations. Ten days before an insurance policy lapses or is canceled during the contract period, the Contractor shall submit to the Department evidence of renewal or replacement of the policy.

If the Contractor fails to maintain any required insurance coverage, the Department may maintain this coverage and withhold or charge the expense to the Contractor or terminate the Contractor's control of the work in accordance with Section 8-1.08, "Termination of Control."

The Contractor is not relieved of its duties and responsibilities to indemnify, defend, and hold harmless the State, its officers, agents, and employees by the Department's acceptance of insurance policies and certificates.

Minimum insurance coverage amounts do not relieve the Contractor for liability in excess of such coverage, nor do they preclude the State from taking other actions available to it, including the withholding of funds under this contract.

7-1.12B(9) Self-Insurance

Self-insurance programs and self-insured retentions in insurance policies are subject to separate annual review and approval by the State.

If the Contractor uses a self-insurance program or self-insured retention, the Contractor shall provide the State with the same protection from liability and defense of suits as would be afforded by first-dollar insurance. Execution of the contract is the Contractor's acknowledgement that the Contractor will be bound by all laws as if the Contractor were an insurer as defined under Insurance Code Section 23 and that the self-insurance program or self-insured retention shall operate as insurance as defined under Insurance Code Section 22.

Replace Section 7-1.125 with:

7-1.125 Legal Actions Against the Department

If legal action is brought against the Department over compliance with a State or Federal law, rule, or regulation applicable to highway work, then:

1. If the Department, in complying with a court order, prohibits you from performing work, the resulting delay is a suspension related to your performance, unless the Department terminates the contract.
2. If a court order other than an order to show cause or the final judgment in the action prohibits the Department from requiring you to perform work, the Department may delete the prohibited work or terminate the contract.

In Section 7-1.13 delete the 5th and 6th paragraphs.

Add:

7-1.50 FEDERAL LAWS FOR FEDERAL-AID CONTRACTS

7-1.50A General

Section 7-1.50, "Federal Laws for Federal-Aid Contracts," includes specifications required in a Federal-aid construction contract and applies to a Federal-aid contract.

Form FHWA-1273 is included in the contract in Section 7-1.50B, "FHWA-1273." The training and promotion section of section II refers to training provisions as if they were included in the special provisions. The Department specifies the provisions in section 7-1.11D of the Standard Specifications. If a number of trainees or apprentices is required, the Department specifies the number in the special provisions. Interpret each FHWA 1273 clause shown in the following table as having the same meaning as the corresponding Department clause:

FHWA 1273 Nondiscrimination Clauses

FHWA 1273 section	FHWA 1273 clause	Department clause
Training and Promotion	In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision.	If section 7-1.11D applies, section 7-1.11D supersedes this subparagraph.
Records and Reports	If on-the-job training is being required by special provision, the contractor will be required to collect and report training data.	If the Contract requires on-the-job training, collect and report training data.

7-1.50B FHWA-1273

**REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS**

- I. General
- II. Nondiscrimination
- III. Nonsegregated Facilities
- IV. Davis-Bacon and Related Act Provisions
- V. Contract Work Hours and Safety Standards Act Provisions
- VI. Subletting or Assigning the Contract
- VII. Safety: Accident Prevention
- VIII. False Statements Concerning Highway Projects
- IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
- X. Compliance with Governmentwide Suspension and Debarment Requirements
- XI. Certification Regarding Use of Contract Funds for Lobbying

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

ATTACHMENTS

A. Employment and Materials Preference for Appalachian Development Highway System or Appalachian Local Access Road Contracts (included in Appalachian contracts only)

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding \$10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under

this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are

applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants / Employees with Disabilities: The contractor must be familiar

with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurance Required by 49 CFR 26.13(b):

a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on [Form FHWA-1391](#). The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor

will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding \$2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages

a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions

of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b.(1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is utilized in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or

will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program. Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-

Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b.(1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency..

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly

rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. Subcontracts. The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility.

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

3. Withholding for unpaid wages and liquidated damages. The FHWA or the contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term "perform work with its own organization" refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

- (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
- (2) the prime contractor remains responsible for the quality of the work of the leased employees;
- (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
- (4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is

evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.

2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost \$25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1. Instructions for Certification – First Tier Participants:

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this

covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov>), which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. Instructions for Certification - Lower Tier Participants:

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost \$25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which

this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov/>), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the

department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed \$100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such recipients shall certify and disclose accordingly.

7-1.50C Female and Minority Goals

To comply with Section II, "Nondiscrimination," of "Required Contract Provisions Federal-Aid Construction Contracts," the Department is including in Section 7-1.50C, "Female and Minority Goals," female and minority utilization goals for Federal-aid construction contracts and subcontracts that exceed \$10,000.

The nationwide goal for female utilization is 6.9 percent.

The goals for minority utilization [45 Fed Reg 65984 (10/3/1980)] are as follows:

Minority Utilization Goals		
	Economic Area	Goal (Percent)
174	Redding CA: Non-SMSA Counties: CA Lassen; CA Modoc; CA Plumas; CA Shasta; CA Siskiyou; CA Tehema	6.8
175	Eureka, CA Non-SMSA Counties: CA Del Norte; CA Humboldt; CA Trinity	6.6
176	San Francisco-Oakland-San Jose, CA: SMSA Counties: 7120 Salinas-Seaside-Monterey, CA CA Monterey 7360 San Francisco-Oakland CA Alameda; CA Contra Costa; CA Marin; CA San Francisco; CA San Mateo 7400 San Jose, CA CA Santa Clara, CA 7485 Santa Cruz, CA CA Santa Cruz 7500 Santa Rosa CA Sonoma 8720 Vallejo-Fairfield-Napa, CA CA Napa; CA Solano Non-SMSA Counties: CA Lake; CA Mendocino; CA San Benito	28.9 25.6 19.6 14.9 9.1 17.1 23.2
177	Sacramento, CA: SMSA Counties: 6920 Sacramento, CA CA Placer; CA Sacramento; CA Yolo Non-SMSA Counties CA Butte; CA Colusa; CA El Dorado; CA Glenn; CA Nevada; CA Sierra; CA Sutter; CA Yuba	16.1 14.3
178	Stockton-Modesto, CA: SMSA Counties: 5170 Modesto, CA CA Stanislaus 8120 Stockton, CA CA San Joaquin Non-SMSA Counties CA Alpine; CA Amador; CA Calaveras; CA Mariposa; CA Merced; CA Toulumne	12.3 24.3 19.8
179	Fresno-Bakersfield, CA SMSA Counties: 0680 Bakersfield, CA CA Kern 2840 Fresno, CA CA Fresno Non-SMSA Counties: CA Kings; CA Madera; CA Tulare	19.1 26.1 23.6
180	Los Angeles, CA: SMSA Counties:	

	0360 Anaheim-Santa Ana-Garden Grove, CA CA Orange	11.9
	4480 Los Angeles-Long Beach, CA CA Los Angeles	28.3
	6000 Oxnard-Simi Valley-Ventura, CA CA Ventura	21.5
	6780 Riverside-San Bernardino-Ontario, CA CA Riverside; CA San Bernardino	19.0
	7480 Santa Barbara-Santa Maria-Lompoc, CA CA Santa Barbara	19.7
	Non-SMSA Counties CA Inyo; CA Mono; CA San Luis Obispo	24.6
181	San Diego, CA: SMSA Counties 7320 San Diego, CA CA San Diego	16.9
	Non-SMSA Counties CA Imperial	18.2

For each July during which work is performed under the contract, you and each non-material-supplier subcontractor with a subcontract of \$10,000 or more must complete Form FHWA PR-1391 (Appendix C to 23 CFR 230). Submit the forms by August 15.

7-1.50D Training

Section 7-1.50D, "Training," applies if a number of trainees or apprentices is specified in the special provisions.

As part of your equal opportunity affirmative action program, provide on-the-job training to develop full journeymen in the types of trades or job classifications involved.

You have primary responsibility for meeting this training requirement.

If you subcontract a contract part, determine how many trainees or apprentices are to be trained by the subcontractor.

Include these training requirements in your subcontract.

Where feasible, 25 percent of apprentices or trainees in each occupation must be in their 1st year of apprenticeship or training.

Distribute the number of apprentices or trainees among the work classifications on the basis of your needs and the availability of journeymen in the various classifications within a reasonable recruitment area.

Before starting work, submit to the Department:

1. Number of apprentices or trainees to be trained for each classification
2. Training program to be used
3. Training starting date for each classification

Obtain the Department's approval for this submitted information before you start work. The Department credits you for each apprentice or trainee you employ on the work who is currently enrolled or becomes enrolled in an approved program.

The primary objective of Section 7-1.50D, "Training," is to train and upgrade minorities and women toward journeymen status. Make every effort to enroll minority and women apprentices or trainees, such as conducting systematic and direct recruitment through public and private sources likely to yield minority and women apprentices or trainees, to the extent they are available within a reasonable recruitment area. Show that you have made the efforts. In making these efforts, do not discriminate against any applicant for training.

Do not employ as an apprentice or trainee an employee:

1. In any classification in which the employee has successfully completed a training course leading to journeyman status or in which the employee has been employed as a journeyman
2. Who is not registered in a program approved by the US Department of Labor, Bureau of Apprenticeship and Training

Ask the employee if the employee has successfully completed a training course leading to journeyman status or has been employed as a journeyman. Your records must show the employee's answers to the questions.

Replace Section 8 with:
SECTION 8 PROSECUTION AND PROGRESS

8-1.01 (BLANK)

8-1.02 ASSIGNMENT

No third-party agreement relieves you or your surety of your responsibility to complete the work. Do not sell, transfer, or otherwise dispose of any contract part without prior written consent from the Department.

If you assign the right to receive contract payments, the Department accepts the assignment upon the Engineer's receipt of a notice. Assigned payments remain subject to deductions and withholds described in the contract. The Department may use withheld payments for work completion whether payments are assigned or not.

8-1.025 PRECONSTRUCTION CONFERENCE

Attend a preconstruction conference with key personnel, including your assigned representative, at a time and location determined by the Engineer. Submit documents as required before the preconstruction conference. You may begin work before the preconstruction conference.

Be prepared to discuss the following topics and documents:

Topics	Document
Potential claim and dispute resolution	Potential claim forms
Contractor's representation	Assignment of Contractor's representative
DBE and DVBE	Final utilization reports
Equipment	Equipment list
Labor compliance and equal employment opportunity	Job site posters and benefit and payroll reports
Material inspection	Notice of Materials to be Used
Materials on hand	Request for Payment for Materials on Hand
Measurements	--
Partnering	Field Guide to Partnering on Caltrans Construction Projects
Quality control	QC plans
Safety	Injury and Illness Prevention Program and job site posters
Schedule	Baseline schedule and Weekly Statement of Working Days
Subcontracting	Subcontracting Request
Surveying	Survey Request
Traffic control	Traffic contingency plan and traffic control plans
Utility work	--
Weight limitations	--
Water pollution control	SWPPP or WPCP
Work restrictions	PLACs
Working drawings	--

8-1.03 BEGINNING OF WORK

Begin work within 15 days after receiving notice that the contract has been approved by the Attorney General or the attorney appointed and authorized to represent the Department. Submit a written notice 72 hours before beginning work. If the project has more than one location of work, submit a separate notice for each location.

You may begin work before receiving the notice of contract approval if you:

1. Deliver the signed contract, bonds, and evidence of insurance to the Department
2. Submit 72-hour notice
3. Obtain an encroachment permit from the Department
4. Are authorized by the Department to begin
5. Perform work at your own risk
6. Perform work under the contract

The Engineer does not count working days for days worked before contract approval.

If the contract is approved, work already performed that complies with the contract is authorized.

If the contract does not get approved, leave the job site in a neat condition. If a facility has been changed, restore it to its former or equivalent condition at your expense.

The Department does not adjust time for beginning before the approval date.

8-1.04 PROGRESS SCHEDULE

8-1.04A General

Reserved

8-1.04B Critical Path Method Schedule

The following definitions apply to critical path method schedules:

activity: Task, event, or other project element on a schedule that contributes to completing the project.

Activities have a description, start date, finish date, duration, and one or more logic ties.

baseline schedule: The initial schedule showing the original work plan beginning on the date of contract approval. This schedule shows no completed work to date and no negative float or negative lag to any activity.

controlling activity: Construction activity that extends the scheduled completion date if delayed.

critical path: Longest continuous chain of activities for the project that has the least amount of total float of all chains. In general, a delay on the critical path extends the scheduled completion date.

critical path method (CPM): Network based planning technique using activity durations and relationships between activities to calculate a schedule for the entire project.

revised schedule: Schedule that incorporates a proposed or past change to logic or activity durations.

scheduled completion date: Planned project completion date shown on the current schedule.

updated schedule: Current schedule developed from the accepted baseline and any subsequent accepted updated or revised schedules through regular monthly review to incorporate actual past progress.

Before or at the preconstruction conference, submit a CPM baseline schedule.

Submit a monthly updated schedule that includes the status of work completed to date and the work yet to be performed as planned.

On each schedule, show:

1. Planned and actual start and completion date of each work activity, including applicable:
 - 1.1. Submittal development
 - 1.2. Submittal review and approval
 - 1.3. Material procurement
 - 1.4. Contract milestones and constraints
 - 1.5. Equipment and plant setup
 - 1.6. Interfaces with outside entities
 - 1.7. Erection and removal of falsework and shoring
 - 1.8. Test periods
 - 1.9. Major traffic stage change
 - 1.10. Final cleanup
2. Order that you propose to prosecute the work
3. Logical links between the time-scaled work activities
4. All controlling activities
5. Legible description of each activity
6. At least one predecessor and one successor to each activity, except for project start and project end milestones
7. Duration of not less than one working day for each activity
8. Start milestone date as the contract approval date

You may include changes on updated schedules that do not alter the critical path or extend the schedule completion date compared to the current schedule. Changes may include:

1. Adding or deleting activities
2. Changing activity constraints
3. Changing durations
4. Changing logic

If any proposed change in planned work results in altering the critical path or extending the scheduled completion date, submit a revised schedule within 15 days of the proposed change.

For each schedule submittal:

1. Submit a plotted original, time-scaled network diagram on a sheet of at least 8.5" x 11" with a title block and timeline
2. If a computer program is used to make the schedule, submit a read-only compact disc or diskette containing the schedule data. Label the compact disc or diskette with:
 - 2.1. Contract number
 - 2.2. CPM schedule number and date produced
 - 2.3. File name

If there is no contract item for progress schedule (critical path method), full compensation for this work is included in the contract prices paid for the items of work involved, and no additional compensation will be allowed therefor.

8-1.05 TEMPORARY SUSPENSION OF WORK

8-1.05A General

The Engineer may suspend work wholly or in part due to any of the following:

1. Conditions are unsuitable for work progress.
2. You fail to do any of the following:
 - 2.1. Fulfill the Engineer's orders.
 - 2.2. Fulfill a contract part.
 - 2.3. Perform weather-dependent work when conditions are favorable so that weather-related unsuitable conditions are avoided or do not occur.

Upon the Engineer's written order of suspension, suspend work immediately. Provide for public safety and a smooth and unobstructed passageway through the work zone during the suspension as specified in Sections 7-1.08, "Public Convenience," and 7-1.09, "Public Safety." Resume work when ordered.

8-1.05B Suspensions Unrelated to Contractor Performance

For a suspension unrelated to your performance, providing for a smooth and unobstructed passageway through the work during the suspension will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The days during a suspension unrelated to your performance are non-working days.

8-1.05C Suspensions Related to Contractor Performance

For a suspension related to your performance, the Department may provide for a smooth and unobstructed passageway through the work during the suspension and deduct the cost from payments.

The days during a suspension related to your performance are working days.

8-1.06 TIME OF COMPLETION

The time to complete the work is specified in the special provisions.

The Engineer issues a Weekly Statement of Working Days by the end of the following week unless the contract is suspended for reasons unrelated to your performance.

The Weekly Statement of Working Days shows:

1. Working days and non-working days during the reporting week
2. Time adjustments
3. Work completion date computations, including working days remaining
4. Controlling activities

You may protest a Weekly Statement of Working Days.

8-1.07 LIQUIDATED DAMAGES

8-1.07A General

The Department specifies liquidated damages (Pub Cont Code § 10226). Liquidated damages, if any, accrue starting on the 1st day after the expiration of the working days through the day of contract acceptance except as specified in Sections 8-1.07B, "Failure to Complete Work Parts within Specified Times," and 8-1.07C, "Failure to Complete Work Parts by Specified Dates."

The Department withholds liquidated damages before the accrual date if the anticipated liquidated damages may exceed the value of the remaining work.

Liquidated damages for all work, except plant establishment, are:

Liquidated Damages		
Total Bid		Liquidated Damages per Day
From over	To	
\$0	\$50,000	\$1,200
\$50,000	\$120,000	\$1,500
\$120,000	\$1,000,000	\$1,900
\$1,000,000	\$5,000,000	\$3,000
\$5,000,000	\$10,000,000	\$5,400
\$10,000,000	\$30,000,000	\$8,300
\$30,000,000	\$100,000,000	\$10,500
\$100,000,000	\$250,000,000	\$28,500

If all work, except plant establishment, is complete and the total number of working days has expired, liquidated damages are \$950 per day.

8-1.07B Failure to Complete Work Parts within Specified Times

The Department may deduct specified damages from payments for each day in completing a work part beyond the time specified for completing the work part.

Damages for untimely completion of work parts may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely completion of work parts and for the whole work.

Damages accrue starting the 1st day after a work part exceeds the specified time through the day the specified work part is complete.

8-1.07C Failure to Complete Work Parts by Specified Dates

The Department may deduct specified damages from payments for each day in completing a work part beyond the specified completion date for the work part.

Damages for untimely work part completion may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely work part completion and the whole work.

Damages accrue starting the 1st day after an unmet completion date through the day the work part is complete.

8-1.07D Director Days

If the work is not completed within the working days, the Director may grant director days if it serves the State's best interest.

By granting director days, the Director adds working days to the contract. The Director may either grant enough days to eliminate the liquidated damages or fewer. In the latter case, the Department deducts liquidated damages for the remaining overrun in contract time. The Director may deduct the Department's engineering, inspection, and overhead costs incurred during the period of extension granted as director days.

8-1.08 TERMINATION OF CONTROL

The Department may terminate your control of the work for failure to do any of the following (Pub Cont Code § 10253):

1. Supply an adequate workforce
2. Supply material as described
3. Pay subcontractors (Pub Cont Code §10262)

4. Prosecute the work as described in the contract

The Department may also terminate your control for failure to maintain insurance coverage.

For a Federal-aid contract, the Department may terminate your control of the work for failure to include "Required Contract Provisions, Federal-Aid Construction Contracts" in subcontracts.

The Department gives you and your surety notice at least 5 days before terminating control. The notice describes the failures and the time allowed to remedy the failures. If failures are not remedied within the time provided, the Department takes control of the work.

The Department may complete the work if the Department terminates your control or you abandon the project (Pub Cont Code § 10255). The Department determines the unpaid balance under Pub Cont Code § 10258 and the contract.

At any time before final payment of all claims, the Department may convert a termination of control to a termination of contract.

8-1.09 DELAYS

8-1.09A General

An excusable delay is a delay of a controlling activity beyond your control, not foreseeable when the work began such as:

1. Change in the work
2. Department action that is not part of the contract
3. Presence of an underground utility main not described in the contract or in a location different from that specified
4. Described facility reconstruction not reconstructed as described, by the utility owner by the date specified, unless the reconstruction is solely for your convenience
5. Department's failure to obtain timely access to the right-of-way
6. Department's failure to perform an action in the time specified

A critical delay is a delay that extends the schedule completion date.

To request a delay-related time or payment adjustment, submit an RFI.

8-1.09B Time Adjustments

For an excusable critical delay, the Department may make a time adjustment. The Engineer uses information from the schedule to evaluate requests for time adjustments.

If requesting an adjustment, submit a revised schedule showing the delay's effect on the controlling activity. If the delay has:

1. Occurred, submit records of dates and what work was performed during the delayed activity
2. Not occurred, submit the expected dates or duration of the delayed activity

If the Engineer requests, update the schedule to the last working day before the start of the delay.

8-1.09C Payment Adjustments

The Department may make a payment adjustment for an excusable delay that affects your costs.

Only losses for idle equipment, idle workers, and equipment moving or transporting are eligible for delay-related payment adjustments.

The Engineer determines payment for idle time of equipment in the same manner as determinations are made for equipment used in the performance of force account work under Section 9-1.03, "Force Account," with the following exceptions:

1. Delay factor in the Labor Surcharge and Equipment Rental Rates applies to each equipment rental rate.
2. Daily number of payable hours equals the normal working hours during the delay, not to exceed 8 hours per day.
3. Delay days exclude non-working days.
4. Markups are not added.

The Engineer determines payment adjustment for idle workers under Section 9-1.03B, "Labor," but does not add markups.

The Engineer includes costs due to necessary extra equipment moving or transporting.

8-1.10 (BLANK)

8-1.11 TERMINATION OF CONTRACT

8-1.11A General

The Director may terminate the contract if it serves the State's best interest. The Department issues you a written notice, implements the termination, and pays you.

8-1.11B Relief from Responsibility for Work

On receiving a termination notice:

1. Stop work
2. Notify subcontractors and suppliers of the contract termination and stop contract-related work
3. Perform the Engineer-ordered work to secure the job site for termination
4. Remove equipment
5. If authorized, settle termination-related claims and liabilities involving subcontractors and suppliers; assign to the Department the rights, titles, or interests held by you with respect to these parties

8-1.11C Responsibility for Materials

On receiving a termination notice, protect unused material until:

1. You submit an inventory of materials already produced, purchased, or ordered but not yet used; include the location of the material.
2. The Engineer identifies materials that will be retained by the Department. Submit bills of sales or other records of material title.
3. The Engineer confirms that unused materials paid by progress payment and materials furnished by the State have been delivered and stored as ordered.
4. Titles are transferred for materials purchased by the Department.

Dispose of materials that will not be retained by the Department.

8-1.11D Contract Acceptance after Termination

The Engineer recommends contract acceptance after determining completion of:

1. Contract work ordered to be completed before termination
2. Other work ordered to secure the project before termination
3. Material delivery and title transfer

The Department pays you under Section 9-1.08, "Payment After Contract Acceptance."

8-1.11E Payment Adjustment for Termination

If the Department issues a termination notice, the Engineer determines payment for termination based on the following:

1. Direct cost for the work:
 - 1.1. Including mobilization, demobilization, securing the job site for termination, and losses from the sale of materials
 - 1.2. Not including the cost of materials you keep, profit realized from the sale of materials, the cost of material damaged by an occurrence as defined in Section 7-1.165, "Damage by Storm, Flood, Tsunami or Earthquake," and other credits.
2. Cost of remedial work, as estimated by the Engineer, is not reimbursed.
3. Allowance for profit not to exceed 4 percent of the cost of the work. Prove a likelihood of having made a profit had the contract not been terminated.
4. Material handling costs for material returned to the vendor or disposed of as ordered.

- 3.1. Use securely attached metal shims or grout
 - 3.2. Do not use wedges to shim the supports
 - 3.3. Do not use shim material in excess of 3 inches
4. Install mechanical indicating elements level, plumb, and rigidly mounted on the concrete undersupports
 5. For a hopper scale, rigidly attach hopper scale lever systems and mechanical indicating elements so no weight is lost from bending or support distortion

Each scale used to determine material payment quantities must be operated by a licensed weighmaster (Bus & Prof Code § 12700 et seq.).

Submit a public weighmaster's certificate or certified daily summary weigh sheets for each weighed material quantity. The Department may witness material weighing and check and compile the daily scale weight record.

Each vehicle operator must obtain weight or load slips from the weighmaster. Submit these records at the delivery point.

9-1.01B(3) Procedures

Daily, weigh empty vehicles used to haul material paid for by weight. Each vehicle must have a legible identification mark. The Department may verify material weight by having an empty and loaded vehicle weighed on any scale the Engineer designates.

For imported topsoil measured by volume, soil amendment, and mulch:

1. Each vehicle must allow a ready and accurate contents determination
2. Unless vehicles are of uniform capacity, each vehicle must have a legible identification mark showing its volume capacity
3. Load vehicles to at least the volume capacity
4. Level vehicle loads on arrival at the delivery point

If determining a quantity paid on a volume basis is impractical or if you request and the Engineer authorizes the request, the Engineer weighs the material and converts the result to a volume measurement. The Engineer determines the conversion factors and, if you agree, adopts this method of measurement.

9-1.01C Final Pay Items

The Department shows a bid item quantity as a final pay item for payment purposes only. For a final pay item, accept payment based on the verified Bid Item List quantity, regardless of actual quantity used unless dimensions are changed by the Engineer.

9-1.01D Quantities of Aggregate and Other Roadway Materials

The Engineer determines the weight of aggregate and other roadway materials that are being paid for by weight as shown and does not include the deducted weight of water in their payment quantities.

Material	Quantity Determination
Aggregate or other roadway material except as otherwise shown in this table	By deducting the weight of water in the material ^a in excess of 3 percent of the dry weight of the material from the weight of the material
Imported borrow, imported topsoil, aggregate subbase	By deducting the weight of water in the material ^a in excess of 6 percent of the dry weight of the material from the weight of the material
Straw	By deducting the weight of water in the material ^a in excess of 15 percent of the dry weight of the material from the weight of the material
Fiber ^b	Engineer does not deduct the weight of water
Aggregate base and aggregate for cement treated bases	As specified in Section 26, "Aggregate Bases," and Section 27, "Cement Treated Bases"

NOTE: Percentage of water is determined by California Test 226.

^aAt the time of weighing

^bWeight of water in the fiber^a must not exceed 15 percent of the dry weight of the fiber.

9-1.02 SCOPE OF PAYMENT

The Department pays you for furnishing the resources and activities required to complete the Contract work. The Department's payment is full compensation for furnishing the resources and activities, including:

1. Risk, loss, damage repair, or cost of whatever character arising from or relating to the work and performance of the work
2. PLACs and taxes

Full compensation for work specified in Sections 1 through 9 is included in the payment for the bid items involved unless:

1. Bid item for the work is shown on the verified Bid Item List
2. Work is specified as paid for as extra work

The Department does not pay for your loss, damage, repair, or extra costs of whatever character arising from or relating to the work that is a direct or indirect result of your choice of construction methods, materials, equipment, or manpower, unless specifically mandated by the Contract.

Payment is:

1. Full compensation for each bid item specified by the description and measurement unit shown on the verified Bid Item List
2. For the price bid for each bid item shown on the verified Bid Item List or as changed by change order with a specified price adjustment

If an alternative is described in the Contract, the Department pays based on the bid items for the details and specifications not described as an alternative.

The Department pays for work performed by change order based on one or a combination of the following:

1. Bid item prices
2. Force account
3. Agreed price
4. Specialist billing

If the Engineer chooses to pay for work performed by change order based on an agreed price, but you and the Engineer cannot agree on the price, the Department pays by force account.

If a portion of extra work is covered by bid items, the Department pays for this work as changed quantities in those items. The Department pays for the remaining portion of the extra work by force account or agreed price.

The Department pays 10 percent annual interest for unpaid and undisputed:

1. Progress payments
2. After-acceptance payment except for claims

For these payments, interest starts to accrue 30 days after the 1st working day following the 20th day of the month payment is due. For extra work bills not submitted within 7 days after performing the work as specified in 5-1.015E, "Extra Work Bills," interest starts to accrue 60 days after the 1st working day following the 20th day of the month payment is due.

The Department pays 6 percent annual interest for unpaid and undisputed claims. Interest starts to accrue 61 days after the Department accepts a claim statement.

The Department pays 6 percent annual interest for awards in arbitration (Civ Code § 3289).

If the amount of a deduction or withhold exceeds final payment, the Department invoices you for the difference, to be paid upon receipt.

9-1.03 FORCE ACCOUNT PAYMENT

9-1.03A General

For work paid by force account, the Engineer compares the Department's records to your daily force account work report. When you and the Engineer agree on the contents of the daily force account work reports, the Engineer accepts the report and the Department pays for the work. If the records differ, the Department pays for the work based only on the information shown on the Department's records.

If a subcontractor performs work at force account, accept an additional 10 percent markup to the total cost of that work paid at force account, including markups specified in Section 9-1.03, as reimbursement for additional administrative costs.

The markups specified in labor, materials, and equipment include compensation for all delay costs, overhead costs, and profit.

If an item's payment is adjusted for work-character changes, the Department excludes your cost of determining the adjustment.

Payment for owner-operated labor and equipment is made at the market-priced invoice submitted.

9-1.03B Labor

Labor payment is full compensation for the cost of labor used in the direct performance of the work plus a 35 percent markup. Force account labor payment consists of:

1. Employer payment to the worker for:
 - 1.1. Basic hourly wage
 - 1.2. Health and welfare
 - 1.3. Pension
 - 1.4. Vacation
 - 1.5. Training
 - 1.6. Other State and federal recognized fringe benefit payments
2. Labor surcharge percentage in Labor Surcharge and Equipment Rental Rates current during the work paid at force account for:
 - 2.1. Workers' compensation insurance
 - 2.2. Social security
 - 2.3. Medicare
 - 2.4. Federal unemployment insurance
 - 2.5. State unemployment insurance
 - 2.6. State training taxes
3. Subsistence and travel allowances paid to the workers
4. Employer payment to supervisors, if authorized

The 35 percent markup consists of payment for all overhead costs related to labor but not designated as costs of labor used in the direct performance of the work including:

1. Home office overhead
2. Field office overhead
3. Bond costs
4. Profit
5. Labor liability insurance
6. Other fixed or administrative costs that are not costs of labor used in the direct performance of the work

9-1.03C Materials

Material payment is full compensation for materials you furnish and use in the work. The Engineer determines the cost based on the material purchase price, including delivery charges, except:

1. A 15 percent markup is added.
2. Supplier discounts are subtracted whether you took them or not.
3. If the Engineer believes the material purchase prices are excessive, the Department pays the lowest current wholesale price for a similar material quantity.
4. If you procured the materials from a source you wholly or partially own, the determined cost is based on the lower of the:
 - 4.1. Price paid by the purchaser for similar materials from that source on Contract items
 - 4.2. Current wholesale price for those materials

5. If you do not submit a material cost record within 30 days of billing, the determined cost is based on the lowest wholesale price:

- 5.1. During that period
- 5.2. In the quantities used

9-1.03D Equipment Rental

9-1.03D(1) General

Equipment rental payment is full compensation for:

1. Rental equipment costs, including moving rental equipment to and from the site of work performed by change order using its own power.
2. Transport equipment costs for rental equipment that cannot be transported economically using its own power. No payment is made during transport for the transported equipment.
3. 15 percent markup.

If you want to return the equipment to a location other than its original location, the payment to move the equipment must not exceed the cost of returning the equipment to its original location. If you use the equipment for work other than work paid by force account, the transportation cost is included in the other work.

Before moving or loading the equipment, obtain authorization for the equipment rental's original location.

The Engineer determines rental costs:

1. Using rates in Labor Surcharge and Equipment Rental Rates:
 - 1.1. By classifying equipment using manufacturer's ratings and manufacturer-approved changes.
 - 1.2. Current during the work paid by force account.
 - 1.3. Regardless of equipment ownership; but the Department uses the rental document rates or minimum rental cost terms if:
 - 1.3.1. Rented from equipment business you do not own.
 - 1.3.2. The Labor Surcharge and Equipment Rental Rates hourly rate is \$10.00 per hour or less.
2. Using rates established by the Engineer for equipment not listed in Labor Surcharge and Equipment Rental Rates. You may submit cost information that helps the Engineer establish the rental rate; but the Department uses the rental document rates or minimum rental cost terms if:
 - 2.1. Rented from equipment business you do not own.
 - 2.2. The Engineer establishes a rate of \$10.00 per hour or less.
3. Using rates for transport equipment not exceeding the hourly rates charged by established haulers.

Equipment rental rates include the cost of:

1. Fuel
2. Oil
3. Lubrication
4. Supplies
5. Small tools that are not consumed by use
6. Necessary attachments
7. Repairs and maintenance
8. Depreciation
9. Storage
10. Insurance
11. Incidentals

The Department pays for small tools consumed by use. The Engineer determines payment for small tools consumed by use based on Contractor-submitted invoices.

9-1.03D(2) Equipment On the Job Site

For equipment on the job site at the time required to perform work paid by force account, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to move the equipment to another location on the job site when the work paid by force account is completed
2. To load and unload equipment
3. Equipment is operated to perform work paid by force account and:
 - 3.1. Hourly rates are paid in 1/2-hour increments
 - 3.2. Daily rates are paid in 1/2-day increments

When rented equipment on the job site is used to perform work at force account not required by the original contract work, the Engineer may authorize rates in excess of those in Labor Surcharge and Equipment Rental Rates if:

1. You submit a request to use rented equipment
2. Equipment is not available from your owned equipment fleet or from your subcontractors
3. Rented equipment is from an independent rental company
4. Proposed equipment rental rate is reasonable
5. Engineer authorizes the equipment source and the rental rate before you use the equipment

The Department pays for fuel consumed during operation of rented equipment not included in the invoiced rental rate.

9-1.03D(3) Equipment Not On the Job Site Required for Original Contract Work

For equipment not on the job site at the time required to perform work paid by force account and required for original Contract work, the time paid is the time the equipment is operated to perform work paid by force account and the time to move the equipment to a location on the job site when the work paid by force account is completed.

The minimum total time paid is:

1. 1 day if daily rates are paid
2. 8 hours if hourly rates are paid

If daily rates are recorded, equipment:

1. Idled is paid as 1/2 day
2. Operated 4 hours or less is paid as 1/2 day
3. Operated 4 hours or more is paid as 1 day

If the minimum total time exceeds 8 hours and if hourly rates are listed, the Department rounds up hours operated to the nearest 1/2-hour increment and pays based on the following table. The table does not apply when equipment is not operated due to breakdowns; in which case rental hours are the hours the equipment was operated.

Equipment Rental Hours

Hours operated	Hours paid
0.0	4.00
0.5	4.25
1.0	4.50
1.5	4.75
2.0	5.00
2.5	5.25
3.0	5.50
3.5	5.75
4.0	6.00
4.5	6.25
5.0	6.50

5.5	6.75
6.0	7.00
6.5	7.25
7.0	7.5
7.5	7.75
>8.0	hours used

9-1.03D(4) Equipment Not On the Job Site Not Required for Original Contract Work

For equipment not on the job site at the time required to perform work paid by force account and not required for original Contract work, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to return the equipment to its source when the work paid by force account is completed
2. To load and unload equipment
3. Equipment is operated to perform work paid by force account

For this equipment, the Engineer may authorize rates in excess of those in Labor Surcharge and Equipment Rental Rates subject to the following:

1. Equipment is not available from your normal sources or from one of your subcontractors
2. Proposed equipment rental rate is reasonable
3. Engineer authorizes the equipment source and the rental rate before you use the equipment

9-1.03D(5) Non-Owner-Operated Dump Truck Rental

Submit the rental rate for non-owner-operated dump truck rental. The Engineer determines the payment rate. Payment for non-owner-operated dump truck rental is for the cost of renting a dump truck, including its driver. For the purpose of markup payment only, the non-owner-operated dump truck is rental equipment and the owner is a subcontractor.

9-1.04 EXTRA WORK PERFORMED BY SPECIALISTS

If the Engineer determines that you or your subcontractors are not capable of performing specialty extra work, a specialist may be used. Itemize the labor, material, and equipment rental costs unless it is not the special service industry's established practice to provide itemization; in which case, the Engineer accepts current market-priced invoices for the work.

The Engineer may accept an invoice as a specialist billing for work performed at an off-job site manufacturing plant or machine shop.

The Engineer determines the cost based on the specialist invoice price minus any available or offered discounts plus a 10 percent markup.

9-1.05 CHANGED QUANTITY PAYMENT ADJUSTMENTS

9-1.05A General

The unit prices specified in Section 9-1.05 are adjusted under Section 9-1.03, "Force Account."

9-1.05B Increases of More Than 25 Percent

If the total bid item quantity exceeds 125 percent of the quantity shown on the verified Bid Item List and if no approved Contract Change Order addresses payment for the quantity exceeding 125 percent, the Engineer may adjust the unit price for the excess quantity under Section 9-1.03, "Force Account," or the following:

1. The adjustment is the difference between the unit price and the unit cost of the total item pay quantity.
2. In determining the unit cost, the Engineer excludes the item's fixed costs. You have recovered the fixed costs in the payment for 125 percent shown on the verified Bid Item List.
3. After excluding fixed costs, the Engineer determines the item unit cost under Section 9-1.03, "Force Account."

If the payment for the number of units of a bid item in excess of 125 percent of the verified Bid Item List is less than \$5,000 at the unit price, the Engineer may not adjust the unit price unless you request it.

9-1.05C Decreases of More Than 25 Percent

If the total item pay quantity is less than 75 percent of the quantity shown on the verified Bid Item List and if no approved Contract Change Order addresses payment for the quantity less than 75 percent, you may request a unit price adjustment. The Engineer may adjust the unit price for the decreased quantity under Section 9-1.03, "Force Account" or the following:

1. The adjustment is the difference between the unit price and the unit cost of the total pay quantity.
2. In determining the unit cost, the Engineer includes the item's fixed costs.
3. After including fixed costs, the Engineer determines the item unit cost under Section 9-1.03, "Force Account."

The Department does not pay more than 75 percent of the item total in the verified Bid Item List.

9-1.05D Eliminated Items

If the Engineer eliminates an item, the Department pays your costs incurred before the Engineer's elimination notification date.

If you order authorized material for an eliminated item before the notification date and the order cannot be canceled, either of the following occurs:

1. If the material is returnable to the vendor, the Engineer orders you to return the material and the Department pays your handling costs and vendor charges.
2. The Department pays your cost for the material and its handling and becomes the material owner.

The Engineer determines the payment for the eliminated bid item under Section 9-1.03, "Force Account."

9-1.06 WORK-CHARACTER CHANGES

The Department adjusts a bid item unit price based on the difference between the cost to perform the work as planned and the cost to perform the work as changed. The Engineer determines the payment adjustment under Section 9-1.03, "Force Account." The Department adjusts payment for only the work portion that changed in character.

9-1.07 PROGRESS PAYMENTS

9-1.07A General

The Department pays you based on Engineer-prepared monthly progress estimates. Each estimate reflects:

1. Total work completed during the pay period
2. Extra work bills if:
 - 2.1. Submitted by the 15th of a month
 - 2.2. Approved by the 20th of a month
3. Amount for materials on hand
4. Amount earned for mobilization
5. Deductions
6. Withholds
7. Resolved potential claims
8. Payment adjustments

Submit certification stating the work complies with the QC procedures. The Engineer does not process a progress estimate without a signed certification.

You may protest a progress payment.

9-1.07B Schedule of Values

Section 9-1.07B applies to a lump sum bid item for which a schedule of values is specified to be submitted.

The sum of the amounts for the work units listed in the schedule of values must equal the lump sum price bid for the bid item.

Obtain authorization of a schedule of values before you perform work shown on the schedule. The Department does not process a progress payment for the bid item without an authorized schedule of values.

Accept progress payments for overhead, profit, bond costs, and other fixed or administrative costs as distributed proportionally among the items listed except that for a contract with a bid item for mobilization, accept progress payments for bond costs as included in the mobilization bid item.

For changed quantities of the work units listed, the Department adjusts payments in the same manner as specified for changed quantities of bid items under Section 9-1.05, "Changed Quantity Payment Adjustments."

9-1.07C Materials On Hand

A material on hand but not incorporated into the work is eligible for progress payment if:

1. Listed in a special provision as eligible and is in compliance with other Contract parts
2. Purchased
3. An invoice is submitted
4. Stored within the State and you submit evidence that the stored material is subject to the Department's control
5. Requested on the Department-furnished form

9-1.07D Mobilization

Mobilization is eligible for partial payments if the Contract includes a bid item for mobilization. The Department makes the partial payments under Pub Cont Code § 10264. If the Contract does not include a mobilization bid item, mobilization is included in the payment for the various bid items.

The Department pays the item total for mobilization in excess of 10 percent of the total bid in the 1st payment after Contract acceptance.

9-1.07E Withholds

9-1.07E(1) General

The Department may withhold payment for noncompliance.

The Department returns the noncompliance withhold in the progress payment following correction of noncompliance.

Withholds are not retentions under Pub Cont Code § 7107 and do not accrue interest under Pub Cont Code § 10261.5.

Withholds are cumulative and independent of deductions.

Section 9-1.07E does not include all withholds that may be taken; the Department may withhold other payments as specified.

9-1.07E(2) Progress Withholds

The Department withholds 10 percent of a partial payment for noncompliant progress. Noncompliant progress occurs when:

1. Total days to date exceed 75 percent of the revised Contract working days
2. Percent of working days elapsed exceeds the percent of value of work completed by more than 15 percent

The Engineer determines the percent of working days elapsed by dividing the total days to date by the revised Contract working days and converting the quotient to a percentage.

The Engineer determines the percent of value of work completed by summing payments made to date and the amount due on the current progress estimate, dividing this sum by the current total estimated value of the work, and converting the quotient to a percentage. These amounts are shown on the Progress Payment Voucher.

When the percent of working days elapsed minus the percent of value of work completed is less than or equal to 15 percent, the Department returns the withhold in the next progress payment.

9-1.07E(3) Performance Failure Withholds

During each estimate period you fail to comply with a Contract part, including submittal of a document as specified, the Department withholds a part of the progress payment. The documents include QC plans, schedules, traffic control plans, and water pollution control submittals.

For 1 performance failure, the Department withholds 25 percent of the progress payment but does not withhold more than 10 percent of the total bid.

For multiple performance failures, the Department withholds 100 percent of the progress payment but does not withhold more than 10 percent of the total bid.

9-1.07E(4) Stop Notice Withholds

The Department may withhold payments to cover claims filed under Civ Code § 3179 et seq.

Stop notice information may be obtained from the Office of External Accounts Payable, Division of Accounting.

9-1.07E(5) Penalty Withholds

Penalties include fines and damages that are proposed, assessed, or levied against you or the Department by a governmental agency or private lawsuit. Penalties are also payments made or costs incurred in settling alleged violations of federal, state, or local laws, regulations, requirements, or PLACs. The cost incurred may include the amount spent for mitigation or correcting a violation.

If you or the Department is assessed a penalty, the Department may withhold the penalty amount until the penalty disposition has been resolved. The Department may withhold penalty funds without notifying you.

Instead of the withhold, you may provide a bond equal to the highest estimated liability for any disputed penalties proposed.

9-1.07E(6)–9-1.07E(10) Reserved

9-1.07F Retentions

The Department does not retain moneys from progress payments due to the Contractor for work performed (Pub Cont Code § 7202).

9-1.07G–9-1.07K Reserved

9-1.08 PAYMENT AFTER CONTRACT ACCEPTANCE

9-1.08A General

Reserved

9-1.08B Payment Before Final Estimate

After Contract acceptance, the Department pays you based on the Engineer-prepared estimate that includes withholds and the balance due after deduction of previous payments.

9-1.08C Proposed Final Estimate

The Engineer estimates the amount of work completed and shows the amount payable in a proposed final estimate based on:

1. Contract items
2. Payment adjustments
3. Work paid by force account or agreed price
4. Extra work
5. Deductions

Submit either a written final estimate acceptance or a claim statement no later than the 30th day after receiving the proposed final estimate. Evidence of the Contractor's receipt of the final estimate and the Engineer's receipt of the Contractor's written acceptance or claim statement is a delivery service's proof of delivery or Engineer's written receipt if hand delivered.

If you claim that the final estimate is less than 90 percent of your total bid, the Department adjusts the final payment to cover your overhead. The adjustment is 10 percent of the difference between the total bid and the final estimate. The Department does not make this adjustment on a terminated contract.

9-1.08D Final Payment and Claims

9-1.08D(1) General

If you accept the proposed final estimate or do not submit a claim statement within 30 days of receiving the estimate, the Engineer furnishes the final estimate to you and the Department pays the amount due within 30 days. This final estimate and payment is conclusive except as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

If you submit a claim statement within 30 days of receiving the Engineer's proposed final estimate, the Engineer furnishes a semifinal estimate to the Contractor and the Department pays the amount due within 30 days. The semifinal estimate is conclusive as to the amount of work completed and the amount payable except as affected by the claims or as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

9-1.08D(2) Claim Statement

9-1.08D(2)(a) General

For each claim, submit a claim statement showing only the identification number that corresponds to the Full and Final Potential Claim Record and the final amount of additional payment requested except:

1. If the final amount of requested payment differs from the amount requested in the Full and Final Potential Claim Record
2. For a claim for quantities, withholds, deductions, liquidated damages, or change order bills
3. For an overhead claim

If the final amount of requested payment differs from the amount requested in the Full and Final Potential Claim Record, submit:

1. Identification number that corresponds to the Full and Final Potential Claim Record
2. Final amount of additional payment requested
3. Basis for the changed amount
4. Contract documentation that supports the changed amount
5. Statement of the reasons the Contract documentation supports the claim

The Engineer notifies you of an omission of or a disparity in the exclusive identification number. Within 15 days of the notification, correct the omission or disparity. If the omission or disparity is not resolved after the 15 days, the Engineer assigns a new number.

For a claim for quantities, withholds, deductions, or change order bills submit:

1. Final amount of additional payment requested
2. Enough detail to enable the Engineer to determine the basis and amounts of the additional payment requested

9-1.08D(2)(b) Overhead Claims

Include with an overhead claim:

1. Final amount of additional payment requested
2. Independent CPA audit report

Failure to submit the audit report with an overhead claim with the claim statement is a waiver of the overhead claim and operates as a bar to arbitration on the claim (Pub Cont Code § 10240.2).

The Department deducts an amount for field and home office overhead paid on added work from any claim for overhead. The value of the added work equals the value of the work completed minus the total bid. The home office overhead deduction equals 5 percent of the added work. The field office overhead deduction equals 5-1/2 percent of the added work.

If you intend to pursue a claim for reimbursement for field or home office overhead beyond that provided expressly by the Contract:

1. Notify the Engineer within 30 days of receipt of the proposed final estimate of your intent to seek reimbursement for specific overhead costs beyond that provided by the Contract
2. Specifically identify each claim and each date associated with each claim from which you seek reimbursement for specific overhead costs beyond that provided by the Contract
3. Timely submit all other claims
4. Within 30 days of receipt of the proposed final estimate, submit an audit report prepared by an independent CPA
 - 4.1. The audit report must show calculations with supporting documentation of actual home office and project field overhead costs

- 4.2. The calculations must specify the actual daily rates for both field and home office overhead for the entire duration of the project expressed as a rate per working day
 - 4.3. The start and end dates of the actual project performance period, number of working days, overhead cost pools, and all allocation bases must be disclosed in the calculations of your actual field and home office overhead daily rates
 - 4.4. Neither daily rate may include a markup for profit
5. Field overhead costs from which the daily rate is calculated must be:
- 5.1. Allowable under 48 CFR 31
 - 5.2. Supported by reliable records
 - 5.3. Related solely to the project
 - 5.4. Incurred during the actual project performance period
 - 5.5. Comprised of only time-related field overhead costs
 - 5.6. Not a direct cost
6. Home office overhead costs from which the daily rate is calculated must be:
- 6.1. Allowable under 48 CFR 31
 - 6.2. Supported by reliable records
 - 6.3. Incurred during the actual project performance period
 - 6.4. Comprised of only fixed home office overhead costs
 - 6.5. Not a direct cost

The actual rate of time-related overhead is subject to authorization by the Engineer.

The CPA's audit must be performed under the Attestation Standards published by the American Institute of Certified Public Accountants. The CPA's audit report must express an opinion whether or not your calculations of your actual field and home office overhead daily rates comply with Section 9-1.08D(2)(b), "Overhead Claims." The attest documentation prepared by the CPA in connection with the audit must be reproduced and submitted for review with the audit report.

The Department provides markups for all work paid by force account. Overhead for field and home office costs are included in the markups. Overhead claims in excess of Contract markups are not allowed under the Contract. If you seek reimbursement for costs not allowed under the Contract, the Department does not pay your cost of performing the independent CPA examination specified in section 9-1.08D(2)(b), "Overhead Claims," including preparation of the audit report.

9-1.08D(2)(c) Declaration

Submit a declaration that includes the following language with the claim statement:

I declare under penalty of perjury, according to the laws of the State of California, that the foregoing claims, with specific reference to the California False Claims Act (Govt Code § 12650 et seq.) and to the extent the project contains federal funding, the U.S. False Claims Act (31 USC § 3729 et seq.), are true and correct, and that this declaration was signed on _____(date)_____, 20__ at _____, California.

9-1.08D(2)(d) Waiver

A claim is waived if:

1. Claim does not have a corresponding Full and Final Potential Claim Record identification number
2. Claim does not have the same nature, circumstances, and basis of claim as the corresponding Full and Final Potential Claim Record
3. Claim is not included in the claim statement
4. You do not comply with the claim procedures
5. You do not submit the declaration specified in 9-1.08D(2)(c), "Declaration"

9-1.08D(3) Final Determination of Claims

Failure to allow timely access to claim supporting data when requested waives the claim.

1. Stop all work within a 60-foot radius of the discovery
2. Protect the discovery area
3. Notify the Engineer

The Department investigates. Do not move archaeological resources or take them from the job site. Do not resume work within the discovery area until authorized.

If, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of an archaeological find, or investigation or recovery of archeological materials, you will be compensated for resulting losses, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays."

If ordered, furnish resources to assist in the investigation or recovery of archaeological resources. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

14-2.03 ARCHAEOLOGICAL MONITORING AREA

Section 14-2.03 applies if an AMA is described in the Contract.

The Department assigns an archaeological monitor to monitor job site activities within the AMA. Do not work within the AMA unless the archeological monitor is present.

The Engineer and the Department archaeological monitor conduct an AMA location field review with you at least 5 business days before start of work. The Department marks the exact boundaries of the AMA on the ground.

If temporary fence (Type ESA) or other enclosure for an AMA is described in the Contract, install temporary fence (Type ESA) or other enclosure to define the boundaries of the AMA during the AMA location field review.

At least 5 business days before starting work within an AMA, submit a schedule of days and hours to be worked for the Engineer's approval. If you require changes in the schedule, submit an update for the Engineer's approval at least 5 business days before any changed work day.

If archaeological resources are discovered within an AMA, comply with Section 14-2.02, "Archaeological Resources."

14-2.04 HISTORIC STRUCTURES

Reserved

14-3 COMMUNITY IMPACTS AND ENVIRONMENTAL JUSTICE

Reserved

14-4 NATIVE AMERICAN CONCERNS

Reserved

14-5 AESTHETICS

Reserved

14-6 BIOLOGICAL RESOURCES

14-6.01 GENERAL

Reserved

14-6.02 BIRD PROTECTION

Protect migratory and nongame birds, their occupied nests, and their eggs.

The Department anticipates nesting or attempted nesting from February 15 to September 1.

The federal Migratory Bird Treaty Act, 16 USC § 703–711, and 50 CFR Pt 10 and Fish & Game Code §§ 3503, 3513, and 3800 protect migratory and nongame birds, their occupied nests, and their eggs.

The federal Endangered Species Act of 1973, 16 USC §§ 1531 and 1543, and the California Endangered Species Act, Fish & Game Code §§ 2050–2115.5, prohibit the take of listed species and protect occupied and unoccupied nests of threatened and endangered bird species.

The Bald and Golden Eagle Protection Act, 16 USC § 668, prohibits the destruction of bald and golden eagles and their occupied and unoccupied nests.

If migratory or nongame bird nests are discovered that may be adversely affected by construction activities or an injured or killed bird is found, immediately:

1. Stop all work within a 100-foot radius of the discovery.
2. Notify the Engineer.

The Department investigates. Do not resume work within the specified radius of the discovery until authorized.

When ordered, use exclusion devices, take nesting prevention measures, remove and dispose of partially constructed and unoccupied nests of migratory or nongame birds on a regular basis to prevent their occupation, or perform any combination of these. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

Prevent nest materials from falling into waterways.

Bird protection that causes a delay to the controlling activity is a condition unfavorable to the suitable prosecution of work as specified in Section 8-1.05, "Temporary Suspension of Work."

14-7 PALEONTOLOGICAL RESOURCES

If paleontological resources are discovered at the job site, do not disturb the material and immediately:

1. Stop all work within a 60-foot radius of the discovery
2. Protect the area
3. Notify the Engineer

The Department investigates and modifies the dimensions of the protected area if necessary. Do not move paleontological resources or take them from the job site. Do not resume work within the specified radius of the discovery until authorized.

14-8 NOISE AND VIBRATION

14-8.01 GENERAL

Reserved

14-8.02 NOISE CONTROL

Do not exceed 86 dBA LMax at 50 feet from the job site activities from 9 p.m. to 6 a.m.

Equip an internal combustion engine with the manufacturer-recommended muffler. Do not operate an internal combustion engine on the job site without the appropriate muffler.

14-9 AIR QUALITY

14-9.01 AIR POLLUTION CONTROL

Comply with air pollution control rules, regulations, ordinances, and statutes that apply to work performed under the Contract, including air pollution control rules, regulations, ordinances, and statutes provided in Govt Code § 11017 (Pub Cont Code § 10231).

Do not burn material to be disposed of.

14-9.02 DUST CONTROL

Prevent and alleviate dust by applying water, dust palliative, or both under Section 14-9.01.

Apply water under Section 17, "Watering."

Apply dust palliative under Section 18, "Dust Palliative."

If ordered, apply water, dust palliative, or both to control dust caused by public traffic. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

14-10 SOLID WASTE DISPOSAL AND RECYCLING

14-10.01 SOLID WASTE DISPOSAL AND RECYCLING

Submit an annual Solid Waste Disposal and Recycling Report between January 1 and 15 for each year work is performed under the Contract at any time during the previous calendar year. Show the types and amounts of project-generated solid waste taken to or diverted from landfills or reused on the project from January 1 through December 31 of the previous calendar year.

Submit a final annual Solid Waste Disposal and Recycling Report within 5 business days after Contract acceptance. Show the types and amounts of project-generated solid waste taken to or diverted from landfills or reused on the project from January 1 to Contract acceptance.

For each failure to submit a completed form, the Department withholds \$10,000.

Preparing Soil

After you prepare an area for lime soil stabilization, test the soil to be stabilized every 500 cubic yards for relative compaction under California Test 231 and moisture content under California Test 226, and verify the surface grades.

Applying Lime

The Engineer determines the final application rate for each lime product proposed from the samples submitted. If the soil being stabilized changes, the Engineer changes the application rate. Based on California Test 373, the Engineer reports the application rates as the percent of lime by dry weight of soil. The Engineer provides the optimum moisture content determined under California Test 373 for each application rate.

Before applying lime, measure the temperature at the ground surface.

If lime in dry form is used, the Engineer verifies the application rate using the drop pan method once per 40,000 square feet stabilized, or twice per day, whichever is greater.

If lime in slurry form is used, report the quantity of slurry placed by measuring the volume of slurry in the holding tank once per 40,000 square feet stabilized, or twice per day, whichever is greater.

Mixing

For each day of initial mixing, test the moisture content. Sample the material immediately after initial mixing.

Randomly test the adequacy of the final mixing with a phenolphthalein indicator solution.

During mixing operations, measure the ground temperature at full mixing depth.

After mixing and before compacting, determine maximum density under California Test 216 from composite samples of the mixed material and at each distinct change in material. Test the moisture content of the mixed material under California Test 226. Test the gradation for compliance with "Materials."

Compaction

Test relative compaction on a wet weight basis.

After initial compaction, determine in-place density under California Test 231 and moisture content under California Test 226 at the same locations. The testing frequency must be 1 test per 250 cubic yards of lime stabilized soil. Test in 0.50-foot depth intervals.

Before requesting to compact material in layers greater than 0.50 foot, construct a test strip in the production area and demonstrate the test strip passes compaction tests using the proposed thickness. The test strip must contain no more material than 1 day's production. The Engineer tests at not more than 0.50-foot depth intervals regardless of the thickness of your layers.

Construct test pads by scraping away material to the depth ordered by the Engineer. If a compaction test fails corrective action must include the layers of material already placed above the test pad elevation.

Finish Grading

Do not proceed with construction activities for subsequent layers of material until the Engineer verifies the final grades of the lime stabilized soil.

Dispute Resolution

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer within 5 days of receiving a test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit written quality control test results and copies of paperwork including worksheets used to determine the disputed test results to the Engineer. An Independent Third Party (ITP) performs referee testing. Before the ITP participates in a dispute resolution, the ITP must be accredited under the Department's Independent Assurance Program. The ITP must be independent of the project. By mutual agreement, the ITP is chosen from:

1. A Department laboratory
2. A Department laboratory in a district or region not in the district or region the project is located
3. The Transportation Laboratory
4. A laboratory not currently employed by you or your lime producer

If split quality control or acceptance samples are not available, the ITP uses any available material representing the disputed material for evaluation.

24-1.02 MATERIALS

24-1.02A Lime

Lime must comply with ASTM C 977 and the following:

Lime		
Quality Characteristic	ASTM	Specification
Available Calcium and Magnesium Oxide(min., %)	C 25 ^a	High Calcium Quicklime: CaO > 90 Dolomitic Quicklime: CaO > 55 and CaO + MgO > 90
Loss on ignition (max., %)	C 25	7 (total loss) 5 (carbon dioxide) 2 (free moisture)
Slaking rate	C 110	30 °C rise in 8 minutes

Notes:

^a You may use ASTM C25 or ASTM C1301 and ASTM C1271.

A 0.5-pound sample of lime dry-sieved in a mechanical sieve shaker for 10 minutes ±30 seconds must comply with:

Sieve Sizes	Percentage Passing
3/8-inch	98-100

Slurry must:

1. Be free of contaminants
2. Contain at least the minimum dry solids
3. Have uniform consistency

If you prepare lime slurry, prepare it at the jobsite.

24-1.02B Water

If available, use potable water. Inform the Engineer if a water source other than potable water is used. If not using potable water, water for mixing soil and lime must:

1. Contain no more than 650 parts per million of chlorides as Cl, and no more than 1,300 parts per million of sulfates as SO₄
2. Not contain an amount of impurities that will cause a reduction in the strength of the stabilize soil

24-1.02C Mixed Material

Take a composite sample from 5 random locations after initial mixing. The moisture content of the composite sample tested under California Test 226 must be a minimum of 3 percent greater than optimum. Determine the moisture versus density relationship of the composite sample material determined under California Test 216, except Part 2, Section E, Paragraph 6 is modified as follows:

After adjustment of the moisture content, compact each of the remaining test specimens in the mold, then record the water adjustment, tamper reading, and the corresponding adjusted wet density from the chart on

Table 1 using the column corresponding to the actual wet weight of the test specimen compacted. Note each of these wet weights on Line I.

The mixed material before compaction excluding rock must comply with:

Sieve Sizes	Percentage Passing
1"	98 - 100
No. 4	60 - 100

24-1.02D Curing Treatment

Curing treatment may be any of the following:

1. Water cure
2. Curing seal
3. Moist material blanket

Curing seal must be SS or CSS grade asphaltic emulsion under Section 94, "Asphaltic Emulsions."

24-1.03 CONSTRUCTION

24-1.03A General

If using different types of lime or lime from more than one source, do not mix them. The Engineer determines separate application rates.

Deliver lime in full loads unless it is the last load needed for a work shift.

Apply lime at ground temperatures above 35 °F. Do not apply lime if you expect the ground temperature to drop below 35 °F before you complete mixing and compacting.

During mixing, maintain the in-place moisture of the soil to be stabilized a minimum 3 percent above the optimum moisture determined under California Test 216 as modified in "Mixed Material." During compaction and finish grading, add water to the surface to prevent drying until the next layer of mixed material is placed, or until you apply curing treatment.

Scarify the surface of lime stabilized soil at least 2 inches between each layer. Do not scarify the final surface of the lime stabilized soil.

Between the time of applying lime and 3 days after applying curing treatment, only allow equipment or vehicles on the soil being stabilized that are essential to the work.

24-1.03B Preparing Soil

Except for soil clods, remove rocks or solids larger than 1/3 of the layer thickness. Regardless of the layer thickness, remove rocks and solids greater than 4 inches. Notify the Engineer if you encounter rocks or solids greater than 1/3 of the layer thickness.

Before adding lime, place the soil to be stabilized to within 0.08 foot of the specified lines and grades and compact to not less than 90 percent relative compaction.

24-1.03C Applying Lime

Apply lime uniformly over the area to be stabilized using a vane spreader.

The Engineer determines the final application rate. Do not vary from this application rate by more than 5 percent.

Apply lime in dry form. If you request and the Engineer approves, you may apply lime in slurry form.

Lime slurry must be in suspension during application. Apply lime slurry uniformly making successive passes over a measured section or roadway until the specified lime content is reached. Apply the residue from lime slurry over the length of the roadway being processed.

24-1.03D Mixing

Lime and soil to be stabilized must be mixed uniformly at least twice to within 0.10 foot of the specified depth at any point. If the mixing depth exceeds the specified depth by more than 10 percent, add lime in proportion to the exceeded depth. The Department does not pay for this added lime.

Mix lime on the same day it is applied. After the initial mixing, allow a mellowing period for at least 36 hours before final mixing. Moisture content during the mellowing period determined under California Test 226 must be at

least 3 percent higher than the optimum moisture content. You may add water and mix during the mellowing period.

Remix until the mixture is uniform with no streaks or pockets of lime.

Except for clods larger than 1 inch, mixed material must have a color reaction with sprayed phenolphthalein alcohol indicator solution.

Complete all the mixing work within 7 days of the initial application of lime.

24-1.03E Compaction

Begin compacting immediately after final mixing, but not less than 36 hours after the beginning of initial mixing.

Compact by using sheepsfoot or segmented wheel rollers immediately followed by steel drum or pneumatic-tired rollers. Do not use vibratory rollers.

If you request and the Engineer approves, you may compact mixed material in layers greater than 0.50 foot.

If the specified thickness is 0.50 foot or less, compact in one layer. If the specified thickness is more than 0.50 foot, compact in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer must not exceed 0.50 foot unless you first demonstrate your equipment and methods provide uniform distribution of lime and achieve the specified compaction.

Use other compaction methods in areas inaccessible to rollers.

Compact the lime stabilized soil to at least 95 percent relative compaction determined under California Test 216 as modified under "Mixed Material." The relative compaction is determined on a wet weight basis.

24-1.03F Finish Grading

Maintain the moisture content of the lime stabilized soil through the entire finish grading operation at a minimum of 3 percent above optimum moisture content.

The finished surface of the lime stabilized soil must not vary more than 0.08 foot above or below the grade established by the Engineer unless the lime stabilized soil is to be covered by material paid for by the cubic yard, in which case the finished surface may not vary above the grade established by the Engineer.

If lime stabilized soil is above the allowable tolerance, trim, remove, and dispose of the excess material. Do not leave loose material on the finished surface. If finish rolling cannot be completed within 2 hours of trimming, defer trimming.

If lime stabilized soil is below the allowable tolerance, you may use trimmed material to fill low areas only if final grading and final compaction occurs within 48 hours of beginning initial compaction. Before placing trimmed material, scarify the surface of the area to be filled at least 2 inches deep.

Finish rolling of trimmed surfaces must be performed with at least 1 complete coverage with steel drum or pneumatic-tired rollers.

24-1.03G Curing

General

Choose the method of curing.

Apply the chosen cure method within 48 hours of completing the sheepsfoot or segmented wheel compaction.

Apply the chosen cure method within the same day of any trimming and finish grading.

Water Cure

Water may be used to cure the finished surface before you place a moist material blanket, or apply curing seal. Keep the surface above the optimum moisture content of the lime stabilized soil. Use this method for no more than 3 days, after which you must place a curing seal or moist material blanket.

Curing Seal

Curing seal equipment must have a gage indicating the volume of curing seal in the storage tank.

If curing seal is used, apply it:

1. To the finished surface of lime stabilized soil under Section 94-1.06, "Applying," of the Standard Specifications
2. At a rate from 0.10 to 0.20 gallon per square yard. The Engineer determines the exact rate
3. When the lime stabilized soil is at optimum moisture
4. When the ambient temperature is above 40 °F and rising

- 5. The asphalt content of the asphalt mixture will be determined, at the option of the Engineer, by extraction tests in conformance with the requirements in California Test 310 or 362, or will be determined in conformance with the requirements in California Test 379. The bitumen ratio pounds of asphalt per 100 pounds of dry aggregate shall not vary by more than 0.5 pound of asphalt above or 0.5 pound of asphalt below the amount designated by the Engineer. Compliance with this requirement will be determined either by taking samples from trucks at the plant or from the mat behind the paver before rolling. If the sample is taken from the mat behind the paver, the bitumen ratio shall be not less than the amount designated by the Engineer, less 0.7 pound of asphalt per 100 pounds of dry aggregate.

In Section 29-1.04B replace the 2nd paragraph with:

Cement treated permeable base shall contain not less than 287 pounds of cement per cubic yard.

In Section 29-1.05 replace the 1st paragraph with:

Asphalt treated permeable base shall be spread and compacted as specified for hot mix asphalt under the "Method" construction process in Section 39, "Hot Mix Asphalt," and these specifications.

In Section 29-1.05 in the 8th paragraph, replace the 2nd sentence with:

The filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," and shall be placed in conformance with the provisions for placing filter fabric for edge drains in Section 68-3.03, "Installation."

In Section 29-1.06 replace the 1st and 2nd paragraphs with:

Cement treated base shall be placed, spread, compacted, and shaped in conformance with the provisions in Section 40-3.04D, "Stationary Side Form Construction," and Section 40-3.04E, "Slip-Form Construction," except that vibrators shall not be used and the third paragraph in Section 40-3.04A, "General," shall not apply.

In Section 29-1.06 in the 9th paragraph, replace the 2nd sentence with:

The filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," and shall be placed in conformance with the provisions for placing filter fabric for edge drains in Section 68-3.03, "Installation."

In Section 29-1.07 replace the 2nd paragraph with:

Hardened treated permeable base with a surface lower than 0.05 foot below the grade established by the Engineer shall be removed and replaced with treated permeable base which complies with these specifications, or if permitted by the Engineer, the low areas shall be filled with pavement material as follows:

1. When pavement material is hot mix asphalt, the low areas shall be filled with hot mix asphalt conforming to the requirements for the lowest layer of hot mix asphalt to be placed as pavement. This shall be done as a separate operation prior to placing the lowest layer of pavement.
2. When pavement material is portland cement concrete, the low areas shall be filled with pavement concrete at the time and in the same operation in which the pavement is placed.
3. Full compensation for filling low areas will be considered as included in the contract price paid per cubic yard for treated permeable base and no additional compensation will be allowed therefor.

^^

**SECTION 37 BITUMINOUS SEALS
(Issued 06-05-09)**

In Section 37-1.03 replace the 4th through 6th paragraphs with:

On 2-lane two-way roadways, W8-7 "LOOSE GRAVEL" signs and W13-1 (35) speed advisory signs shall be furnished and placed adjacent to both sides of the traveled way where screenings are being spread on a traffic lane.

4. Rubberized hot mix asphalt (gap graded) [RHMA-G]

The special provisions specify the HMA construction process, including:

1. Standard
2. Method
3. Quality Control / Quality Assurance (QC / QA)

39-1.02 MATERIALS

39-1.02A Geosynthetic Pavement Interlayer

Geosynthetic pavement interlayer must comply with the specifications for pavement fabric, paving mat, paving grid, paving geocomposite grid, or geocomposite strip membrane in Section 88-1.07, "Pavement Interlayer."

39-1.02B Tack Coat

Tack coat must comply with the specifications for asphaltic emulsion in Section 94, "Asphaltic Emulsion," or asphalt binder in Section 92, "Asphalts." Choose the type and grade.

Notify the Engineer if you dilute asphaltic emulsion with water. The weight ratio of added water to asphaltic emulsion must not exceed 1 to 1.

Measure added water either by weight or volume in compliance with the specifications for weighing, measuring, and metering devices under Section 9-1.01, "Measurement of Quantities," or you may use water meters from water districts, cities, or counties. If you measure water by volume, apply a conversion factor to determine the correct weight.

With each dilution, submit in writing:

1. The weight ratio of water to bituminous material in the original asphaltic emulsion
2. The weight of asphaltic emulsion before diluting
3. The weight of added water
4. The final dilution weight ratio of water to asphaltic emulsion

39-1.02C Asphalt Binder

Asphalt binder in HMA must comply with Section 92, "Asphalts," or Section 39-1.02D, "Asphalt Rubber Binder." The special provisions specify the grade.

Asphalt binder for geosynthetic pavement interlayer must comply with Section 92, "Asphalts." Choose from Grades PG 64-10, PG 64-16, or PG 70-10.

39-1.02D Asphalt Rubber Binder

General

Use asphalt rubber binder in RHMA-G, RHMA-O, and RHMA-O-HB. Asphalt rubber binder must be a combination of:

1. Asphalt binder
2. Asphalt modifier
3. Crumb rubber modifier (CRM)

The combined asphalt binder and asphalt modifier must be 80.0 ± 2.0 percent by weight of the asphalt rubber binder.

Asphalt Modifier

Asphalt modifier must be a resinous, high flash point, and aromatic hydrocarbon, and comply with:

Asphalt Modifier for Asphalt Rubber Binder

Quality Characteristic	ASTM	Specification
Viscosity, m ² /s (x 10 ⁻⁶) at 100 °C	D 445	X ± 3 ^a
Flash Point, CL.O.C., °C	D 92	207 minimum
Molecular Analysis		
Asphaltenes, percent by mass	D 2007	0.1 maximum
Aromatics, percent by mass	D 2007	55 minimum

Note:

^a The symbol "X" is the proposed asphalt modifier viscosity. "X" must be between 19 and 36. A change in "X" requires a new asphalt rubber binder design.

Asphalt modifier must be from 2.0 percent to 6.0 percent by weight of the asphalt binder in the asphalt rubber binder.

Crumb Rubber Modifier

CRM consists of a ground or granulated combination of scrap tire CRM and high natural CRM. CRM must be 75.0 ± 2.0 percent scrap tire CRM and 25.0 ± 2.0 percent high natural CRM by total weight of CRM. Scrap tire CRM must be from any combination of automobile tires, truck tires, or tire buffings.

Sample and test scrap tire CRM and high natural CRM separately. CRM must comply with:

Crumb Rubber Modifier for Asphalt Rubber Binder

Quality Characteristic	Test Method	Specification
Scrap tire CRM gradation (% passing No. 8 sieve)	LP-10	100
High natural CRM gradation (% passing No. 10 sieve)	LP-10	100
Wire in CRM (% max.)	LP-10	0.01
Fabric in CRM (% max.)	LP-10	0.05
CRM particle length (inch max.) ^a	--	3/16
CRM specific gravity ^a	CT 208	1.1 – 1.2
Natural rubber content in high natural CRM (%) ^a	ASTM D 297	40.0 – 48.0

Note:

^a Test at mix design and for Certificate of Compliance.

Only use CRM ground and granulated at ambient temperature. If steel and fiber are cryogenically separated, it must occur before grinding and granulating. Only use cryogenically produced CRM particles that can be ground or granulated and not pass through the grinder or granulator.

CRM must be dry, free-flowing particles that do not stick together. CRM must not cause foaming when combined with the asphalt binder and asphalt modifier. You may add calcium carbonate or talc up to 3 percent by weight of CRM.

Asphalt Rubber Binder Design and Profile

Submit in writing an asphalt rubber binder design and profile that complies with the asphalt rubber binder specifications. In the design, designate the asphalt, asphalt modifier, and CRM and their proportions. The profile is not a performance specification and only serves to indicate expected trends in asphalt rubber binder properties during binder production. The profile must include the same component sources for the asphalt rubber binder used.

Design the asphalt rubber binder from testing you perform for each quality characteristic and for the reaction temperatures expected during production. The 24-hour (1,440-minute) interaction period determines the design profile. At a minimum, mix asphalt rubber binder components, take samples, and perform and record the following tests:

Asphalt Rubber Binder Reaction Design Profile

Test	Minutes of Reaction ^a							Limits
	45	60	90	120	240	360	1440	
Cone penetration @ 77 °F, 0.10-mm (ASTM D 217)	X ^b				X		X	25 - 70
Resilience @ 77 °F, percent rebound (ASTM D 5329)	X				X		X	18 min.
Field softening point, °F (ASTM D 36)	X				X		X	125 - 165
Viscosity, centipoises (LP-11)	X	X	X	X	X	X	X	1,500 - 4,000

Notes:

^a Six hours (360 minutes) after CRM addition, reduce the oven temperature to 275 °F for a period of 16 hours. After the 16-hour (1320 minutes) cool-down after CRM addition, reheat the binder to the reaction temperature expected during production for sampling and testing at 24 hours (1440 minutes).

^b "X" denotes required testing

Asphalt Rubber Binder

After interacting for a minimum of 45 minutes, asphalt rubber binder must comply with:

Asphalt Rubber Binder

Quality Characteristic	Test for Quality Control or Acceptance	Test Method	Specification	
			Minimum	Maximum
Cone penetration @ 77 °F, 0.10-mm	Acceptance	ASTM D 217	25	70
Resilience @ 77 °F, percent rebound	Acceptance	ASTM D 5329	18	--
Field softening point, °F	Acceptance	ASTM D 36	125	165
Viscosity @ 375 °F, centipoises	Quality Control	LP-11	1,500	4,000

39-1.02E Aggregate

Aggregate must be clean and free from deleterious substances. Aggregate:

1. Retained on the No. 4 sieve is coarse
2. Passing the No. 4 sieve is fine
3. Added and passing the No. 30 sieve is supplemental fine, including:
 - 3.1. Hydrated lime
 - 3.2. Portland cement
 - 3.3. Fines from dust collectors

The special provisions specify the aggregate gradation for each HMA type.

The specified aggregate gradation is before the addition of asphalt binder and includes supplemental fines. The Engineer tests for aggregate grading under California Test 202, modified by California Test 105 if there is a difference in specific gravity of 0.2 or more between the coarse and fine parts of different aggregate blends.

Choose a sieve size target value (TV) within each target value limit presented in the aggregate gradation tables.

**Aggregate Gradation
(Percentage Passing)
HMA Types A and B**

3/4-inch HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
1"	100	—
3/4"	90 - 100	TV ±5
1/2"	70 - 90	TV ±6
No. 4	45 - 55	TV ±7
No. 8	32 - 40	TV ±5
No. 30	12 - 21	TV ±4
No. 200	2 - 7	TV ±2

1/2-inch HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/4"	100	—
1/2"	95 - 99	TV ±6
3/8"	75 - 95	TV ±6
No. 4	55 - 66	TV ±7
No. 8	38 - 49	TV ±5
No. 30	15 - 27	TV ±4
No. 200	2 - 8	TV ±2

3/8-inch HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
1/2"	100	—
3/8"	95 - 100	TV ±6
No. 4	58 - 72	TV ±7
No. 8	34 - 48	TV ±6
No. 30	18 - 32	TV ±5
No. 200	2 - 9	TV ±2

No. 4 HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/8"	100	—
No. 4	95 - 100	TV ±7
No. 8	72 - 77	TV ±7
No. 30	37 - 43	TV ±7
No. 200	2 - 12	TV ±4

Rubberized Hot Mix Asphalt - Gap Graded (RHMA-G)

3/4-inch RHMA-G

Sieve Sizes	Target Value Limits	Allowable Tolerance
1"	100	—
3/4"	95 - 100	TV ±5
1/2"	83 - 87	TV ±6
3/8"	65 - 70	TV ±6
No. 4	28 - 42	TV ±7
No. 8	14 - 22	TV ±5
No. 200	0 - 6	TV ±2

1/2-inch RHMA-G

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/4"	100	—
1/2"	90 - 100	TV ±6
3/8"	83 - 87	TV ±6
No. 4	28 - 42	TV ±7
No. 8	14 - 22	TV ±5
No. 200	0 - 6	TV ±2

Open Graded Friction Course (OGFC)

1-inch OGFC

Sieve Sizes	Target Value Limits	Allowable Tolerance
1 1/2"	100	—
1"	99 - 100	TV ±5
3/4"	85 - 96	TV ±5
1/2"	55 - 71	TV ±6
No. 4	10 - 25	TV ±7
No. 8	6 - 16	TV ±5
No. 200	1 - 6	TV ±2

1/2-inch OGFC

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/4"	100	—
1/2"	95 - 100	TV ±6
3/8"	78 - 89	TV ±6
No. 4	28 - 37	TV ±7
No. 8	7 - 18	TV ±5
No. 30	0 - 10	TV ±4
No. 200	0 - 3	TV ±2

3/8-inch OGFC

Sieve Sizes	Target Value Limits	Allowable Tolerance
1/2"	100	—
3/8"	90 - 100	TV ±6
No. 4	29 - 36	TV ±7
No. 8	7 - 18	TV ±6
No. 30	0 - 10	TV ±5
No. 200	0 - 3	TV ±2

Before the addition of asphalt binder and lime treatment, aggregate must comply with:

Aggregate Quality

Quality Characteristic	Test Method	HMA Type			
		A	B	RHMA-G	OGFC
Percent of crushed particles	CT 205				
Coarse aggregate (% min.)					
One fractured face		90	25	--	90
Two fractured faces		75	--	90	75
Fine aggregate (% min.)					
(Passing No. 4 sieve and retained on No. 8 sieve.)					
One fractured face		70	20	70	90
Los Angeles Rattler (% max.)	CT 211				
Loss at 100 Rev.		12	--	12	12
Loss at 500 Rev.		45	50	40	40
Sand equivalent (min.) ^a	CT 217	47	42	47	--
Fine aggregate angularity (% min.) ^b	CT 234	45	45	45	--
Flat and elongated particles (% max. by weight @ 5:1)	CT 235	10	10	10	10

Notes:

^a Reported value must be the average of 3 tests from a single sample.

^b The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

39-1.02F Reclaimed Asphalt Pavement

You may produce HMA using reclaimed asphalt pavement (RAP). HMA produced using RAP must comply with the specifications for HMA except aggregate quality specifications do not apply to RAP. You may substitute RAP aggregate for a part of the virgin aggregate in HMA in a quantity not exceeding 15.0 percent of the aggregate blend. Do not use RAP in OGFC and RHMA-G.

Assign the substitution rate of RAP aggregate for virgin aggregate with the job mix formula (JMF) submittal. The JMF must include the percent of RAP used. If you change your assigned RAP aggregate substitution rate by more than 5 percent (within the 15.0 percent limit), submit a new JMF.

Process RAP from asphalt concrete. You may process and stockpile RAP throughout the project's life. Prevent material contamination and segregation. Store RAP in stockpiles on smooth surfaces free of debris and organic material. Processed RAP stockpiles must consist only of homogeneous RAP.

39-1.03 HOT MIX ASPHALT MIX DESIGN REQUIREMENTS

39-1.03A General

A mix design consists of performing California Test 367 and laboratory procedures on combinations of aggregate gradations and asphalt binder contents to determine the optimum binder content (OBC) and HMA mixture qualities. If RAP is used, use Laboratory Procedure LP-9. The result of the mix design becomes the proposed JMF.

Use Form CEM-3512 to document aggregate quality and mix design data. Use Form CEM-3511 to present the JMF.

Laboratories testing aggregate qualities and preparing the mix design and JMF must be qualified under the Department's Independent Assurance Program. Take samples under California Test 125.

The Engineer reviews the aggregate qualities, mix design, and JMF and verifies and accepts the JMF.

You may change the JMF during production. Do not use the changed JMF until the Engineer accepts it. Except when adjusting the JMF in compliance with Section 39-1.03E, "Job Mix Formula Verification," perform a new mix design and submit in writing a new JMF submittal for changing any of the following:

1. Target asphalt binder percentage
2. Asphalt binder supplier
3. Asphalt rubber binder supplier
4. Component materials used in asphalt rubber binder or percentage of any component materials
5. Combined aggregate gradation
6. Aggregate sources
7. Substitution rate for RAP aggregate of more than 5 percent
8. Any material in the JMF

For OGFC, submit in writing a complete JMF submittal except asphalt binder content. The Engineer determines the asphalt binder content under California Test 368 within 20 days of your complete JMF submittal and provides you a Form CEM-3513.

39-1.03B Hot Mix Asphalt Mix Design

Perform a mix design that produces HMA in compliance with:

Hot Mix Asphalt Mix Design Requirements

Quality Characteristic	Test Method	HMA Type		
		A	B	RHMA-G
Air voids content (%)	CT 367 ^a	4.0	4.0	Special Provisions
Voids in mineral aggregate (% min.)	LP-2			
No. 4 grading		17.0	17.0	--
3/8" grading		15.0	15.0	--
1/2" grading		14.0	14.0	18.0 – 23.0 ^b
3/4" grading	13.0	13.0	18.0 – 23.0 ^b	
Voids filled with asphalt (%)	LP-3			
No. 4 grading		76.0 – 80.0	76.0 – 80.0	Note d
3/8" grading		73.0 – 76.0	73.0 – 76.0	
1/2" grading		65.0 – 75.0	65.0 – 75.0	
3/4" grading	65.0 – 75.0	65.0 – 75.0		
Dust proportion	LP-4			
No. 4 and 3/8" gradings		0.9 – 2.0	0.9 – 2.0	Note d
1/2" and 3/4" gradings		0.6 – 1.3	0.6 – 1.3	
Stabilometer value (min.) ^c	CT 366			
No. 4 and 3/8" gradings		30	30	--
1/2" and 3/4" gradings		37	35	23

Notes:

^a Calculate the air voids content of each specimen using California Test 309 and Lab Procedure LP-1. Modify California Test 367, Paragraph C5, to use the exact air voids content specified in the selection of OBC.

^b Voids in mineral aggregate for RHMA-G must be within this range.

^c Modify California Test 304, Part 2.B.2.c: "After compaction in the compactor, cool to 140 °± 5 °F by allowing the briquettes to cool at room temperature for 0.5-hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

^d Report this value in the JMF submittal.

For stability and air voids content, prepare 3 briquettes at the OBC and test for compliance. Report the average of 3 tests. Prepare new briquettes and test if the range of stability for the 3 briquettes is more than 8 points. The average air void content may vary from the specified air void content by ±0.5 percent.

You may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If you use the same briquettes and tests using bulk specific gravity fail, you may prepare 3 new briquettes and determine a new bulk specific gravity.

39-1.03C Job Mix Formula Submittal

Each JMF submittal must consist of:

1. Proposed JMF on Form CEM-3511
2. Mix design documentation on Form CEM-3512 dated within 12 months of submittal
3. JMF verification on Form CEM-3513, if applicable
4. JMF renewal on Form CEM-3514, if applicable
5. Materials Safety Data Sheets (MSDS) for:
 - 5.1. Asphalt binder
 - 5.2. Base asphalt binder used in asphalt rubber binder
 - 5.3. CRM and asphalt modifier used in asphalt rubber binder
 - 5.4. Blended asphalt rubber binder mixture

- 5.5. Supplemental fine aggregate except fines from dust collectors
- 5.6. Antistrip additives

If the Engineer requests in writing, sample the following materials in the presence of the Engineer and place in labeled containers weighing no more than 50 pounds each:

1. Coarse, fine, and supplemental fine aggregate from stockpiles, cold feed belts, or hot bins. Samples must include at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines. The Department combines these aggregate samples to comply with the JMF target values submitted on Form CEM-3511.
2. RAP from stockpiles or RAP system. Samples must be at least 60 pounds.
3. Asphalt binder from the binder supplier. Samples must be in two 1-quart cylindrical shaped cans with open top and friction lids.
4. Asphalt rubber binder with the components blended in the proportions to be used. Samples must be in four 1-quart cylindrical shaped cans with open top and friction lids.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate and RAP, split the samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

39-1.03D Job Mix Formula Review

The Engineer reviews each mix design and proposed JMF within 5 business days from the complete JMF submittal. The review consists of reviewing the mix design procedures and comparing the proposed JMF with the specifications.

The Engineer may verify aggregate qualities during this review period.

39-1.03E Job Mix Formula Verification

If you cannot submit a Department-verified JMF on Form CEM-3513 dated within 12 months before HMA production, the Engineer verifies the JMF.

Based on your testing and production experience, you may submit on Form CEM-3511 an adjusted JMF before the Engineer's verification testing. JMF adjustments may include a change in the:

1. Asphalt binder content target value up to ± 0.6 percent from the optimum binder content value submitted on Form CEM-3512 except do not adjust the target value for asphalt rubber binder for RHMA-G below 7.0 percent
2. Aggregate gradation target values within the target value limits specified in the aggregate gradation tables

For HMA Type A, Type B, and RHMA-G, the Engineer verifies the JMF from samples taken from HMA produced by the plant to be used. Notify the Engineer in writing at least 2 business days before sampling materials.

In the Engineer's presence and from the same production run, take samples of:

1. Aggregate
2. Asphalt binder
3. RAP
4. HMA

Sample aggregate from cold feed belts or hot bins. Sample RAP from the RAP system. Sample HMA under California Test 125 except if you request in writing and the Engineer approves, you may sample from any of the following locations:

1. The plant
2. A truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

You may sample from a different project including a non-Department project if you make arrangements for the Engineer to be present during sampling.

For aggregate, RAP, and HMA, split the samples into at least 4 parts and label their containers. Submit 3 split parts to the Engineer and use 1 part for your testing.

The Engineer verifies each proposed JMF within 20 days of receiving all verification samples and the JMF submittal has been accepted. If you request in writing, the Engineer verifies RHMA-G quality requirements within 3 business days of sampling. Verification is testing for compliance with the specifications for:

1. Aggregate quality
2. Aggregate gradation (JMF TV \pm tolerance)
3. Asphalt binder content (JMF TV \pm tolerance)
4. HMA quality specified in the table Hot Mix Asphalt Mix Design Requirements except:
 - 4.1. Air voids content (design value \pm 2.0 percent)
 - 4.2. Voids filled with asphalt (report only if an adjustment for asphalt binder content target value is less than or equal to \pm 0.3 percent from OBC)
 - 4.3. Dust proportion (report only if an adjustment for asphalt binder content target value is less than or equal to \pm 0.3 percent from OBC)

The Engineer prepares 3 briquettes from a single split sample. To verify the JMF for stability and air voids content, the Engineer tests the 3 briquettes and reports the average of 3 tests. The Engineer prepares new briquettes if the range of stability for the 3 briquettes is more than 8 points.

The Engineer may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If the Engineer uses the same briquettes and the tests using bulk specific gravity fail, the Engineer prepares 3 new briquettes and determines a new bulk specific gravity.

If the Engineer verifies the JMF, the Engineer provides you a Form CEM-3513.

If the Engineer's tests on plant-produced samples do not verify the JMF, the Engineer notifies you in writing and you must submit a new JMF submittal or submit an adjusted JMF based on your testing. JMF adjustments may include a change in the:

1. Asphalt binder content target value up to \pm 0.6 percent from the optimum binder content value submitted on Form CEM-3512 except do not adjust the target value for asphalt rubber binder for RHMA-G below 7.0 percent
2. Aggregate gradation target values within the target value limits specified in the aggregate gradation tables

You may adjust the JMF only once due to a failed verification test. An adjusted JMF requires a new Form CEM-3511 and verification of a plant-produced sample.

A verified JMF is valid for 12 months.

For each HMA type and aggregate size specified, the Engineer verifies at the State's expense up to 2 proposed JMF including a JMF adjusted after verification failure. The Engineer deducts \$3,000 from payments for each verification exceeding this limit. This deduction does not apply to verifications initiated by the Engineer or JMF renewal.

39-1.03F Job Mix Formula Renewal

You may request a JMF renewal by submitting the following:

1. Proposed JMF on Form CEM-3511
2. A previously verified JMF documented on Form CEM-3513 dated within 12 months
3. Mix design documentation on Form CEM-3512 used for the previously verified JMF

If the Engineer requests in writing, sample the following materials in the presence of the Engineer and place in labeled containers weighing no more than 50 pounds each:

1. Coarse, fine, and supplemental fine aggregate from stockpiles, cold feed belts, or hot bins. Samples must include at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines. The Department combines these aggregate samples to comply with the JMF target values submitted on Form CEM-3511.
2. RAP from stockpiles or RAP system. Samples must be at least 60 pounds.
3. Asphalt binder from the binder supplier. Samples must be in two 1-quart cylindrical shaped cans with open top and friction lids.

4. Asphalt rubber binder with the components blended in the proportions to be used. Samples must be in four 1-quart cylindrical shaped cans with open top and friction lids.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate and RAP, split samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

The Engineer may verify aggregate qualities during this review period.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate, RAP, and HMA, split the samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

The Engineer verifies the JMF renewal submittal under Section 39-1.03E, "Job Mix Formula Verification," except:

1. The Engineer retains samples until you provide test results for your part on Form CEM-3514.
2. The Engineer tests samples of materials obtained from the HMA production unit after you submit test results that comply with the specifications for the quality characteristics under Section 39-1.03E, "Job Mix Formula Verification."
3. The Engineer verifies each proposed JMF renewal within 20 days of receiving verification samples.
4. You may not adjust the JMF due to a failed verification.
5. For each HMA type and aggregate gradation specified, the Engineer verifies at the State's expense 1 proposed JMF renewal within a 12-month period.

The most recent aggregate quality test results within the past 12 months may be used for verification of JMF renewal or the Engineer may perform aggregate quality tests for verification of JMF renewal.

If the Engineer verifies the JMF renewal, the Engineer provides you a Form CEM-3513.

39-1.03G Job Mix Formula Modification

For an accepted JMF, you may change binder source one time during production.

Submit your modified JMF request a minimum of 3 business days before production. Each modified JMF submittal must consist of:

1. Proposed modified JMF on Form CEM-3511.
2. Mix design records on Form CEM-3512 for the accepted JMF to be modified.
3. JMF verification on Form CEM-3513 for the accepted JMF to be modified.
4. Quality characteristics test results for the modified JMF as specified in section 39-1.03B. Perform tests at the mix design OBC as shown on Form CEM-3512.
5. If required, California Test 371 test results for the modified JMF.

With an accepted modified JMF submittal, the Engineer verifies each modified JMF within 5 business days of receiving all verification samples. If California Test 371 is required, the Engineer tests for California Test 371 within 10 days of receiving verification samples.

The Engineer verifies the modified JMF after the modified JMF HMA is placed on the project and verification samples are taken within the first 750 tons following sampling requirements in Section 39-1.03E, "Job Mix Formula Verification." The Engineer tests verification samples for compliance with:

1. Stability as shown in the table titled "Hot Mix Asphalt Mix Design Requirements"
2. Air void content at design value ± 2.0 percent
3. Voids in mineral aggregate as shown in the table titled "Hot Mix Asphalt Mix Design Requirements"
4. Voids filled with asphalt if an adjustment for asphalt binder content TV is more than ± 0.3 percent from the original OBC shown on Form CEM-3512.
5. Dust proportion if an adjustment for asphalt binder content TV is more than ± 0.3 percent from OBC shown on Form CEM-3512.

If the modified JMF is verified, the Engineer revises your Form CEM-3513 to include the new binder source. Your revised Form CEM-3513 will have the same expiration date as the original Form CEM-3513 for the accepted JMF that is modified.

If a modified JMF is not verified, stop production and any HMA placed using the modified JMF is rejected.

The Engineer deducts \$2,000 from payments for each modified JMF verification. The Engineer deducts an additional \$2,000 from payments for each modified JMF verification that requires California Test 371.

39-1.03H Job Mix Formula Acceptance

You may start HMA production if:

1. The Engineer's review of the JMF shows compliance with the specifications.
2. The Department has verified the JMF within 12 months before HMA production.
3. The Engineer accepts the verified JMF.

39-1.04 CONTRACTOR QUALITY CONTROL

39-1.04A General

Establish, maintain, and change a quality control system to ensure materials and work comply with the specifications. Submit quality control test results to the Engineer within 3 business days of a request except when QC / QA is specified.

You must identify the HMA sampling location in your Quality Control Plan. During production, take samples under California Test 125. You may sample HMA from:

1. The plant
2. The truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

39-1.04B Prepaving Conference

Meet with the Engineer at a prepaving conference at a mutually agreed time and place. Discuss methods of performing the production and paving work.

39-1.04C Asphalt Rubber Binder

Take asphalt rubber binder samples from the feed line connecting the asphalt rubber binder tank to the HMA plant. Sample and test asphalt rubber binder under Laboratory Procedure LP-11.

Test asphalt rubber binder for compliance with the viscosity specifications in Section 39-1.02, "Materials." During asphalt rubber binder production and HMA production using asphalt rubber binder, measure viscosity every hour with not less than 1 reading for each asphalt rubber binder batch. Log measurements with corresponding time and asphalt rubber binder temperature. Submit the log daily in writing.

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance." With the Certificate of Compliance, submit test results in writing for CRM and asphalt modifier with each truckload delivered to the HMA plant. A Certificate of Compliance for asphalt modifier must not represent more than 5,000 pounds. Use an AASHTO-certified laboratory for testing.

Sample and test gradation and wire and fabric content of CRM once per 10,000 pounds of scrap tire CRM and once per 3,400 pounds of high natural CRM. Sample and test scrap tire CRM and high natural CRM separately.

Submit certified weight slips in writing for the CRM and asphalt modifier furnished.

39-1.04D Aggregate

Determine the aggregate moisture content and RAP moisture content in continuous mixing plants at least twice a day during production and adjust the plant controller. Determine the RAP moisture content in batch mixing plants at least twice a day during production and adjust the plant controller.

39-1.04E Reclaimed Asphalt Pavement

Perform RAP quality control testing each day.

Sample RAP once daily and determine the RAP aggregate gradation under Laboratory Procedure LP-9 and submit the results to the Engineer in writing with the combined aggregate gradation.

39-1.04F Density Cores

To determine density for Standard and QC / QA projects, take 4-inch or 6-inch diameter density cores at least once every 5 business days. Take 1 density core for every 250 tons of HMA from random locations the Engineer designates. Take density cores in the Engineer's presence and backfill and compact holes with material authorized by the Engineer. Before submitting a density core to the Engineer, mark it with the density core's location and place it in a protective container.

If a density core is damaged, replace it with a density core taken within 1 foot longitudinally from the original density core. Relocate any density core located within 1 foot of a rumble strip to 1 foot transversely away from the rumble strip.

39-1.04G Briquettes

Prepare 3 briquettes for each stability and air voids content determination. Report the average of 3 tests. Prepare new briquettes and test if the range of stability for the 3 briquettes is more than 12 points.

You may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If you use these briquettes and tests using bulk specific gravity fail, you may prepare 3 new briquettes and determine a new bulk specific gravity.

39-1.05 ENGINEER'S ACCEPTANCE

The Engineer's acceptance of HMA is specified in the sections for each HMA construction process.

The Engineer samples materials for testing under California Test 125 and the applicable test method except samples may be taken from:

1. The plant from:
 - 1.1. A truck
 - 1.2. An automatic sampling device
2. The mat behind the paver

Sampling must be independent of Contractor quality control, statistically-based, and random. If you request, the Engineer splits samples and provides you with a part.

The Engineer accepts HMA based on:

1. Accepted JMF
2. Accepted QCP for Standard and QC / QA
3. Compliance with the HMA Acceptance tables
4. Acceptance of a lot for QC / QA
5. Visual inspection

The Engineer prepares 3 briquettes for each stability and air voids content determination. The Engineer reports the average of 3 tests. The Engineer prepares new briquettes and test if the range of stability for the 3 briquettes is more than 8 points.

The Engineer may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If the Engineer uses the same briquettes and the tests using bulk specific gravity fail, the Engineer prepares 3 new briquettes and determines a new bulk specific gravity.

39-1.06 DISPUTE RESOLUTION

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer in writing within 5 business days of receiving a test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit written quality control test results and copies of paperwork including worksheets used to determine the disputed test results to the Engineer. An Independent Third Party (ITP) performs referee testing. Before the ITP participates in a dispute resolution, the ITP must be accredited under the Department's Independent Assurance Program. The ITP must be independent of the project. By mutual agreement, the ITP is chosen from:

1. A Department laboratory
2. A Department laboratory in a district or region not in the district or region the project is located
3. The Transportation Laboratory
4. A laboratory not currently employed by you or your HMA producer

If split quality control or acceptance samples are not available, the ITP uses any available material representing the disputed HMA for evaluation.

39-1.07 PRODUCTION START-UP EVALUATION

The Engineer evaluates HMA production and placement at production start-up.

Within the first 750 tons produced on the first day of HMA production, in the Engineer's presence and from the same production run, take samples of:

1. Aggregate
2. Asphalt binder
3. RAP
4. HMA

Sample aggregate from cold feed belts or hot bins. Take RAP samples from the RAP system. Sample HMA under California Test 125 except if you request in writing and the Engineer approves, you may sample HMA from:

1. The plant
2. The truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

For aggregate, RAP, and HMA, split the samples into at least 4 parts and label their containers. Submit 3 split parts to the Engineer and keep 1 part.

For Standard and QC / QA projects, you and the Engineer must test the split samples and report test results in writing within 3 business days of sampling. If you proceed before receipt of the test results, the Engineer may consider the HMA placed to be represented by these test results.

For Standard and QC / QA projects, take 4-inch or 6-inch diameter density cores within the first 750 tons on the first day of HMA production. For each density core, the Engineer reports the bulk specific gravity determined under California Test 308, Method A in addition to the percent of maximum theoretical density. You may test for in-place density at the density core locations and include them in your production tests for percent of maximum theoretical density.

39-1.08 PRODUCTION

39-1.08A General

Produce HMA in a batch mixing plant or a continuous mixing plant. Proportion aggregate by hot or cold feed control.

HMA plants must be Department-qualified. Before production, the HMA plant must have a current qualification under the Department's Materials Plant Quality Program.

During production, you may adjust:

1. Hot or cold feed proportion controls for virgin aggregate and RAP
2. The set point for asphalt binder content

39-1.08B Mixing

Mix HMA ingredients into a homogeneous mixture of coated aggregates.

Asphalt binder must be between 275 °F and 375 °F when mixed with aggregate.

Asphalt rubber binder must be between 375 °F and 425 °F when mixed with aggregate.

When mixed with asphalt binder, aggregate must not be more than 325 °F except aggregate for OGFC with unmodified asphalt binder must be not more than 275 °F. Aggregate temperature specifications do not apply when you use RAP.

HMA with or without RAP must not be more than 325 °F.

39-1.08C Asphalt Rubber Binder

Deliver scrap tire CRM and high natural CRM in separate bags.

Either proportion and mix asphalt binder, asphalt modifier, and CRM simultaneously or premix the asphalt binder and asphalt modifier before adding CRM. If you premix asphalt binder and asphalt modifier, asphalt binder must be from 375 to 425 degrees F when you add the asphalt modifier. Mix them for at least 20 minutes. When you add CRM, the asphalt binder and asphalt modifier must be between 375 °F and 425 °F.

Do not use asphalt rubber binder during the first 45 minutes of the reaction period. During this period, the asphalt rubber binder mixture must be between 375 °F and the lower of 425 °F or 25 °F below the asphalt binder's flash point indicated in the MSDS.

If any asphalt rubber binder is not used within 4 hours after the reaction period, discontinue heating. If the asphalt rubber binder drops below 375 °F, reheat before use. If you add more scrap tire CRM to the reheated asphalt rubber binder, the binder must undergo a 45-minute reaction period. The added scrap tire CRM must not exceed 10 percent of the total asphalt rubber binder weight. Reheated and reacted asphalt rubber binder must comply with the viscosity specifications for asphalt rubber binder in Section 39-1.02, "Materials." Do not reheat asphalt rubber binder more than twice.

39-1.09 SUBGRADE, TACK COAT, AND GEOSYNTHETIC PAVEMENT INTERLAYER

39-1.09A General

Prepare subgrade or apply tack coat to surfaces receiving HMA. If specified, place geosynthetic pavement interlayer over a coat of asphalt binder.

39-1.09B Subgrade

Subgrade to receive HMA must comply with the compaction and elevation tolerance specifications in the sections for the material involved. Subgrade must be free of loose and extraneous material. If HMA is paved on existing base or pavement, remove loose paving particles, dirt, and other extraneous material by any means including flushing and sweeping.

39-1.09C Tack Coat

Apply tack coat:

1. To existing pavement including planed surfaces
2. Between HMA layers
3. To vertical surfaces of:
 - 3.1. Curbs
 - 3.2. Gutters
 - 3.3. Construction joints

Before placing HMA, apply tack coat in 1 application at the minimum residual rate specified for the condition of the underlying surface:

Tack Coat Application Rates for HMA Type A, Type B, and RHMA-G

HMA over:	Minimum Residual Rates (gallons per square yard)		
	CSS1/CSS1h, SS1/SS1h and QS1h/CQS1h Asphaltic Emulsion	CRS1/CRS2, RS1/RS2 and QS1/CQS1 Asphaltic Emulsion	Asphalt Binder and PMRS2/PMCRS2 and PMRS2h/PMCRS2h Asphaltic Emulsion
New HMA (between layers)	0.02	0.03	0.02
PCC and existing HMA (AC) surfaces	0.03	0.04	0.03
Planed PCC and HMA (AC) surfaces	0.05	0.06	0.04

Tack Coat Application Rates for OGFC

OGFC over:	Minimum Residual Rates (gallons per square yard)		
	CSS1/CSS1h, SS1/SS1h and QS1h/CQS1h Asphaltic Emulsion	CRS1/CRS2, RS1/RS2 and QS1/CQS1 Asphaltic Emulsion	Asphalt Binder and PMRS2/PMCRS2 and PMRS2h/PMCRS2h Asphaltic Emulsion
New HMA	0.03	0.04	0.03
PCC and existing HMA (AC) surfaces	0.05	0.06	0.04
Planed PCC and HMA (AC) surfaces	0.06	0.07	0.05

If you dilute asphaltic emulsion, mix until homogeneous before application.

Apply to vertical surfaces with a residual tack coat rate that will thoroughly coat the vertical face without running off.

If you request in writing and the Engineer authorizes, you may:

1. Change tack coat rates
2. Omit tack coat between layers of new HMA during the same work shift if:
 - 2.1. No dust, dirt, or extraneous material is present
 - 2.2. The surface is at least 140 °F

Immediately in advance of placing HMA, apply additional tack coat to damaged areas or where loose or extraneous material is removed.

Close areas receiving tack coat to traffic. Do not track tack coat onto pavement surfaces beyond the job site.

Asphalt binder tack coat must be between 285 °F and 350 °F when applied.

39-1.09D Geosynthetic Pavement Interlayer

Place geosynthetic pavement interlayer in compliance with the manufacturer's recommendations.

Before placing the geosynthetic pavement interlayer and asphalt binder:

1. Repair cracks 1/4 inch and wider, spalls, and holes in the pavement. The State pays for this repair work under Section 4-1.03D, "Extra Work."
2. Clean the pavement of loose and extraneous material.

Immediately before placing the interlayer, apply 0.25 gallon ± 0.03 gallon of asphalt binder per square yard of interlayer or until the fabric is saturated. Apply asphalt binder the width of the geosynthetic pavement interlayer plus 3 inches on each side. At interlayer overlaps, apply asphalt binder on the lower interlayer the same overlap distance as the upper interlayer.

Asphalt binder must be from 285 °F to 350 °F and below the minimum melting point of the geosynthetic pavement interlayer when applied.

Align and place the interlayer with no overlapping wrinkles, except a wrinkle that overlaps may remain if it is less than 1/2 inch thick. If the overlapping wrinkle is more than 1/2 inch thick, cut the wrinkle out and overlap the interlayer no more than 2 inches.

The minimum HMA thickness over the interlayer must be 0.12 foot thick including conform tapers. Do not place the interlayer on a wet or frozen surface.

Overlap the interlayer borders between 2 inches and 4 inches. In the direction of paving, overlap the following roll with the preceding roll at any break.

You may use rolling equipment to correct distortions or wrinkles in the interlayer.

If asphalt binder tracked onto the interlayer or brought to the surface by construction equipment causes interlayer displacement, cover it with a small quantity of HMA.

Before placing HMA on the interlayer, do not expose the interlayer to:

1. Traffic except for crossings under traffic control and only after you place a small HMA quantity
2. Sharp turns from construction equipment
3. Damaging elements

Pave HMA on the interlayer during the same work shift.

39-1.10 SPREADING AND COMPACTING EQUIPMENT

Paving equipment for spreading must be:

1. Self-propelled
2. Mechanical
3. Equipped with a screed or strike-off assembly that can distribute HMA the full width of a traffic lane
4. Equipped with a full-width compacting device
5. Equipped with automatic screed controls and sensing devices that control the thickness, longitudinal grade, and transverse screed slope

Install and maintain grade and slope references.

The screed must produce a uniform HMA surface texture without tearing, shoving, or gouging.

The paver must not leave marks such as ridges and indentations unless you can eliminate them by rolling.

Rollers must be equipped with a system that prevents HMA from sticking to the wheels. You may use a parting agent that does not damage the HMA or impede the bonding of layers.

In areas inaccessible to spreading and compacting equipment:

1. Spread the HMA by any means to obtain the specified lines, grades and cross sections.
2. Use a pneumatic tamper, plate compactor, or equivalent to achieve thorough compaction.

39-1.11 TRANSPORTING, SPREADING, AND COMPACTING

Do not pave HMA on a wet pavement or frozen surface.

You may deposit HMA in a windrow and load it in the paver if:

1. Paver is equipped with a hopper that automatically feeds the screed
2. Loading equipment can pick up the windrowed material and deposit it in the paver hopper without damaging base material
3. Activities for deposit, pick-up, loading, and paving are continuous
4. HMA temperature in the windrow does not fall below 260 °F

You may pave HMA in 1 or more layers on areas less than 5 feet wide and outside the traveled way including shoulders. You may use mechanical equipment other than a paver for these areas. The equipment must produce a uniform smoothness and texture.

HMA handled, spread, or windrowed must not stain the finished surface of any improvement including pavement.

Do not use petroleum products such as kerosene or diesel fuel to release HMA from trucks, spreaders, or compactors.

HMA must be free of:

1. Segregation
2. Coarse or fine aggregate pockets
3. Hardened lumps

Longitudinal joints in the top layer must match specified lane edges. Alternate longitudinal joint offsets in lower layers at least 0.5 foot from each side of the specified lane edges. You may request in writing other longitudinal joint placement patterns.

Until the adjoining through lane's top layer has been paved, do not pave the top layer of:

1. Shoulders
2. Tapers
3. Transitions
4. Road connections
5. Driveways
6. Curve widenings
7. Chain control lanes

8. Turnouts
9. Turn pockets

If the number of lanes change, pave each through lane's top layer before paving a tapering lane's top layer. Simultaneous to paving a through lane's top layer, you may pave an adjoining area's top layer including shoulders. Do not operate spreading equipment on any area's top layer until completing final compaction.

If HMA (leveling) is specified, fill and level irregularities and ruts with HMA before spreading HMA over base, existing surfaces, or bridge decks. You may use mechanical equipment other than a paver for these areas. The equipment must produce a uniform smoothness and texture. HMA used to change an existing surface's cross slope or profile is not HMA (leveling).

If placing HMA against the edge of existing pavement, sawcut or grind the pavement straight and vertical along the joint and remove extraneous material without damaging the surface remaining in place. If placing HMA against the edge of a longitudinal or transverse construction joint and the joint is damaged or not placed to a neat line, sawcut or grind the pavement straight and vertical along the joint and remove extraneous material without damaging the surface remaining in place. Repair or remove and replace damaged pavement at your expense.

Rolling must leave the completed surface compacted and smooth without tearing, cracking, or shoving. Complete finish rolling activities before the pavement surface temperature is:

1. Below 150 °F for HMA with unmodified binder
2. Below 140 °F for HMA with modified binder
3. Below 200 °F for RHMA-G

If a vibratory roller is used as a finish roller, turn the vibrator off.

Do not use a pneumatic tired roller to compact RHMA-G.

For Standard and QC/QA, if a 3/4-inch aggregate grading is specified, you may use a 1/2-inch aggregate grading if the specified total paved thickness is at least 0.15 foot and less than 0.20 foot thick.

Spread and compact HMA under Section 39-3.03, "Spreading and Compacting Equipment," and Section 39-3.04, "Transporting, Spreading, and Compacting," for any of the following:

1. Specified paved thickness is less than 0.15 foot.
2. Specified paved thickness is less than 0.20 foot and a 3/4-inch aggregate grading is specified and used.
3. You spread and compact at:
 - 3.1. Asphalt concrete surfacing replacement areas
 - 3.2. Leveling courses
 - 3.3. Areas the Engineer determines conventional compaction and compaction measurement methods are impeded

Do not open new HMA pavement to public traffic until its mid-depth temperature is below 160 °F.

If you request in writing and the Engineer authorizes, you may cool HMA Type A and Type B with water when rolling activities are complete. Apply water under Section 17, "Watering."

Spread sand at a rate between 1 pound and 2 pounds per square yard on new RHMA-G, RHMA-O, and RHMA-O-HB pavement when finish rolling is complete. Sand must be free of clay or organic matter. Sand must comply with Section 90-3.03, "Fine Aggregate Grading." Keep traffic off the pavement until spreading sand is complete.

39-1.12 SMOOTHNESS

39-1.12A General

Determine HMA smoothness with a profilograph and a straightedge.

Smoothness specifications do not apply to OGFC placed on existing pavement not constructed under the same project.

If portland cement concrete is placed on HMA:

1. Cold plane the HMA finished surface to within specified tolerances if it is higher than the grade specified by the Engineer.
2. Remove and replace HMA if the finished surface is lower than 0.05 foot below the grade specified by the Engineer.

39-1.12B Straightedge

The HMA pavement top layer must not vary from the lower edge of a 12-foot long straightedge:

1. More than 0.01 foot when the straight edge is laid parallel with the centerline
2. More than 0.02 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. More than 0.02 foot when the straightedge is laid within 24 feet of a pavement conform

39-1.12C Profilograph

Under California Test 526, determine the zero (null) blanking band Profile Index (PI_0) and must-grinds on the top layer of HMA Type A, Type B, and RHMA-G pavement. Take 2 profiles within each traffic lane, 3 feet from and parallel with the edge of each lane.

A must-grind is a deviation of 0.3 inch or more in a length of 25 feet. You must correct must-grinds.

For OGFC, only determine must-grinds when placed over HMA constructed under the same project. The top layer of the underlying HMA must comply with the smoothness specifications before placing OGFC.

Profile pavement in the Engineer's presence. Choose the time of profiling.

On tangents and horizontal curves with a centerline radius of curvature 2,000 feet or more, the PI_0 must be at most 2.5 inches per 0.1-mile section.

On horizontal curves with a centerline radius of curvature between 1,000 feet and 2,000 feet including pavement within the superelevation transitions, the PI_0 must be at most 5 inches per 0.1-mile section.

Before the Engineer accepts HMA pavement for smoothness, submit written final profilograms.

Submit 1 electronic copy of profile information in Microsoft Excel and 1 electronic copy of longitudinal pavement profiles in ".erd" format or other ProVAL compatible format to the Engineer and to:

Smoothness@dot.ca.gov

The following HMA pavement areas do not require a PI_0 . You must measure these areas with a 12-foot straightedge and determine must-grinds with a profilograph:

1. New HMA with a total thickness less than 0.25 foot
2. HMA sections of city or county streets and roads, turn lanes and collector lanes that are less than 1,500 feet in length

The following HMA pavement areas do not require a PI_0 . You must measure these areas with a 12-foot straightedge:

1. Horizontal curves with a centerline radius of curvature less than 1,000 feet including pavement within the superelevation transitions of those curves
2. Within 12 feet of a transverse joint separating the pavement from:
 - 2.1. Existing pavement not constructed under the same project
 - 2.2. A bridge deck or approach slab
3. Exit ramp termini, truck weigh stations, and weigh-in-motion areas
4. If steep grades and superelevation rates greater than 6 percent are present on:
 - 4.1. Ramps
 - 4.2. Connectors
5. Turn lanes
6. Areas within 15 feet of manholes or drainage transitions
7. Acceleration and deceleration lanes for at-grade intersections
8. Shoulders and miscellaneous areas
9. HMA pavement within 3 feet from and parallel to the construction joints formed between curbs, gutters, or existing pavement

39-1.12D Smoothness Correction

If the top layer of HMA Type A, Type B, or RHMA-G pavement does not comply with the smoothness specifications, grind the pavement to within tolerances, remove and replace it, or place a layer of HMA. The Engineer must authorize your choice of correction before the work begins.

Remove and replace the areas of OGFC not in compliance with the must-grind and straightedge specifications, except you may grind OGFC for correcting smoothness:

1. At a transverse joint separating the pavement from pavement not constructed under the same project
2. Within 12 feet of a transverse joint separating the pavement from a bridge deck or approach slab

Corrected HMA pavement areas must be uniform rectangles with edges:

1. Parallel to the nearest HMA pavement edge or lane line
2. Perpendicular to the pavement centerline

Measure the corrected HMA pavement surface with a profilograph and a 12-foot straightedge and correct the pavement to within specified tolerances. If a must-grind area or straightedged pavement cannot be corrected to within specified tolerances, remove and replace the pavement.

On ground areas not overlaid with OGFC, apply fog seal coat under Section 37-1, "Seal Coats."

39-1.13 MISCELLANEOUS AREAS AND DIKES

Miscellaneous areas are outside the traveled way and include:

1. Median areas not including inside shoulders
2. Island areas
3. Sidewalks
4. Gutters
5. Gutter flares
6. Ditches
7. Overside drains
8. Aprons at the ends of drainage structures

Spread miscellaneous areas in 1 layer and compact to the specified lines and grades.

For miscellaneous areas and dikes:

1. Do not submit a JMF.
2. Choose the 3/8-inch or 1/2-inch HMA Type A and Type B aggregate gradations.
3. Minimum asphalt binder content must be 6.8 percent for 3/8-inch aggregate and 6.0 percent for 1/2-inch aggregate. If you request in writing and the Engineer authorizes, you may reduce the minimum asphalt binder content.
4. Choose asphalt binder Grade PG 70-10 or the same grade specified for HMA.

39-2 STANDARD

39-2.01 DESCRIPTION

If HMA is specified as Standard, construct it under Section 39-1, "General," this Section 39-2, "Standard," and Section 39-5, "Measurement and Payment."

39-2.02 CONTRACTOR QUALITY CONTROL

39-2.02A Quality Control Plan

Establish, implement, and maintain a Quality Control Plan (QCP) for HMA. The QCP must describe the organization and procedures you will use to:

1. Control the quality characteristics
2. Determine when corrective actions are needed (action limits)
3. Implement corrective actions

When you submit the proposed JMF, submit the written QCP. You and the Engineer must discuss the QCP during the prepaving conference.

The QCP must address the elements affecting HMA quality including:

1. Aggregate
2. Asphalt binder
3. Additives
4. Production
5. Paving

The Engineer reviews each QCP within 5 business days from the submittal. Hold HMA production until the Engineer accepts the QCP in writing. The Engineer's QCP acceptance does not mean your compliance with the QCP will result in acceptable HMA. Section 39-1.05, "Engineer's Acceptance," specifies HMA acceptance.

39-2.02B Quality Control Testing

Perform sampling and testing at the specified frequency for the following quality characteristics:

Minimum Quality Control – Standard

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	HMA Type			
			A	B	RHMA-G	OGFC
Aggregate gradation ^a	CT 202	1 per 750 tons and any remaining part at the end of the project	JMF ± Tolerance ^b			
Sand equivalent (min.) ^c	CT 217		47	42	47	--
Asphalt binder content (%)	CT 379 or 382		JMF ± 0.45	JMF ± 0.45	JMF ± 0.50	JMF ± 0.50
HMA moisture content (% , max.)	CT 226 or CT 370	1 per 2,500 tons but not less than 1 per paving day	1.0	1.0	1.0	1.0
Field compaction, (% , max. theoretical density) ^{d,e}	Quality control plan	2 per business day (min.)	91 - 97	91 - 97	91 - 97	--
Stabilometer value (min.) ^{c, f} No. 4 and 3/8" gradings 1/2" and 3/4" gradings	CT 366	One per 4,000 tons or 2 per 5 business days, whichever is more	30	30	--	--
			37	35	23	--
Air voids content (%) ^{c, g}	CT 367		4 ± 2	4 ± 2	Specification ± 2	--
Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants ^h	CT 226 or CT 370	2 per day during production	--	--	--	--
Percent of crushed particles coarse aggregate (% , min.) One fractured face Two fractured faces Fine aggregate (% , min) (Passing No. 4 sieve and retained on No. 8 sieve.) One fractured face	CT 205	As necessary and designated in the QCP. At least once per project	90	25	--	90
			75	--	90	75
			70	20	70	90
Los Angeles Rattler (% , max.) Loss at 100 rev. Loss at 500 rev.	CT 211		12 45	-- 50	12 40	12 40

Flat and elongated particles (% max. by weight @ 5:1)	CT 235		Report only	Report only	Report only	Report only
Fine aggregate angularity (% min.) ⁱ	CT 234		45	45	45	--
Voids filled with asphalt (%) ^j No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-3		76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	Report only	--
Voids in mineral aggregate (% min.) ^j No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-2		17.0 15.0 14.0 13.0	17.0 15.0 14.0 13.0	-- -- 18.0 – 23.0 ^k 18.0 – 23.0 ^k	--
Dust proportion ^j No. 4 and 3/8" gradings 1/2" and 3/4" gradings	LP-4		0.9 – 2.0 0.6 – 1.3	0.9 – 2.0 0.6 – 1.3	Report only	--
Smoothness	Section 39-1.12	--	12-foot straightedge, must-grind, and PI ₀	12-foot straightedge, must-grind, and PI ₀	12-foot straightedge, must-grind, and PI ₀	12-foot straightedge and must-grind
Asphalt rubber binder viscosity @ 375 °F, centipoises	Section 39-1.02D	Section 39-1.04C	--	--	1,500 – 4,000	1,500 – 4,000
Asphalt modifier	Section 39-1.02D	Section 39-1.04C	--	--	Section 39-1.02D	Section 39-1.02D
Crumb rubber modifier	Section 39-1.02D	Section 39-1.04C	--	--	Section 39-1.02D	Section 39-1.02D

Notes:

^a Determine combined aggregate gradation containing RAP under Laboratory Procedure LP-9.

^b The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

^c Report the average of 3 tests from a single split sample.

^d Determine field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.

2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

^e To determine field compaction use:

1. In-place density measurements using the method specified in your QC.

2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

^f Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ± 5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

^g Determine the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

^h For adjusting the plant controller at the HMA plant.

ⁱ The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

^j Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.

^k Voids in mineral aggregate for RHMA-G must be within this range.

For any single quality characteristic except smoothness, if 2 consecutive quality control test results do not comply with the action limits or specifications:

1. Stop production.
2. Notify the Engineer in writing.
3. Take corrective action.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

39-2.03 ENGINEER'S ACCEPTANCE

39-2.03A Testing

The Engineer samples for acceptance testing and tests for:

HMA Acceptance - Standard

Quality Characteristic	Test Method	HMA Type						
		A	B	RHMA-G	OGFC			
Aggregate gradation ^a	CT 202	JMF ± Tolerance ^c	JMF ± Tolerance ^c	JMF ± Tolerance ^c	JMF ± Tolerance ^c			
Sieve						3/4"	1/2"	3/8"
1/2"						X ^b		
3/8"							X	
No. 4								X
No. 8						X	X	X
No. 200	X	X	X					
Sand equivalent (min.) ^d	CT 217	47	42	47	--			
Asphalt binder content (%)	CT 379 or 382	JMF ± 0.45	JMF ± 0.45	JMF ± 0.50	JMF ± 0.50			
HMA moisture content (% max.)	CT 226 or CT 370	1.0	1.0	1.0	1.0			
Field compaction (% max. theoretical density) ^{e,f}	CT 375	91 – 97	91 – 97	91 – 97	--			
Stabilometer value (min.) ^{d,g}	CT 366							
No. 4 and 3/8" gradings		30	30	--	--			
1/2" and 3/4" gradings		37	35	23	--			
Air voids content (%) ^{d,h}	CT 367	4 ± 2	4 ± 2	Specification ± 2	--			
Percent of crushed particles	CT 205							
Coarse aggregate (% min.)								
One fractured face		90	25	--	90			
Two fractured faces		75	--	90	75			
Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.)								
One fractured face	70	20	70	90				
Los Angeles Rattler (% max.)	CT 211	12	--	12	12			
Loss at 100 rev.		45	50	40	40			
Loss at 500 rev.								
Fine aggregate angularity (% min.) ⁱ	CT 234	45	45	45	--			
Flat and elongated particles (%, max. by weight @ 5:1)	CT 235	Report only	Report only	Report only	Report only			
Voids filled with asphalt (%) ^j	LP-3			Report only	--			
No. 4 grading		76.0 – 80.0	76.0 – 80.0					
3/8" grading		73.0 – 76.0	73.0 – 76.0					
1/2" grading		65.0 – 75.0	65.0 – 75.0					
3/4" grading	65.0 – 75.0	65.0 – 75.0						
Voids in mineral aggregate (% min.) ^j	LP-2							
No. 4 grading		17.0	17.0	--	--			
3/8" grading		15.0	15.0	--	--			
1/2" grading		14.0	14.0	18.0 – 23.0 ^k				
3/4" grading	13.0	13.0	18.0 – 23.0 ^k					
Dust proportion ^j	LP-4			Report only	--			
No. 4 and 3/8" gradings		0.9 – 2.0	0.9 – 2.0					
1/2" and 3/4" gradings		0.6 – 1.3	0.6 – 1.3					
Smoothness	Section 39-1.12	12-foot straightedge, must-grind, and PI ₀	12-foot straightedge, must-grind, and PI ₀	12-foot straightedge, must-grind, and PI ₀	12-foot straightedge and must-grind			
Asphalt binder	Various	Section 92	Section 92	Section 92	Section 92			
Asphalt rubber binder	Various	--	--	Section 92-	Section 92-			

				1.02(C) and Section 39-1.02D	1.02(C) and Section 39-1.02D
Asphalt modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D
Crumb rubber modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D

^a The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

^b "X" denotes the sieves the Engineer considers for the specified aggregate gradation.

^c The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

^d The Engineer reports the average of 3 tests from a single split sample.

^e The Engineer determines field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, or No.4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

^f To determined field compaction, the Engineer uses:

1. California Test 308, Method A, to determine in-place density of each density core.
2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

^g Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ±5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

^h The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

ⁱ The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

^j Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.

^k Voids in mineral aggregate for RHMA-G must be within this range.

No single test result may represent more than the smaller of 750 tons or 1 day's production.

For any single quality characteristic except smoothness, if 2 consecutive acceptance test results do not comply with the specifications:

1. Stop production.
2. Take corrective action.
3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

The Engineer tests the density core you take from each 250 tons of HMA production. The Engineer determines the percent of maximum theoretical density for each density core by determining the density core's density and dividing by the maximum theoretical density.

The Engineer determines the percent of maximum theoretical density from density cores taken from the final layer measured the full depth of the total paved HMA thickness if any of the following applies:

1. 1/2-inch, 3/8-inch, or No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot and any layer is less than 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot and any layer is less than 0.20 foot.

For percent of maximum theoretical density, the Engineer determines a deduction for each test result outside the specifications in compliance with:

Reduced Payment Factors for Percent of Maximum Theoretical Density

HMA Type A and B and RHMA-G Percent of Maximum Theoretical Density	Reduced Payment Factor	HMA Type A and B and RHMA-G Percent of Maximum Theoretical Density	Reduced Payment Factor
91.0	0.0000	97.0	0.0000
90.9	0.0125	97.1	0.0125
90.8	0.0250	97.2	0.0250
90.7	0.0375	97.3	0.0375
90.6	0.0500	97.4	0.0500
90.5	0.0625	97.5	0.0625
90.4	0.0750	97.6	0.0750
90.3	0.0875	97.7	0.0875
90.2	0.1000	97.8	0.1000
90.1	0.1125	97.9	0.1125
90.0	0.1250	98.0	0.1250
89.9	0.1375	98.1	0.1375
89.8	0.1500	98.2	0.1500
89.7	0.1625	98.3	0.1625
89.6	0.1750	98.4	0.1750
89.5	0.1875	98.5	0.1875
89.4	0.2000	98.6	0.2000
89.3	0.2125	98.7	0.2125
89.2	0.2250	98.8	0.2250
89.1	0.2375	98.9	0.2375
89.0	0.2500	99.0	0.2500
< 89.0	Remove and Replace	> 99.0	Remove and Replace

39-2.04 TRANSPORTING, SPREADING, AND COMPACTING

Determine the number of rollers needed to obtain the specified density and surface finish.

39-3 METHOD

39-3.01 DESCRIPTION

If HMA is specified as Method, construct it under Section 39-1, "General," this Section 39-3, "Method," and Section 39-5, "Measurement and Payment."

39-3.02 ENGINEER'S ACCEPTANCE

39-3.02A Testing

The Engineer samples for acceptance testing and tests for:

HMA Acceptance - Method

Quality Characteristic	Test Method	HMA Type			
		A	B	RHMA-G	OGFC
Aggregate gradation ^a	CT 202	JMF ± Tolerance ^b			
Sand equivalent (min.) ^c	CT 217	47	42	47	--
Asphalt binder content (%)	CT 379 or 382	JMF ± 0.45	JMF ± 0.45	JMF ± 0.50	JMF ± 0.50
HMA moisture content (% max.)	CT 226 or CT 370	1.0	1.0	1.0	1.0
Stabilometer value (min.) ^{c,d} No. 4 and 3/8" gradings 1/2" and 3/4" gradings	CT 366	30	30	--	--
		37	35	23	--
Percent of crushed particles Coarse aggregate (% min.) One fractured face Two fractured faces Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.) One fractured face	CT 205	90	25	--	90
		75	--	90	75
		70	20	70	90
Los Angeles Rattler (% max.) Loss at 100 rev. Loss at 500 rev.	CT 211	12	--	12	12
		45	50	40	40
Air voids content (%) ^{c,e}	CT 367	4 ± 2	4 ± 2	Specification ± 2	--
Fine aggregate angularity (% min.) ^f	CT 234	45	45	45	--
Flat and elongated particles (% max. by weight @ 5:1)	CT 235	Report only	Report only	Report only	Report only
Voids filled with asphalt (%) ^g No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-3	76.0 – 80.0	76.0 – 80.0	Report only	--
		73.0 – 76.0	73.0 – 76.0		
		65.0 – 75.0	65.0 – 75.0		
		65.0 – 75.0	65.0 – 75.0		
Voids in mineral aggregate (% min.) ^g No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-2	17.0	17.0	--	--
		15.0	15.0	--	
		14.0	14.0	18.0 – 23.0 ^h	
		13.0	13.0	18.0 – 23.0 ^h	
Dust proportion ^g No. 4 and 3/8" gradings 1/2" and 3/4" gradings	LP-4	0.9 – 2.0	0.9 – 2.0	Report only	--
		0.6 – 1.3	0.6 – 1.3		
Smoothness	Section 39-1.12	12-foot straightedge and must-grind			
Asphalt binder	Various	Section 92	Section 92	Section 92	Section 92
Asphalt rubber binder	Various	--	--	Section 92-1.02(C) and Section 39-	Section 92-1.02(C) and Section 39-

				1.02D	1.02D
Asphalt modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D
Crumb rubber modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D

^aThe Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

^bThe tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

^cThe Engineer reports the average of 3 tests from a single split sample.

^dModify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ±5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

^eThe Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

^fThe Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

^gReport only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.

^hVoids in mineral aggregate for RHMA-G must be within this range.

No single test result may represent more than the smaller of 750 tons or 1 day's production.

For any single quality characteristic except smoothness, if 2 consecutive acceptance test results do not comply with the specifications:

1. Stop production.
2. Take corrective action.
3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

39-3.03 SPREADING AND COMPACTING EQUIPMENT

Each paver spreading HMA Type A and Type B must be followed by 3 rollers:

1. One vibratory roller specifically designed to compact HMA. The roller must be capable of at least 2,500 vibrations per minute and must be equipped with amplitude and frequency controls. The roller's gross static weight must be at least 7.5 tons.
2. One oscillating type pneumatic-tired roller at least 4 feet wide. Pneumatic tires must be of equal size, diameter, type, and ply. The tires must be inflated to 60 psi minimum and maintained so that the air pressure does not vary more than 5 psi.
3. One steel-tired, 2-axle tandem roller. The roller's gross static weight must be at least 7.5 tons.

Each roller must have a separate operator. Rollers must be self-propelled and reversible.

Compact RHMA-G under the specifications for compacting HMA Type A and Type B except do not use pneumatic-tired rollers.

Compact OGFC with steel-tired, 2-axle tandem rollers. If placing over 300 tons of OGFC per hour, use at least 3 rollers for each paver. If placing less than 300 tons of OGFC per hour, use at least 2 rollers for each paver. Each roller must weigh between 126 pounds to 172 pounds per linear inch of drum width. Turn the vibrator off.

39-3.04 TRANSPORTING, SPREADING, AND COMPACTING

Pave HMA in maximum 0.25-foot thick compacted layers.

If the surface to be paved is both in sunlight and shade, pavement surface temperatures are taken in the shade.

Spread HMA Type A and Type B only if atmospheric and surface temperatures are:

Minimum Atmospheric and Surface Temperatures

Compacted Layer Thickness, feet	Minimum Atmospheric and Surface Temperatures			
	Atmospheric, ° F		Surface, ° F	
	Unmodified Asphalt Binder	Modified Asphalt Binder ^a	Unmodified Asphalt Binder	Modified Asphalt Binder ^a
< 0.15	55	50	60	55
0.15 – 0.25	45	45	50	50

Note:

^a Except asphalt rubber binder.

If the asphalt binder for HMA Type A and Type B is:

1. Unmodified asphalt binder, complete:
 - 1.1. First coverage of breakdown compaction before the surface temperature drops below 250 °F
 - 1.2. Breakdown and intermediate compaction before the surface temperature drops below 200 °F
 - 1.3. Finish compaction before the surface temperature drops below 150 °F
2. Modified asphalt binder, complete:
 - 2.1. First coverage of breakdown compaction before the surface temperature drops below 240 °F
 - 2.2. Breakdown and intermediate compaction before the surface temperature drops below 180 °F
 - 2.3. Finish compaction before the surface temperature drops below 140 °F

For RHMA-G:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and the surface temperature is at least 60 °F.
2. Complete the first coverage of breakdown compaction before the surface temperature drops below 285 °F.
3. Complete breakdown and intermediate compaction before the surface temperature drops below 250 °F.
4. Complete finish compaction before the surface temperature drops below 200 °F.
5. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For OGFC with unmodified asphalt binder:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and the surface temperature is at least 60 °F.
2. Complete first coverage using 2 rollers before the surface temperature drops below 240 °F.
3. Complete all compaction before the surface temperature drops below 200 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For OGFC with modified asphalt binder except asphalt rubber binder:

1. Only spread and compact if the atmospheric temperature is at least 50 °F and the surface temperature is at least 50 °F.
2. Complete first coverage using 2 rollers before the surface temperature drops below 240 °F.
3. Complete all compaction before the surface temperature drops below 180 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For RHMA-O and RHMA-O-HB:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and surface temperature is at least 60 °F.

2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 280 °F.
3. Complete compaction before the surface temperature drops below 250 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until the mixture is transferred to the paver's hopper or to the pavement surface.

For RHMA-G and OGFC, tarpaulins are not required if the time from discharge to truck until transfer to the paver's hopper or the pavement surface is less than 30 minutes.

HMA compaction coverage is the number of passes needed to cover the paving width. A pass is 1 roller's movement parallel to the paving in either direction. Overlapping passes are part of the coverage being made and are not a subsequent coverage. Do not start a coverage until completing the prior coverage.

Start rolling at the lower edge and progress toward the highest part.

Perform breakdown compaction of each layer of HMA Type A, Type B, and RHMA-G with 3 coverages using a vibratory roller. The speed of the vibratory roller in miles per hour must not exceed the vibrations per minute divided by 1,000. If the HMA layer thickness is less than 0.08 foot, turn the vibrator off. The Engineer may order fewer coverages if the HMA layer thickness is less than 0.15 foot.

Perform intermediate compaction of each layer of HMA Type A and Type B with 3 coverages using a pneumatic-tired roller at a speed not to exceed 5 mph.

Perform finish compaction of HMA Type A, Type B, and RHMA-G with 1 coverage using a steel-tired roller.

Compact OGFC with 2 coverages using steel-tired rollers.

39-4 QUALITY CONTROL / QUALITY ASSURANCE

39-4.01 DESCRIPTION

If HMA is specified as Quality Control / Quality Assurance, construct it under Section 39-1, "General," this Section 39-4, "Quality Control / Quality Assurance," and Section 39-5, "Measurement and Payment."

39-4.02 GENERAL

The QC / QA construction process consists of:

1. Establishing, maintaining, and changing if needed a quality control system providing assurance the HMA complies with the specifications
2. Sampling and testing at specified intervals, or sublots, to demonstrate compliance and to control process
3. The Engineer sampling and testing at specified intervals to verify testing process and HMA quality
4. The Engineer using test results, statistical evaluation of verified quality control tests, and inspection to accept HMA for payment

A lot is a quantity of HMA. The Engineer designates a new lot when:

1. 20 sublots are complete
2. The JMF changes
3. Production stops for more than 30 days

Each lot consists of no more than 20 sublots. A subplot is 750 tons except HMA paved at day's end greater than 250 tons is a subplot. If HMA paved at day's end is less than 250 tons, you may either make this quantity a subplot or include it in the previous subplot's test results for statistical evaluation.

39-4.03 CONTRACTOR QUALITY CONTROL

39-4.03A General

Use a composite quality factor, Q_{FC} , and individual quality factors, Q_{FCi} , to control your process and evaluate your quality control program. For quality characteristics without quality factors, use your quality control plan's action limits to control process.

Control HMA quality including:

1. Materials
2. Proportioning
3. Spreading and compacting
4. Finished roadway surface

Develop, implement, and maintain a quality control program that includes:

1. Inspection
2. Sampling
3. Testing

39-4.03B Quality Control Plan

With the JMF submittal, submit a written Quality Control Plan (QCP). The QCP must comply with the Department's Quality Control Manual for Hot Mix Asphalt Production and Placement. Discuss the QCP with the Engineer during the prepaving conference.

The Engineer reviews each QCP within 5 business days from the submittal. Hold HMA production until the Engineer accepts the QCP in writing. The Engineer's QCP acceptance does not mean your compliance with the QCP will result in acceptable HMA. Section 39-1.05, "Engineer's Acceptance," specifies HMA acceptance.

The QCP must include the name and qualifications of a Quality Control Manager. The Quality Control Manager administers the QCP and during paving must be at the job site within 3 hours of receiving notice. The Quality Control Manager must not be any of the following on the project:

1. Foreman
2. Production or paving crewmember
3. Inspector
4. Tester

The QCP must include action limits and details of corrective action you will take if a test result for any quality characteristic falls outside an action limit.

As work progresses, you must submit a written QCP supplement to change quality control procedures, personnel, tester qualification status, or laboratory accreditation status.

39-4.03C Quality Control Inspection, Sampling, And Testing

Sample, test, inspect, and manage HMA quality control.

Provide a roadway inspector while HMA paving activities are in progress. Provide a plant inspector during HMA production.

Inspectors must comply with the Department's Quality Control Manual for Hot Mix Asphalt Production and Placement.

Provide a testing laboratory and personnel for quality control testing. Provide the Engineer unrestricted access to the quality control activities. Before providing services for the project, the Engineer reviews, accredits, and qualifies the testing laboratory and personnel under the Department's Independent Assurance Program.

The minimum random sampling and testing for quality control is:

Minimum Quality Control – QC / QA

Quality Characteristic	Test Method	Min-imum Sampling and Testing Frequen-cy	HMA Type			Location of Sampling	Max. Report-ing Time Allow-ance
			A	B	RHMA-G		
Aggregate gradation ^a	CT 202	1 per 750 tons	JMF ± Tolerance ^b	JMF ± Tolerance ^b	JMF ± Tolerance ^b	CT 125	24 hours
Asphalt binder content (%)	CT 379 or 382		JMF ±0.45	JMF ±0.45	JMF ±0.5	Loose Mix Behind Paver See CT 125	
Field compaction (% max. theoretical density) ^{c,d}	QC Plan		92 - 96	92 - 96	91 - 96	QC Plan	
Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants ^e	CT 226 or CT 370	2 per day during produc-tion	--	--	--	Stock-piles or cold feed belts	--
Sand equivalent (min.) ^f	CT 217	1 per 750 tons	47	42	47	CT 125	24 hours
HMA moisture content (% max.)	CT 226 or CT 370	1 per 2,500 tons but not less than 1 per paving day	1.0	1.0	1.0	Loose Mix Behind Paver See CT 125	24 hours
Stabilometer Value (min.) ^{f, g} No. 4 and 3/8" gradings 1/2" and 3/4" gradings	CT 366	1 per 4,000 tons or 2 per 5 bus-iness days,	30 37	30 35	-- 23		48 hours
Air voids content (%) ^{f, h}	CT 367	whichever is more	4 ± 2	4 ± 2	Specifica-tion ± 2		

Percent of crushed particles coarse aggregate (% min.) One fractured face Two fractured faces Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.) One fractured face	CT 205	As necessary and designated in QCP. At least once per project.	90	25	--	CT 125	48 hours
			75	--	90		
			70	20	70		
Los Angeles Rattler (% max.) Loss at 100 rev. Loss at 500 rev.	CT 211		12 45	-- 50	12 40	CT 125	
Fine aggregate angularity (% min.) ⁱ	CT 234		45	45	45	CT 125	
Flat and elongated particle (% max. by weight @ 5:1)	CT 235		Report only	Report only	Report only	CT 125	
Voids filled with asphalt (%) ^j No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-3		76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	Report only	LP-3	
Voids in mineral aggregate (% min.) ^j No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-2	17.0 15.0 14.0 13.0	17.0 15.0 14.0 13.0	-- -- 18.0 – 23.0 ^k 18.0 – 23.0 ^k	LP-2		
Dust proportion ^j No. 4 and 3/8" gradings 1/2" and 3/4" gradings	LP-4	0.9 – 2.0 0.6 – 1.3	0.9 – 2.0 0.6 – 1.3	Report only	LP-4		
Smoothness	Section 39-1.12	--	12-foot straight-edge, must-grind, and PI ₀	12-foot straight-edge, must-grind, and PI ₀	12-foot straight-edge, must-grind, and PI ₀	--	
Asphalt rubber binder viscosity @ 375 °F, centipoises	Section 39-1.02D	--	--	--	1,500 – 4,000	Section 39-1.02D	24 hours
Crumb rubber modifier	Section 39-1.02D	--	--	--	Section 39-1.02D	Section 39-1.02D	48 hours

Notes:

^a Determine combined aggregate gradation containing RAP under Laboratory Procedure LP-9.

^b The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

^c Determine field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

^d To determine field compaction use:

1. In-place density measurements using the method specified in your QC.
2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

^e For adjusting the plant controller at the HMA plant.

^f Report the average of 3 tests from a single split sample.

^g Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ± 5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

^h Determine the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

ⁱ The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

^j Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.

^k Voids in mineral aggregate for RHMA-G must be within this range.

Within the specified reporting time, submit written test results including:

1. Sampling location, quantity, and time
2. Testing results
3. Supporting data and calculations

If test results for any quality characteristic are beyond the action limits in the QCP, take corrective actions. Document the corrective actions taken in the inspection records under Section 39-4.03E, "Records of Inspection and Testing."

Stop production, notify the Engineer in writing, take corrective action, and demonstrate compliance with the specifications before resuming production and placement on the State highway if:

1. A lot's composite quality factor, QF_C , or an individual quality factor, QF_{QC_i} for $i = 3, 4, \text{ or } 5$, is below 0.90 determined under Section 39-4.03F, "Statistical Evaluation," using quality control data
2. An individual quality factor, QF_{QC_i} for $i = 1 \text{ or } 2$, is below 0.75 using quality control data
3. Quality characteristics for which a quality factor, QF_{QC_i} , is not determined has 2 consecutive quality control tests not in compliance with the specifications

39-4.03D Charts And Records

Record sampling and testing results for quality control on forms provided in the "Quality Control Manual for Hot Mix Asphalt," or on forms you submit with the QCP. The QCP must also include form posting locations and submittal times.

Submit quality control test results using the Department's statistical evaluation program, HMAPay, available at

www.dot.ca.gov/hq/construc/hma/index.htm

39-4.03E Records Of Inspection And Testing

During HMA production, submit in writing a daily:

1. HMA Construction Daily Record of Inspection. Also make this record available at the HMA plant and job site each day.
2. HMA Inspection and Testing Summary. Include in the summary:
 - 2.1. QC worksheet with updated test results from the HMAPay program
 - 2.2. Test forms with the testers' signatures and Quality Control Manager's initials.
 - 2.3. Inspection forms with the inspectors' signatures and Quality Control Manager's initials.
 - 2.4. A list and explanation of deviations from the specifications or regular practices.
 - 2.5. A signed statement by the Quality Control Manager that says:

"It is hereby certified that the information contained in this record is accurate, and that information, tests, or calculations documented herein comply with the specifications of the contract and the

standards set forth in the testing procedures. Exceptions to this certification are documented as part of this record."

Retain for inspection the records generated as part of quality control including inspection, sampling, and testing for at least 3 years after final acceptance.

39-4.03F Statistical Evaluation

General

Determine a lot's composite quality factor, QF_C , and the individual quality factors, QF_{QC_i} . Perform statistical evaluation calculations to determine these quality factors based on quality control test results for:

1. Aggregate gradation
2. Asphalt binder content
3. Percent of maximum theoretical density

The Engineer grants a waiver and you must use 1.0 as the individual quality factor for percent of maximum theoretical density, QF_{QC5} , for HMA paved in:

1. Areas where the total paved thickness is less than 0.15 foot
2. Areas where the total paved thickness is less than 0.20 foot and a 3/4-inch grading is specified and used
3. Dig outs
4. Leveling courses
5. Areas where, in the opinion of the Engineer, compaction or compaction measurement by conventional methods is impeded

Statistical Evaluation Calculations

Use the Variability-Unknown / Standard Deviation Method to determine the percentage of a lot not in compliance with the specifications.

Determine the percentage of work not in compliance with the specification limits for each quality characteristic as follows:

1. Calculate the arithmetic mean (\bar{X}) of the test values

$$\bar{X} = \frac{\sum X}{n}$$

where:

x = individual test values
n = number of test values

2. Calculate the standard deviation

$$s = \sqrt{\frac{n(\sum x^2) - (\sum x)^2}{n(n-1)}}$$

where:

$\sum(x^2)$ = sum of the squares of individual test values
 $(\sum x)^2$ = sum of the individual test values squared
n = number of test values

3. Calculate the upper quality index (Q_u)

$$Q_u = \frac{USL - \bar{X}}{s}$$

where:

USL = target value plus the production tolerance or upper specification limit

s = standard deviation
 \bar{X} = arithmetic mean

4. Calculate the lower quality index (QL);

$$Q_L = \frac{\bar{X} - LSL}{s}$$

where:

LSL = target value minus production tolerance or lower specification limit
s = standard deviation
 \bar{X} = arithmetic mean

5. From the table, Upper Quality Index Q_U or Lower Quality Index Q_L , of this Section 39-4.03F, "Statistical Evaluation", determine P_U ;

where:

P_U = the estimated percentage of work outside the USL.
 $P_U = 0$, when USL is not specified.

6. From the table, Upper Quality Index Q_U or Lower Quality Index Q_L , of this Section 39-4.03F, "Statistical Evaluation," determine P_L ;

where:

P_L = the estimated percentage of work outside the LSL.
 $P_L = 0$, when LSL is not specified.

7. Calculate the total estimated percentage of work outside the USL and LSL, percent defective

$$\text{Percent defective} = P_U + P_L$$

P_U and P_L are determined from:

P _U or P _L	Upper Quality Index Q _U or Lower Quality Index Q _L												
	Sample Size (n)												
	5	6	7	8	9	10-11	12-14	15-17	18-22	23-29	30-42	43-66	>66
0	1.72	1.88	1.99	2.07	2.13	2.20	2.28	2.34	2.39	2.44	2.48	2.51	2.56
1	1.64	1.75	1.82	1.88	1.91	1.96	2.01	2.04	2.07	2.09	2.12	2.14	2.16
2	1.58	1.66	1.72	1.75	1.78	1.81	1.84	1.87	1.89	1.91	1.93	1.94	1.95
3	1.52	1.59	1.63	1.66	1.68	1.71	1.73	1.75	1.76	1.78	1.79	1.80	1.81
4	1.47	1.52	1.56	1.58	1.60	1.62	1.64	1.65	1.66	1.67	1.68	1.69	1.70
5	1.42	1.47	1.49	1.51	1.52	1.54	1.55	1.56	1.57	1.58	1.59	1.59	1.60
6	1.38	1.41	1.43	1.45	1.46	1.47	1.48	1.49	1.50	1.50	1.51	1.51	1.52
7	1.33	1.36	1.38	1.39	1.40	1.41	1.41	1.42	1.43	1.43	1.44	1.44	1.44
8	1.29	1.31	1.33	1.33	1.34	1.35	1.35	1.36	1.36	1.37	1.37	1.37	1.38
9	1.25	1.27	1.28	1.28	1.29	1.29	1.30	1.30	1.30	1.31	1.31	1.31	1.31
10	1.21	1.23	1.23	1.24	1.24	1.24	1.25	1.25	1.25	1.25	1.25	1.26	1.26
11	1.18	1.18	1.19	1.19	1.19	1.19	1.20	1.20	1.20	1.20	1.20	1.20	1.20
12	1.14	1.14	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
13	1.10	1.10	1.10	1.10	1.10	1.10	1.11	1.11	1.11	1.11	1.11	1.11	1.11
14	1.07	1.07	1.07	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
15	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
16	1.00	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
17	0.97	0.96	0.95	0.95	0.95	0.95	0.94	0.94	0.94	0.94	0.94	0.94	0.94
18	0.93	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90
19	0.90	0.89	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
20	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.83
21	0.84	0.82	0.82	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	0.80	0.79
22	0.81	0.79	0.79	0.78	0.78	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.76
23	0.77	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.73	0.73	0.73	0.73	0.73
24	0.74	0.73	0.72	0.72	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70
25	0.71	0.70	0.69	0.69	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.66
26	0.68	0.67	0.67	0.65	0.65	0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.63
27	0.65	0.64	0.63	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.61	0.61	0.60
28	0.62	0.61	0.60	0.59	0.59	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.57
29	0.59	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.55	0.55	0.55	0.55	0.54
30	0.56	0.55	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52
31	0.53	0.52	0.51	0.51	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.49
32	0.50	0.49	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46
33	0.47	0.48	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.43
34	0.45	0.43	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.41	0.41	0.41	0.40
35	0.42	0.40	0.40	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.38	0.38	0.38
36	0.39	0.38	0.37	0.37	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
37	0.36	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.32
38	0.33	0.32	0.32	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.30	0.30
39	0.30	0.30	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
40	0.28	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
41	0.25	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
42	0.23	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
43	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
44	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
45	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
46	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
47	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
48	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
49	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1. If the value of Q_U or Q_L does not correspond to a value in the table, use the next lower value.
2. If Q_U or Q_L are negative values, P_U or P_L is equal to 100 minus the table value for P_U or P_L.

Quality Factor Determination

Determine individual quality factors, QF_{QC_i} , using percent defective = $P_U + P_L$ and:

Quality Factor	Quality Factors												
	Maximum Allowable Percent Defective ($P_U + P_L$)												
	Sample Size (n)												
	5	6	7	8	9	10-11	12-14	15-17	18-22	23-29	30-42	43-66	>66
1.05				0	0	0	0	0	0	0	0	0	0
1.04			0	1	3	5	4	4	4	3	3	3	3
1.03		0	2	4	6	8	7	7	6	5	5	4	4
1.02		1	3	6	9	11	10	9	8	7	7	6	6
1.01	0	2	5	8	11	13	12	11	10	9	8	8	7
1.00	22	20	18	17	16	15	14	13	12	11	10	9	8
0.99	24	22	20	19	18	17	16	15	14	13	11	10	9
0.98	26	24	22	21	20	19	18	16	15	14	13	12	10
0.97	28	26	24	23	22	21	19	18	17	16	14	13	12
0.96	30	28	26	25	24	22	21	19	18	17	16	14	13
0.95	32	29	28	26	25	24	22	21	20	18	17	16	14
0.94	33	31	29	28	27	25	24	22	21	20	18	17	15
0.93	35	33	31	29	28	27	25	24	22	21	20	18	16
0.92	37	34	32	31	30	28	27	25	24	22	21	19	18
0.91	38	36	34	32	31	30	28	26	25	24	22	21	19
0.90	39	37	35	34	33	31	29	28	26	25	23	22	20
0.89	41	38	37	35	34	32	31	29	28	26	25	23	21
0.88	42	40	38	36	35	34	32	30	29	27	26	24	22
0.87	43	41	39	38	37	35	33	32	30	29	27	25	23
0.86	45	42	41	39	38	36	34	33	31	30	28	26	24
0.85	46	44	42	40	39	38	36	34	33	31	29	28	25
0.84	47	45	43	42	40	39	37	35	34	32	30	29	27
0.83	49	46	44	43	42	40	38	36	35	33	31	30	28
0.82	50	47	46	44	43	41	39	38	36	34	33	31	29
0.81	51	49	47	45	44	42	41	39	37	36	34	32	30
0.80	52	50	48	46	45	44	42	40	38	37	35	33	31
0.79	54	51	49	48	46	45	43	41	39	38	36	34	32
0.78	55	52	50	49	48	46	44	42	41	39	37	35	33
0.77	56	54	52	50	49	47	45	43	42	40	38	36	34
0.76	57	55	53	51	50	48	46	44	43	41	39	37	35
0.75	58	56	54	52	51	49	47	46	44	42	40	38	36
Reject	60	57	55	53	52	51	48	47	45	43	41	40	37
	61	58	56	55	53	52	50	48	46	44	43	41	38
	62	59	57	56	54	53	51	49	47	45	44	42	39
	63	61	58	57	55	54	52	50	48	47	45	43	40
	64	62	60	58	57	55	53	51	49	48	46	44	41

Reject Values Greater Than Those Shown Above

Notes:

- To obtain a quality factor when the estimated percent outside specification limits from table, "Upper Quality Index Q_U or Lower Quality Index Q_L ," does not correspond to a value in the table, use the next larger value.

Compute the composite of single quality factors, QF_C , for a lot using:

$$QF_C = \sum_{i=1}^5 w_i QF_{QC_i}$$

where:

- QF_C = the composite quality factor for the lot rounded to 2 decimal places.
- QF_{QC_i} = the quality factor for the individual quality characteristic.
- w = the weighting factor listed in the table HMA Acceptance – QC / QA.

$i =$ the quality characteristic index number in the table HMA Acceptance – QC / QA.

39-4.04 ENGINEER'S QUALITY ASSURANCE

39-4.04A General

The Engineer assures quality by:

1. Reviewing mix designs and proposed JMF
2. Inspecting procedures
3. Conducting oversight of quality control inspection and records
4. Verification sampling and testing during production and paving

39-4.04B Verification Sampling And Testing

General

The Engineer samples:

1. Aggregate to verify gradation
2. HMA to verify asphalt binder content

Verification

For aggregate gradation and asphalt binder content, the minimum ratio of verification testing frequency to quality control testing frequency is 1:5. The Engineer performs at least 3 verification tests per lot.

Using the t-test, the Engineer compares quality control tests results for aggregate gradation and asphalt binder content with corresponding verification test results. The Engineer uses the average and standard deviation of up to 20 sequential sublots for the comparison. The Engineer uses production start-up evaluation tests to represent the first subplot. When there are less than 20 sequential sublots, the Engineer uses the maximum number of sequential sublots available. The 21st subplot becomes the 1st subplot ($n = 1$) in the next lot.

The t-value for a group of test data is computed as follows:

$$t = \frac{|\bar{X}_c - \bar{X}_v|}{S_p \sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \quad \text{and} \quad S_p^2 = \frac{S_c^2(n_c - 1) + S_v^2(n_v - 1)}{n_c + n_v - 2}$$

where:

$n_c =$ Number of quality control tests (2 minimum, 20 maximum).

$n_v =$ Number of verification tests (minimum of 1 required).

$\bar{X}_c =$ Mean of quality control tests.

$\bar{X}_v =$ Mean of verification tests.

$S_p =$ Pooled standard deviation (When $n_v = 1$, $S_p = S_c$).

$S_c =$ Standard deviation of quality control tests.

$S_v =$ Standard deviation of verification tests (when $n_v > 1$).

The comparison of quality control test results and the verification test results is at a level of significance of $\alpha = 0.025$. The Engineer computes t and compares it to the critical t-value, t_{crit} , from:

Critical T-Value

Degrees of freedom (n _c +n _v -2)	<i>t_{crit}</i> (for α = 0.025)	Degrees of freedom (n _c +n _v -2)	<i>t_{crit}</i> (for α = 0.025)
1	24.452	18	2.445
2	6.205	19	2.433
3	4.177	20	2.423
4	3.495	21	2.414
5	3.163	22	2.405
6	2.969	23	2.398
7	2.841	24	2.391
8	2.752	25	2.385
9	2.685	26	2.379
10	2.634	27	2.373
11	2.593	28	2.368
12	2.560	29	2.364
13	2.533	30	2.360
14	2.510	40	2.329
15	2.490	60	2.299
16	2.473	120	2.270
17	2.458	∞	2.241

If the t-value computed is less than or equal to *t_{crit}*, quality control test results are verified.

If the t-value computed is greater than *t_{crit}* and both \bar{X}_v and \bar{X}_c comply with acceptance specifications, the quality control tests are verified. You may continue to produce and place HMA with the following allowable differences:

- $|\bar{X}_v - \bar{X}_c| \leq 1.0$ percent for any grading
- $|\bar{X}_v - \bar{X}_c| \leq 0.1$ percent for asphalt binder content

If the t-value computed is greater than *t_{crit}* and the $|\bar{X}_v - \bar{X}_c|$ for grading or asphalt binder content are greater than the allowable differences, quality control test results are not verified and:

- The Engineer notifies you in writing.
- You and the Engineer must investigate why the difference exist.
- If the reason for the difference cannot be found and corrected, the Engineer's test results are used for acceptance and pay.

39-4.05 ENGINEER'S ACCEPTANCE

39-4.05A Testing

The Engineer samples for acceptance testing and tests for:

HMA Acceptance – QC / QA

Index (i)	Quality Characteristic				Weight -ing Factor (w)	Test Method	HMA Type		
							A	B	RHMA-G
	Aggregate gradation ^a					CT 202	JMF ± Tolerance ^c		
	Sieve	3/4"	1/2"	3/8"					
1	1/2"	X ^b	--	--	0.05				
1	3/8"	--	X	--	0.05				
1	No. 4	--	--	X	0.05				
2	No. 8	X	X	X	0.10				
3	No. 200	X	X	X	0.15				
4	Asphalt binder content (%)				0.30	CT 379 or 382	JMF ± 0.45	JMF ± 0.45	JMF ± 0.5
5	Field compaction (% max. theoretical density) ^{d,e}				0.40	CT 375	92 – 96	92 – 96	91 – 96
	Sand equivalent (min.) ^f					CT 217	47	42	47
	Stabilometer value (min.) ^{f, g}					CT 366			
	No. 4 and 3/8" gradings						30	30	--
	1/2" and 3/4" gradings						37	35	23
	Air voids content (%) ^{f, h}					CT 367	4 ± 2	4 ± 2	Specification ± 2
	Percent of crushed particles coarse aggregate (% min.)					CT 205			
	One fractured face						90	25	--
	Two fractured faces						75	--	90
	Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.)								
	One fractured face						70	20	70
	HMA moisture content (% max.)					CT 226 or CT 370	1.0	1.0	1.0
	Los Angeles Rattler (% max.)					CT 211			
	Loss at 100 rev.						12	--	12
	Loss at 500 rev.						45	50	40
	Fine aggregate angularity (% min.) ⁱ					CT 234	45	45	45
	Flat and elongated particle (% max. by weight @ 5:1)					CT 235	Report only	Report only	Report only
	Voids in mineral aggregate (% min.) ^j								(Note k)
	No. 4 grading						17.0	17.0	--
	3/8" grading					LP-2	15.0	15.0	--
	1/2" grading						14.0	14.0	18.0 - 23.0
	3/4" grading						13.0	13.0	18.0 - 23.0
	Voids filled with asphalt (%) ^j								
	No. 4 grading					LP-3	76.0 - 80.0	76.0 - 80.0	Report only
	3/8" grading						73.0 - 76.0	73.0 - 76.0	
	1/2" grading						65.0 - 75.0	65.0 - 75.0	
	3/4" grading						65.0 - 75.0	65.0 - 75.0	
	Dust proportion ^j					LP-4			
	No. 4 and 3/8" gradings						0.9 - 2.0	0.9 - 2.0	Report only
	1/2" and 3/4" gradings						0.6 - 1.3	0.6 - 1.3	

	Smoothness		Section 39-1.12	12-foot straight-edge, must-grind, and PI ₀	12-foot straight-edge, must-grind, and PI ₀	12-foot straight-edge, must-grind, and PI ₀
	Asphalt binder		Various	Section 92	Section 92	Section 92
	Asphalt rubber binder		Various	--	--	Section 92-1.02(C) and Section 39-1.02D
	Asphalt modifier		Various	--	--	Section 39-1.02D
	Crumb rubber modifier		Various	--	--	Section 39-1.02D

Notes:

^a The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

^b "X" denotes the sieves the Engineer considers for the specified aggregate gradation.

^c The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

^d The Engineer determines field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, or No.4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

^e To determined field compaction, the Engineer uses:

1. California Test 308, Method A, to determine in-place density of each density core.
2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

^f The Engineer reports the average of 3 tests from a single split sample.

^g Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ± 5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

^h The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

ⁱ The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

^j Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.

^k Voids in mineral aggregate for RHMA-G must be within this range.

The Engineer determines the percent of maximum theoretical density from the average density of 3 density cores you take from every 750 tons of production or part thereof divided by the maximum theoretical density.

The Engineer determines the percent of maximum theoretical density from density cores taken from the final layer measured the full depth of the total paved HMA thickness if any of the following applies:

1. If 1/2-inch, 3/8-inch, or No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot and any layer is less than 0.15 foot.
2. If 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot and any layer is less than 0.20 foot.

The Engineer calculates QF_{QC*i*} for i = 1, 2, 3, and 4 using quality control data and QF_{QC*i*} for i = 5 using quality assurance data.

The Engineer stops production and terminates a lot if:

1. The lot's composite quality factor, QF_C, or an individual quality factor, QF_{QC*i*} for i = 3, 4, or 5, is below 0.90 determined under Section 39-4.03F, "Statistical Evaluation"
2. An individual quality factor, QF_{QC*i*} for i = 1 or 2, is below 0.75

- Quality characteristics for which a quality factor, QF_{QC_i} , is not determined has 2 consecutive acceptance or quality control tests not in compliance with the specifications

For any single quality characteristic for which a quality factor, QF_{QC_i} , is not determined, except smoothness, if 2 consecutive acceptance test results do not comply with specifications:

- Stop production.
- Take corrective action.
- In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
- Demonstrate compliance with the specifications before resuming production and placement on the State highway.

39-4.05B Statistical Evaluation, Determination Of Quality Factors And Acceptance

Statistical Evaluation and Determination of Quality Factors

To determine the individual quality factor, QF_{QC_i} , for any quality factor $i = 1$ through 5 or a lot's composite quality factor, QF_C , for acceptance and payment adjustment, the Engineer uses the evaluation specifications under Section 39-4.03F, "Statistical Evaluation," and:

- Verified quality control test results for aggregate gradation
- Verified quality control test results for asphalt binder content
- The Engineer's test results for percent of maximum theoretical density

Lot Acceptance Based on Quality Factors

The Engineer accepts a lot based on the quality factors determined for aggregate gradation and asphalt binder content, QF_{QC_i} for $i = 1$ through 4, using the total number of verified quality control test result values and the total percent defective ($P_U + P_L$).

The Engineer accepts a lot based on the quality factor determined for maximum theoretical density, QF_{QC_5} , using the total number of test result values from density cores and the total percent defective ($P_U + P_L$).

The Engineer calculates the quality factor for the lot, QF_C , which is a composite of weighted individual quality factors, QF_{QC_i} , determined for each quality characteristic in the HMA Acceptance – QC / QA table in Section 39-4.05A, "Testing."

The Engineer accepts a lot based on quality factors if:

- The current composite quality factor, QF_C , is 0.90 or greater
- Each individual quality factor, QF_{QC_i} for $i = 3, 4,$ and 5 , is 0.90 or greater
- Each individual quality factor, QF_{QC_i} for $i = 1$ and 2 , is 0.75 or greater

No single quality characteristic test may represent more than the smaller of 750 tons or 1 day's production.

Payment Adjustment

If a lot is accepted, the Engineer adjusts payment with the following formula:

$$PA = \sum_{i=1}^n HMA CP * w_i * [QF_{QC_i} * (HMATT - WHMATT_i) + WHMATT_i] - (HMA CP * HMATT)$$

where:

$PA =$	Payment adjustment rounded to 2 decimal places.
$HMA CP =$	HMA contract price.
$HMATT =$	HMA total tons represented in the lot.
$WHMATT_i =$	Total tons of waived quality characteristic HMA.
$QF_{QC_i} =$	Running quality factor for the individual quality characteristic. QF_{QC_i} for $i = 1$ through 4 must be from verified Contractor's QC results. QF_{QC_5} must be determined from the Engineer's results on density cores taken for percent of maximum theoretical density determination.
$w =$	Weighting factor listed in the HMA acceptance table.

i = Quality characteristic index number in the HMA acceptance table.

If the payment adjustment is a negative value, the Engineer deducts this amount from payment. If the payment adjustment is a positive value, the Engineer adds this amount to payment.

The 21st subplot becomes the 1st subplot ($n = 1$) in the next lot. When the 21st sequential subplot becomes the 1st subplot, the previous 20 sequential subplots become a lot for which the Engineer determines a quality factor. The Engineer uses this quality factor to pay for the HMA in the lot. If the next lot consists of less than 8 sublots, these sublots must be added to the previous lot for quality factor determination using 21 to 27 sublots.

39-4.05C Dispute Resolution

For a lot, if you or the Engineer dispute any quality factor, QF_{QC_i} , or verification test result, every subplot in that lot must be retested.

Referee tests must be performed under the specifications for acceptance testing.

Any quality factor, QF_{QC_i} , must be determined using the referee tests.

For any quality factor, QF_{QC_i} , for $i = 1$ through 5, dispute resolution:

1. If the difference between the quality factors for QF_{QC_i} using the referee test result and the disputed test result is less than or equal to 0.01, the original test result is correct.
2. If the difference between the quality factor for QF_{QC_i} using the referee test result and the disputed test result is more than 0.01, the quality factor determined from the referee tests supersedes the previously determined quality factor.

39-5 MEASUREMENT AND PAYMENT

39-5.01 MEASUREMENT

The contract item for HMA is measured by weight. The weight of each HMA mixture designated in the Engineer's Estimate must be the combined mixture weight.

If tack coat, asphalt binder, and asphaltic emulsion are paid with separate contract items, their contract items are measured under Section 92, "Asphalts," or Section 94, "Asphaltic Emulsions," as the case may be.

If recorded batch weights are printed automatically, the contract item for HMA is measured by using the printed batch weights, provided:

1. Total aggregate and supplemental fine aggregate weight per batch is printed. If supplemental fine aggregate is weighed cumulatively with the aggregate, the total aggregate batch weight must include the supplemental fine aggregate weight.
2. Total asphalt binder weight per batch is printed.
3. Each truckload's zero tolerance weight is printed before weighing the first batch and after weighing the last batch.
4. Time, date, mix number, load number and truck identification is correlated with a load slip.
5. A copy of the recorded batch weights is certified by a licensed weighmaster and submitted to the Engineer.

The contract item for placing HMA dike is measured by the linear foot along the completed length. The contract item for placing HMA in miscellaneous areas is measured as the in-place compacted area in square yards. In addition to the quantities measured on a linear foot or square yard basis, the HMA for dike and miscellaneous areas are measured by weight.

The contract item for geosynthetic pavement interlayer is measured by the square yard for the actual pavement area covered.

39-5.02 PAYMENT

The contract prices paid per ton for hot mix asphalt as designated in the Engineer's Estimate include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in constructing hot mix asphalt, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If HMA is specified to comply with Section 39-4, "Quality Control / Quality Assurance," the Engineer adjusts payment under that section.

Full compensation for the Quality Control Plan and prepaving conference is included in the contract prices paid per ton for hot mix asphalt as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for performing and submitting mix designs and for Contractor sampling, testing, inspection, testing facilities, and preparation and submittal of results is included in the contract prices paid per ton for HMA as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for reclaimed asphalt pavement is included in the contract prices paid per ton for HMA as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

The contract price paid per ton for hot mix asphalt (leveling) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in hot mix asphalt (leveling), complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The State pays for HMA dike at the contract price per linear foot for place HMA dike and by the ton for HMA. The contract prices paid per linear foot for place hot mix asphalt dike as designated in the Engineer's Estimate include full compensation for furnishing all labor, tools, equipment, and incidentals, and for doing all the work involved in placing HMA dike, complete in place, including excavation, backfill, and preparation of the area to receive the dike, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The State pays for HMA specified to be a miscellaneous area at the contract price per square yard for place hot mix asphalt (miscellaneous area) and per ton for hot mix asphalt. The contract price paid per square yard for place hot mix asphalt (miscellaneous area) includes full compensation for furnishing all labor, tools, equipment, and incidentals, and for doing all the work involved in placing HMA (miscellaneous area) complete in place, including excavation, backfill, and preparation of the area to receive HMA (miscellaneous area), as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If the Quality Control / Quality Assurance construction process is specified, HMA placed in dikes and miscellaneous areas is paid for at the contract price per ton for hot mix asphalt under Section 39-4, "Quality Control / Quality Assurance." Section 39-4.05B, "Statistical Evaluation, Determination of Quality Factors and Acceptance," does not apply to HMA placed in dikes and miscellaneous areas.

If there are no contract items for place hot mix asphalt dike and place hot mix asphalt (miscellaneous area) and the work is specified, full compensation for constructing HMA dikes and HMA (miscellaneous areas) including excavation, backfill, and preparation of the area to receive HMA dike or HMA (miscellaneous area) is included in the contract price paid per ton for the hot mix asphalt designated in the Engineer's Estimate and no separate payment will be made therefor.

The contract price paid per square yard for geosynthetic pavement interlayer includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing geosynthetic pavement interlayer, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per ton for paving asphalt (binder, geosynthetic pavement interlayer) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying paving asphalt (binder, geosynthetic pavement interlayer), complete in place, including spreading sand to cover exposed binder material, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

Full compensation for small quantities of HMA placed on geosynthetic pavement interlayer to prevent displacement during construction is included in the contract price paid per ton for the HMA being paved over the interlayer and no separate payment will be made therefor.

The contract price paid per ton for tack coat includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying tack coat, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The Engineer does not adjust payment for increases or decreases in the quantities for tack coat, regardless of the reason for the increase or decrease. Section 4-1.03B, "Increased or Decreased Quantities," does not apply to the items for tack coat.

Full compensation for performing smoothness testing, submitting written and electronic copies of tests, and performing corrective work including applying fog seal coat is included in the contract price paid per ton for the HMA designated in the Engineer's Estimate and no separate payment will be made therefor.

Full compensation for spreading sand on RHMA-G, RHMA-O, and RHMA-O-HB surfaces and for sweeping and removing excess sand is included in the contract price paid per ton for rubberized hot mix asphalt as designated in the Engineer's Estimate and no separate payment will be made therefor.

If the dispute resolution ITP determines the Engineer's test results are correct, the Engineer deducts the ITP's testing costs from payments. If the ITP determines your test results are correct, the State pays the ITP's testing costs. If, in the Engineer's opinion, work completion is delayed because of incorrect Engineer test results, the Department makes payment and time adjustments under Section 8-1.09, "Delays."

40-1.02F Concrete Field Qualification

Submit field qualification data and test reports including:

1. Mixing date
2. Mixing equipment and procedures used
3. Batch volume in cubic yards
4. Type and source of ingredients used
5. Penetration of the concrete
6. Air content of the plastic concrete
7. Age and strength at time of concrete beam testing

Field qualification test reports must be certified with a signature by an official in responsible charge of the laboratory performing the tests.

40-1.02G Frequency Measuring Device (Tachometer)

Submit calibration documentation and operational guidelines for frequency measuring devices for concrete consolidation vibrators.

40-1.02H Manufacturer's Recommendations and Instructions

If used and at least 15 days before delivery to the job site, submit manufacturer's recommendations and instructions for storage and installation of:

1. Threaded tie bar splice couplers
2. Chemical adhesive (drill and bond)
3. Silicone liquid sealant
4. Asphalt rubber liquid sealant
5. Preformed compression seals
6. Joint filler material

40-1.02I Mix Proportions

At least 15 days before starting testing for mix proportions, submit a copy of the AASHTO accreditation for your laboratory determining the mix proportions. At least 30 days before starting field qualification, submit the proposed concrete mix proportions, the corresponding mix identifications, and laboratory test reports including the modulus of rupture for each trial mixture at 10, 21, 28, and 42 days.

40-1.02J Preformed Compression Seal

Submit the manufacturer's data sheet used to develop the recommended preformed compression seal based on the joint dimensions.

40-1.02K Concrete Pavement Early Age Crack Mitigation System

At least 24 hours before each paving shift, submit:

1. Early age stress and strength predictions
2. Scheduled sawing and curing activities
3. Contingency plan if volunteer cracking occurs

At least 24 hours before paving, meet with the Engineer to review the submittals for the early age crack mitigation system.

During paving, update the system with current weather data obtained from a portable weather station. Before paving concrete pavement with these updates, submit new stress and strength predictions and curing and sawing activity schedules.

40-1.02L Profilograms

Submit profilograms within 5 business days of initial profiling and within 2 business days of profiling corrected sections.

Submit 1 electronic copy of profile information in ".erd" format or other ProVAL compatible format to the Engineer and to:

Smoothness@dot.ca.gov

Submit the original of final profilograms before the Engineer accepts the contract.
Submitted profilograms become the Department's property.

40-1.02M Protecting Concrete Pavement During Cold Weather

Submit a plan for protecting concrete pavement during the initial 72 hours after paving when the forecasted minimum ambient temperature is below 40 degrees F.

40-1.02N Quality Control Charts

Submit updated quality control charts each paving day.

40-1.02O Quality Control Plan

At least 30 days before the start of field qualification, submit a concrete pavement quality control plan (QCP).

40-1.03 QUALITY CONTROL AND ASSURANCE

40-1.03A Contractor Quality Control Plan

Establish, implement, and maintain a QCP for concrete pavement. The QCP must describe the organization and procedures you use to:

1. Control the production process
2. Determine if changes to the production process are needed
3. Implement changes

The QCP must address the elements affecting concrete pavement quality including:

1. Mix proportions
2. Aggregate gradation
3. Materials quality
4. Stockpile management
5. Line and grade control
6. Proportioning
7. Mixing and transportation
8. Placing and consolidation
9. Contraction and construction joints
10. Dowel bar placement, alignment, and anchorage
11. Tie bar placement
12. Modulus of rupture
13. Finishing and curing
14. Surface smoothness
15. Joint sealant and compression seal installation

The QCP must include details of corrective action to be taken if any process is out of control. As a minimum, a process is out of control if any of the following occurs:

1. For fine and coarse aggregate gradation, 2 consecutive running averages of 4 tests are outside the specification limits
2. For individual penetration or air content measurements:
 - 2.1. One point falls outside the suspension limit line
 - 2.2. Two points in a row fall outside the action limit line

Stop production and take corrective action for out of control processes or the Engineer rejects subsequent material.

40-1.03B Quality Control Testing

Select random locations and perform sampling and testing in compliance with:

Quality Control Testing		
Test	Frequency	Test Method
Cleanness value	2 per day	CT 227
Sand equivalent	2 per day	CT 217
Aggregate gradation	2 per day	CT 202
Air content (freeze thaw) ^a	1 per hour	CT 504
Air content (non-freeze thaw)	1 per 4 hours	CT 504
Density	1 per 4 hours	CT 518
Penetration	1 per 4 hours	CT 533
Calibration of moisture meter ^{b, c}	1 per day	CT 223 or CT 226

Notes:

^a If air entrainment is specified, make at least 1 air content measurement per hour. If air entrainment is not specified, make at least 1 air content measurement per 4 hours.

^b Make at least 1 measurement of moisture content per week to check the calibration of an electronically actuated moisture meter.

^c Random location sampling and testing is not applicable.

If air entrainment is specified, the testing laboratory and tester must be qualified under the Department's Independent Assurance Manual. The manual is available from the Transportation Laboratory.

40-1.03C Control Charts

Maintain control charts to identify potential problems and assignable causes. Post a copy of each control chart at a location determined by the Engineer.

Individual measurement control charts must use the target values in the mix proportions as indicators of central tendency.

Develop linear control charts for:

1. Cleanness value
2. Sand equivalent
3. Fine and coarse aggregate gradation
4. Air content
5. Penetration

Control charts must include:

1. Contract number
2. Mix proportions
3. Test number
4. Each test parameter
5. Action and suspension limits
6. Specification limits
7. Quality control test results

For fine and coarse aggregate gradation control charts, record the running average of the previous 4 consecutive gradation tests for each sieve and superimpose the specification limits.

For penetration and air content control charts, record the individual measurements and superimpose the following action and suspension limits:

Penetration and Air Content Action and Suspension Limits		
Control Parameter	Individual Measurements	
	Action Limit	Suspension Limit
Penetration, CT 533	1 inch	1-1/2 inch
Air content, CT 504	±1.0 percent	±1.5 percent

40-1.03D Contractor's Laboratory

Use a laboratory that complies with ASTM C 1077 to determine the mix proportions for concrete pavement. The laboratory must have a current AASHTO accreditation for:

1. AASHTO T 97 or ASTM C 78
2. ASTM C 192/C 192M

40-1.03E Joint Sealant and Compression Seal Installation Training

Before installing joint sealant or compression seals, arrange for a representative from the joint sealant or compression seal manufacturer to provide training on the cleaning and preparation of the joint and installing the sealant or seal. Until your personnel and the Department's personnel have been trained, do not install joint sealant or compression seals.

40-1.03F Frequency Measuring Device (Tachometer)

Before each day's concrete pavement placement and at intervals not to exceed 4 hours of production, test and record vibration frequency for concrete consolidation vibrators.

40-1.03G Early Age Concrete Pavement Crack Mitigation System

Develop and implement a system for predicting concrete pavement stresses and strength during the initial 72 hours after paving. The system must include:

1. Subscribing to a weather service to obtain forecasts for wind speed, ambient temperatures, humidity, and cloud cover
2. Portable weather station with anemometer, temperature and humidity sensors, located at the paving site
3. Early age concrete pavement stress and strength prediction computer program
4. Analyzing, monitoring, updating, and reporting the system's predictions

40-1.03H Curing Compound

Sample curing compound from shipping containers at the manufacturer's source of supply. Split the samples.

40-1.03I Concrete Pavement Smoothness

Within 10 days after paving, measure the Profile Index (PI_0) of the concrete pavement surface using a zero (null) blanking band under California Test 526.

For the following concrete pavement areas, the Engineer does not require a profilograph and you must test and correct high points determined by a 12-foot straightedge placed parallel with and perpendicular to the centerline:

1. Horizontal curves with a centerline radius of curvature less than 1,000 feet including concrete pavement within the superelevation transitions of those curves.
2. Exit ramp termini, truck weigh stations, and weigh-in-motion areas
3. Where steep grades and superelevation rates greater than 6 percent are present on:
 - 3.1. Ramps
 - 3.2. Connectors
4. Turn lanes and areas around manholes or drainage transitions
5. Acceleration and deceleration lanes for at-grade intersections
6. Shoulders and miscellaneous gore areas

Use a California Profilograph to determine the concrete pavement profile. If the profilograph uses a mechanical recorder, use an electronic scanner to reduce the profilogram.

The profilograph operator must be qualified under the Department's Independent Assurance Manual. The manual is available from the Department's Materials Engineering and Testing Services Web site.

40-1.03J Profilograph Test Procedure

Notify the Engineer at least 2 business days before performing profilograph testing. Each day before performing profilograph testing, notify the Engineer of the start location. Perform profilograph testing in the Engineer's presence.

Before starting profilograph testing, remove foreign objects from the concrete pavement surface.

Before starting profilograph testing, calibrate the profilograph in the Engineer's presence. If the Engineer chooses not to be present during profilograph testing, you may perform the testing with the Engineer's written approval. Note the Engineer's absence on the profilogram.

Determine PI_0 values for the final concrete pavement surface of each 0.1-mile section of a traffic lane. Take 2 profiles within each traffic lane, 3 feet from and parallel with the edge of each lane. Each section's PI_0 is the average of the PI_0 values for the measurements within that traffic lane. A section that is less than 0.01 mile and is the result of an interruption to continuous concrete pavement surface must comply with the PI_0 specifications for a full section. Adjust the PI_0 for a partial section to reflect a full section.

Use stationing to locate vertical deviations greater than 0.3 inches. The profilogram stationing must be the same as the project stationing. Note 0.1-mile segments on the profilogram.

Label the profilogram with:

1. Contract number
2. County and route number
3. Stationing
4. Operator's name
5. Test date
6. Test number
7. Traffic direction
8. Traffic lane (numbered from left to right in direction of travel)
9. Test wheel path (left or right in direction of travel)
10. Test direction
11. Paving direction

40-1.03K Smoothness Corrective Action

Correct concrete pavement not complying with the Engineer's acceptance specifications for smoothness by grinding under Section 42-2, "Grinding."

Do not grind before:

1. Ten days after concrete pavement placement
2. The concrete has developed a modulus of rupture of at least 550 psi

Grind the entire lane width. When completed, the lane width must be uniform in texture and appearance. Square the corrected area's start and end normal to the paved surface's centerline.

Retest sections where corrections were made.

40-1.03L Acceptance Criteria

General

Concrete pavement is accepted based on the Department's testing for the concrete pavement quality characteristics shown in the following table:

Concrete Pavement Acceptance Testing		
Quality Characteristic	Quantity	Test
28-day modulus of rupture	1,000 cubic yards	CT 523
Thickness	1,200 square yards for primary area measurements	CT 531
Dowel bar placement	700 square yards	Measurement
Tie bar placement	4,000 square yards	Measurement
Coefficient of friction	One day's paving	CT 342
Air content (freeze-thaw) ^a	One day's paving	CT 504

Note:

^a Air content tests must be performed under California Test 504 if air entrainment is specified.

Pavement smoothness may be accepted based on the Department's testing. A single test represents no more than 0.1 mile.

Acceptance of modulus of rupture, thickness, dowel bar and tie bar placement, coefficient of friction, smoothness, and air content, does not constitute final concrete pavement acceptance.

Modulus of Rupture

The Engineer accepts concrete pavement for modulus of rupture on a lot basis. The minimum modulus of rupture for each lot is 570 psi at 28 days.

For each lot of concrete for concrete pavement:

1. Quantity must not exceed 1,000 cubic yards.
2. Department determines the modulus of rupture of test beams aged 10 days and 28 days.
3. Department calculates the modulus of rupture by averaging the individual test results of 2 beams aged for 28 days.

The Department provides molds and machines for modulus of rupture acceptance testing. Provide material and labor the Engineer may require.

Concrete Pavement Smoothness

If the Department tests for smoothness, the tests are performed under Section 40-1.03I, "Concrete Pavement Smoothness."

The Engineer accepts concrete pavement for smoothness in compliance with the following:

1. For tangents and horizontal curves having a centerline radius of curvature 2,000 feet or more, the PI_0 must be at most 2-1/2 inches per 0.1-mile section.
2. For horizontal curves having a centerline radius of curvature from 1,000 to 2,000 feet including concrete pavement within the superelevation transitions of those curves, the PI_0 must be at most 5 inches per 0.1-mile section.
3. If using a profilograph to measure smoothness, the surface must not have individual high points greater than 0.3 inch.
4. If using a straightedge to measure smoothness, the surface must be within 0.02 foot of the straightedge's lower edge.

Profile index specifications apply to existing pavement within 50 feet of the transverse joint separating new concrete pavement and the existing pavement.

If the Department's profilograph test results do not match yours, the Engineer may order you to recalibrate your profilograph equipment and perform a retest. If your test results are inaccurate due to operator error, the Engineer may disqualify your profilograph operator. If the Engineer determines your test results are inaccurate, the Engineer does not make adjustments to payment or contract time for recalibrating, retesting, and delays.

Concrete Pavement Thickness

The Engineer accepts concrete pavement for thickness based on coring in the primary area, which is the area placed in 1 day for each thickness. Concrete pavement thickness must not be deficient by more than 0.05 foot.

After corrective grinding has been completed, core concrete pavement in the primary area under Section 40-3.16, "Obtaining Drilled Cores," at locations determined by the Engineer and in the Engineer's presence. The core specimen diameter must be 4 inches. To identify the limits of concrete pavement deficient in thickness by more than 0.05 foot, you may divide primary areas into secondary areas. Specifications that may affect concrete pavement thickness such as allowable tolerances for subgrade construction do not change the thickness specified for concrete pavement.

In each primary area, the Engineer measures concrete pavement thickness every 1,200 square yards and any remaining area. The Engineer measures cores under California Test 531 to the nearest 0.01 foot. Core at least 1 foot from existing, contiguous, and parallel concrete pavement not constructed as part of this contract.

You may request the Engineer make additional thickness measurements and use them to determine the average thickness variation. The Engineer determines the locations with random sampling methods.

If each thickness measurement in a primary area is less than 0.05 foot deficient, the Engineer calculates the average thickness deficiency in that primary area. The Engineer uses 0.02 foot for a thickness difference more than 0.02 foot over the specified thickness.

For each thickness measurement in a primary area deficient by more than 0.05 foot, the Engineer determines a secondary area where the thickness deficiency is more than 0.05 foot. The Engineer determines this secondary area

by measuring the thickness of each concrete pavement slab adjacent to the measurement found to be more than 0.05 foot deficient. The Engineer continues to measure the thickness until an area that is bound by slabs with thickness deficient by 0.05 foot or less is determined.

Slabs without bar reinforcement are defined as the areas bound by longitudinal and transverse joints and concrete pavement edges. Slabs with bar reinforcement are defined as the areas bound by longitudinal joints and concrete pavement edges and 15-foot lengths. Secondary area thickness measurements in a slab determine that entire slab's thickness.

The Engineer measures the remaining primary area thickness after removing the secondary areas from consideration for determining the average thickness deficiency.

The Engineer determines the slabs to remove and replace.

Required Use of Air-Entraining Admixtures

If air-entraining admixtures are specified, the Engineer may choose to accept concrete pavement for air content based on your air content quality control tests. The Engineer decides to use your air content quality control tests based on a *t*-test that determines the difference in the means of your test and the Engineer's verification tests. The Engineer calculates the *t*-value of the test data as follows:

$$t = \frac{|\bar{X}_c - \bar{X}_v|}{S_p \sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \quad \text{and} \quad S_p^2 = \frac{S_c^2(n_c - 1) + S_v^2(n_v - 1)}{n_c + n_v - 2}$$

where:

- n_c = Number of your quality control tests (minimum of 6 required)
- n_v = Number of verification tests (minimum of 2 required)
- \bar{X}_c = Mean of your quality control tests
- \bar{X}_v = Mean of the verification tests
- S_p = Pooled standard deviation
(When $n_v = 1$, $S_p = S_c$)
- S_c = Standard deviation of your quality control tests
- S_v = Standard deviation of the verification tests (when $n_v > 1$)

The Engineer compares your quality control test results with the Department's verification test results at a level of significance of $\alpha = 0.01$. The Engineer compares the *t*-value to t_{crit} , determined from:

t_{crit}	
degrees of freedom ($n_c + n_v - 2$)	t_{crit} (for $\alpha = 0.01$)
1	63.657
2	9.925
3	5.841
4	4.604
5	4.032
6	3.707
7	3.499
8	3.355
9	3.250
10	3.169

If the *t*-value calculated is less than or equal to t_{crit} , your quality control test results are verified. If the *t*-value calculated is greater than t_{crit} , quality control test results are not verified.

If your quality control test results are not verified, core at least 3 specimens from concrete pavement under Section 40-3.16, "Obtaining Drilled Cores." The Engineer selects the core locations. Your approved third party independent testing laboratory must test these specimens for air content under ASTM C 457. The Engineer

compares these test results with your quality control test results using the *t*-test method. If your quality control test results are verified based on this comparison, the Engineer uses the quality control test results for acceptance of concrete pavement for air content. If your quality control test results are not verified based on this comparison, the Engineer uses the air content of core specimens determined under ASTM C 457 for acceptance.

Dowel Bar and Tie Bar Placement

Dowel bar alignment must comply with section 40-3.06. Tie bar alignment must comply with Section 40-3.05. Except for CRCP, core specimens for:

1. Dowel bar placement
2. Tie bar placement
3. Concrete consolidation

Obtain cores under Section 40-3.16, "Obtaining Drilled Cores." The Engineer determines the core locations. Each core must have a nominal diameter of 4 inches. Core each day's paving within 2 business days in compliance with:

1. One test for every 700 square yards of doweled concrete pavement or remaining fraction of that area. Each dowel bar test consists of 2 cores, 1 on each dowel bar end to expose both ends and allow measurement.
2. One test for every 4,000 square yards of concrete pavement with tie bars or remaining fraction of that area. Each tie bar test consists of 2 cores, 1 on each tie bar end to expose both ends and allow measurement.

If the tests indicate dowel or tie bars are not placed within the specified tolerances or if there are air voids around the dowel or tie bars, core additional specimens to determine the limits of unacceptable work.

The Engineer determines the slabs to remove and replace.

If the Engineer approves your request, slabs may remain in place with an adjustment in payment for:

1. Dowel bars with centers from ± 2 inches to ± 3 inches from the saw cut of a transverse contraction joint or with deficient concrete consolidation around the dowel bars
2. Tie bars placed outside their specified placement and position or with deficient concrete consolidation around the tie bars

Bar Reinforcing Steel

The Engineer accepts concrete pavement for bar reinforcing steel based on inspection before concrete placement.

Curing Compound

Curing compound sampled from shipping containers from the manufacturer's supply source or from the job site must match the test results for viscosity, nonvolatile content, and pigment content within the specified tolerances listed in the precision and bias statements for the test methods.

40-2 MATERIALS

40-2.01 CONCRETE

40-2.01A General

Concrete must comply with Section 90, "Portland Cement Concrete."

40-2.01B Aggregate

The specifications for reduction in Operating Range and Contract Compliance for cleanness value and sand equivalent specified under Section 90-2.02A, "Coarse Aggregate," and Section 90-2.02B, "Fine Aggregate," do not apply to concrete pavement.

Combined aggregate gradings must comply with Section 90-3, "Aggregate Gradings," and the difference between the percent passing the 3/8-inch sieve and the percent passing the No. 8 sieve must not be less than 16 percent of the total aggregate.

40-2.01C Cementitious Material

Concrete for concrete pavement must contain from 505 pounds to 675 pounds cementitious material per cubic yard. Determine the minimum cementitious materials content. Use your value for minimum cementitious material content for *MC* in equation 1 and equation 2 of section 90-1.02B(3).

40-2.01D Mix Proportions

Your laboratory determining mix proportions must determine the minimum cementitious materials content or the maximum water to cementitious materials ratio and:

1. You must make trial mixtures no more than 24 months before field qualification.
2. Modulus of rupture used to determine the minimum cementitious materials content or maximum water to cementitious materials ratio must be 570 psi at 28 days age and 650 psi at 42 days age.
3. Your laboratory must determine an increase in the cementitious materials content or a decrease in the water to cementitious materials ratio from the trial mixtures to ensure concrete pavement complies with the specifications.

If changing an aggregate supply source or the mix proportions, produce a trial batch and field-qualify the new concrete. The Engineer does not adjust contract time for performing sampling, testing, and qualifying new mix proportions or changing an aggregate supply source.

40-2.01E Field Qualification

Proposed mix proportions must be field qualified before you place concrete pavement. Use an American Concrete Institute (ACI) certified "Concrete Laboratory Technician, Grade I" to perform field qualification tests and calculations.

The Engineer accepts field qualification if five beams made and tested under California Test 523 comply with the following:

1. At a minimum, beams are tested at 10, 21, and 28 days of age
2. At your choice of age not later than 28 days, no single beam's modulus of rupture is less than 550 psi and the average modulus of rupture is at least 570 psi

40-2.02 TIE BARS

Tie bars must be deformed bars.

If the project is not shown to be in high desert or any mountain climate region, tie bars must be one of the following:

1. Epoxy-coated bar reinforcement. Bars must comply with Section 52-1.02B, "Epoxy-coated Reinforcement" except bars must comply with either ASTM A 706/A 706M; ASTM A 996/A 996M; or ASTM A 615/A 615M, Grade 40 or 60.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.
3. Low carbon, chromium-steel bars complying with ASTM A 1035/A 1035M.

If the project is shown to be in high desert or any mountain climate region, tie bars must be one of the following:

1. Epoxy-coated bar reinforcement. Bars must comply with "Epoxy-coated Prefabricated Reinforcement" in the special provisions except bars must comply with either ASTM A 706/A 706M; ASTM A 996/A 996M; or ASTM A 615/A 615M, Grade 40 or 60.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.

Fabricate, sample, and handle epoxy-coated deformed tie bars at the job site under ASTM D 3963/D 3963M and Section 52-1.02B, "Epoxy-coated Reinforcement."

Do not bend tie bars.

40-2.03 DOWEL BARS

40-2.03A General

Dowel bars must be plain bars. Fabricate, sample, and handle epoxy-coated dowel bars under ASTM D 3963/D 3963M and section 52-1.02B, "Epoxy-coated Reinforcement," except each sample must be 18 inches long.

If the project is not shown to be in high desert or any mountain climate region, dowel bars must be one of the following:

1. Epoxy-coated bars. Bars must comply with ASTM A 615/A 615M, Grade 40 or 60. Epoxy coating must comply with either (1) Section 52-1.02B, "Epoxy-coated Reinforcement" or (2) "Epoxy-coated Prefabricated Reinforcement" in the special provisions.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.
3. Low carbon, chromium-steel bars under ASTM A 1035/A 1035M.

If the project is shown to be in high desert or any mountain climate region, dowel bars must be one of the following:

1. Epoxy-coated bars. Bars must comply with ASTM A 615/A 615M, Grade 40 or 60. Epoxy coating must comply with "Epoxy-coated Prefabricated Reinforcement" in the special provisions.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.

40-2.03B Dowel Bar Lubricant

Dowel bar lubricant must be either (1) petroleum paraffin based or (2) curing compound no. 3. Paraffin-based lubricant must be either Dayton Superior DSC BB-Coat, Valvoline Tectyl 506, or an approved equal. Petroleum paraffin based lubricant must be factory-applied.

40-2.04 CURING COMPOUND

Curing compound must be curing compound (1) or (2) with white pigment under Section 90-7.01B, "Curing Compound Method."

Reflectance must be at least 60 percent when tested under ASTM E 1347.

40-2.05 CHEMICAL ADHESIVE (DRILL AND BOND)

Chemical adhesive for drilling and bonding dowels and tie bars must be prequalified. A list of prequalified chemical adhesives is available on the Department's Materials Engineering and Testing Services website. The prequalified list indicates the appropriate chemical adhesive system for the concrete temperature and installation conditions.

Each chemical adhesive system must clearly and permanently show the following:

1. Manufacturer's name
2. Model number of the system
3. Manufacture date
4. Batch number
5. Expiration date
6. Current International Conference of Building Officials Evaluation Report number
7. Directions for use
8. Warnings or precautions required by state and federal laws and regulations

40-2.06 DOWEL AND TIE BAR BASKETS

For dowel and tie bar baskets, wire must comply with ASTM A 82/A 82M and be welded under ASTM A 185/A 185M, Section 7.4. The minimum wire-size no. is W10. Use either U-frame or A-frame shaped assemblies.

If the project is not shown to be in high desert or any mountain climate region. Baskets may be epoxy-coated, and the epoxy coating must comply with either (1) Section 52-1.02B, "Epoxy-coated Reinforcement" or (2) "Epoxy-coated Prefabricated Reinforcement" in the special provisions.

If the project is shown to be in high desert or any mountain climate region, wire for dowel bar and tie bar baskets must be one of the following:

1. Epoxy-coated wire under "Epoxy-coated Prefabricated Reinforcement" in the special provisions
2. Stainless-steel wire. Wire must be descaled, pickled, and polished solid stainless-steel. Wire must comply with (1) the chemical requirements in ASTM A 276/A 276M, UNS Designation S31603 or S31803 and (2) the tension requirements in ASTM A 1022/ A 1022M.

Handle epoxy-coated tie bar and dowel bar baskets under ASTM D 3963/D 3963M and either (1) Section 52-1.02B, "Epoxy-coated Reinforcement" or (2) "Epoxy-coated Prefabricated Reinforcement" in the special provisions.

Fasteners must be driven fasteners under ASTM F 1667. Fasteners on lean concrete base or HMA must have a minimum shank diameter of 3/16 inch and a minimum shank length of 2-1/2 inches. For asphalt treated permeable base or cement treated permeable base, the shank diameter must be at least 3/16 inch and the shank length must be at least 5 inches.

Fasteners, clips, and washers must have a minimum 0.2-mil thick zinc coating applied either by electroplating or galvanizing.

40-2.07 BACKER RODS

Backer rods must be Type 1 under ASTM D 5249. Backer rod diameter must be at least 25 percent greater than the sawcut joint width. Backer rod material must be expanded, crosslinked, closed-cell polyethylene foam. No bond or adverse reaction may occur between the backer rod and sealant.

40-2.08 JOINT FILLER MATERIAL

Joint filler for isolation joints must be preformed expansion joint filler for concrete (bituminous type) under ASTM D 994.

40-2.09 HYDRAULIC CEMENT GROUT (NON-SHRINK)

Hydraulic cement grout (non-shrink) must comply with ASTM C 1107/ C 1107M. Use clean, uniform, rounded aggregate filler to extend the grout. Aggregate filler must not exceed 60 percent of the grout mass or the maximum recommended by the manufacturer, whichever is less. Aggregate filler moisture content must not exceed 0.5 percent. Aggregate filler must comply with:

Aggregate Filler Grading

Sieve Size	Percentage Passing
1/2-inch	100
3/8-inch	85 - 100
No. 4	10 - 30
No. 8	0 - 10
No. 16	0 - 5

40-2.10 BAR REINFORCEMENT

Bar reinforcement must be deformed bars.

If the project is not shown to be in high desert or any mountain climate region, bar reinforcement must comply with section 52.

If the project is shown to be in high desert or any mountain climate regions, bar reinforcement must be one of the following:

1. Epoxy-coated bar reinforcement under section 52-2.03B except bars must comply with either ASTM A 706/A 706M; ASTM A 996/A 996M; or ASTM A 615/A 615M, Grade 40 or 60. Bars must be handled under ASTM D 3963/D 3963M and section 52-2.02C.
2. Low carbon, chromium steel bar complying with ASTM A 1035/A 1035M

40-2.11 JOINT SEALANT

40-2.11A General

Do not use hot-pour sealant that will melt the backer rod.

40-2.11B Silicone Joint Sealant

Silicone joint sealant must be prequalified. A list of prequalified silicone joint sealant available on the Department's Materials Engineering and Testing Services Web site at:
http://www.dot.ca.gov/hq/esc/approved_products_list/

40-2.11C Asphalt Rubber Joint Sealant

Asphalt rubber joint sealant must:

1. Be a mixture of paving asphalt and ground rubber containing not less than 22 percent ground rubber by weight. One hundred percent of ground rubber must pass a No. 8 sieve. Ground rubber must be vulcanized or a combination of vulcanized and devulcanized materials.
2. Comply with ASTM D 6690, Type II except:
 - 2.1. The cone penetration requirement must not exceed 120 at 77 F, 5 ounces, 5 seconds.
 - 2.2. The resilience requirement must be a minimum 50 percent recovery when tested at 77 F.
3. Have a Ring and Ball softening point of 135 °F minimum when tested under AASHTO T 53.
4. Be capable of being melted and applied to cracks and joints at temperatures below 400 °F.
5. Not be applied when the concrete pavement surface temperature is below 50 °F.

40-2.11D Preformed Compression Joint Seals

Preformed compression joint seals must comply with ASTM D 2628. Lubricant adhesive used with the seals must comply with ASTM D 2835. Preformed compression joint seals must have 5 or 6 cells, except seals for Type A2 and Type B joints may have 4 cells. Install preformed compression joint seals in compliance with the manufacturer's recommendations. Show evidence that the seals are compressed from 30 to 50 percent for the joint width at the time of installation.

40-2.12 WATER

Water for core drilling may be obtained from a potable water source, or submit proof that it does not contain:

1. More than 1,000 parts per million of chlorides as Cl
2. More than 1,300 parts per million of sulfates as SO₄
3. Impurities that cause pavement discoloration or surface etching

40-3 CONSTRUCTION

40-3.01 WATER SUPPLY

Before placing concrete pavement, develop enough water supply for the work.

40-3.02 SUBGRADE PREPARATION

Immediately before placing concrete, the subgrade to receive concrete pavement must be:

1. In compliance with the specified compaction and elevation tolerances
2. Free of loose and extraneous material
3. Uniformly moist, but free of standing or flowing water
4. Excavated for thickened parts of concrete pavement end anchors with no disturbed compaction outside the end anchor dimensions

If cement treated permeable base is specified, cover the base surface with asphaltic emulsion before placing concrete pavement. Apply the asphaltic emulsion uniformly at a rate of 0.1 gallons per square yard. Asphaltic emulsion must comply with anionic slow-setting type, SS1h grade in Section 94, "Asphaltic Emulsions." Repair damaged asphaltic emulsion before placing concrete pavement.

40-3.03 PROPORTIONING

Proportion aggregate and bulk cementitious materials under Section 90-5, "Proportioning."

40-3.04 PLACING CONCRETE

40-3.04A General

Place concrete pavement with stationary side forms or slip-form paving equipment.

Place consecutive concrete loads within 30 minutes of each other. Construct a transverse construction joint when concrete placement is interrupted by more than 30 minutes. The transverse construction joint must coincide with the next contraction joint location, or you must remove fresh concrete pavement to the preceding transverse joint location.

Place concrete pavement in full slab widths separated by construction joints or monolithically in multiples of full lane widths with a longitudinal contraction joint at each traffic lane line.

Do not retemper concrete.

If the concrete pavement surface width is constructed as specified, you may construct concrete pavement sides on a batter not flatter than 6:1 (vertical:horizontal).

40-3.04B Concrete Pavement Widening

If concrete pavement is placed adjacent to existing pavement not constructed as part of the contract, grind the existing concrete pavement lane or shoulder adjacent to the new concrete pavement. Perform the grinding before new concrete pavement is placed. The new concrete pavement must match the elevation of the existing concrete pavement after grinding. Grind existing concrete pavement under Section 42-2, "Grinding," except profile index must comply with the pavement smoothness specifications in Section 40-1.03, "Quality Control and Assurance."

Use paving equipment with padded crawler tracks or rubber-tired wheels on the existing concrete pavement with enough offset to avoid breaking or cracking the existing concrete pavement's edge.

40-3.04C Concrete Pavement Transition Panel

For concrete pavement placed in a transition panel, texture the surface with a drag strip of burlap, a broom, or a spring steel tine device that produces scoring in the finished surface. The scoring must be either parallel with or transverse to the centerline. For the method you choose, texture at the time that produces the coarsest texture.

40-3.04D Stationary Side Form Construction

Stationary side forms must be straight and without defects including warps, bends, and indentations. Side forms must be metal except at end closures and transverse construction joints where other materials may be used.

You may build up side forms by attaching a section to the top or bottom. If attached to the top of metal forms, the attached section must be metal.

The side form's base width must be at least 80 percent of the specified concrete pavement thickness.

Side forms including interlocking connections with adjoining forms must be rigid enough to prevent springing from subgrading and paving equipment and concrete pressure.

Construct subgrade to final grade before placing side forms. Side forms must bear fully on the foundation throughout their length and base width. Place side forms to the specified grade and alignment of the finished concrete pavement's edge. Support side forms during concrete placing, compacting, and finishing.

After subgrade work is complete and immediately before placing concrete, true side forms and set to line and grade for a distance that avoids delays due to form adjustment.

Clean and oil side forms before each use.

Side forms must remain in place for at least 1 day after placing concrete and until the concrete pavement edge no longer requires protection from the forms.

Spread, screed, shape, and consolidate concrete with 1 or more machines. The machine must uniformly distribute and consolidate the concrete. The machines must operate to place the concrete pavement to the specified cross section with minimal hand work.

Consolidate the concrete without segregation. If vibrators are used:

1. The vibration rate must be at least 3,500 cycles per minute for surface vibrators and 5,000 cycles per minute for internal vibrators
2. Amplitude of vibration must cause perceptible concrete surface movement at least 1 foot from the vibrating element
3. Use a calibrated tachometer for measuring frequency of vibration
4. Vibrators must not rest on side forms or new concrete pavement
5. Power to vibrators must automatically cease when forward or backward motion of the paving machine is stopped

Use high-frequency internal vibrators within 15 minutes of depositing concrete on the subgrade to uniformly consolidate the concrete across the paving width including adjacent to forms. Do not use vibrators to shift the mass of concrete.

40-3.04E Slip-Form Construction

If slip-form construction is used, spread, screed, shape, and consolidate concrete to the specified cross section with slip-form machines and minimal hand work. Slip-form paving machines must be equipped with traveling side forms and must not segregate the concrete.

Do not deviate from the specified concrete pavement alignment by more than 0.1 foot.

Slip-form paving machines must use high frequency internal vibrators to consolidate concrete. You may mount vibrators with their axes parallel or normal to the concrete pavement alignment. If mounted with axes parallel to the concrete pavement alignment, space vibrators no more than 2.5 feet measured center to center. If mounted with axes normal to the concrete pavement alignment, space the vibrators with a maximum 0.5-foot lateral clearance between individual vibrators.

Each vibrator must have a vibration rate from 5,000 cycles per minute to 8,000 cycles per minute. The amplitude of vibration must cause perceptible concrete surface movement at least 1 foot from the vibrating element. Use a calibrated tachometer to measure frequency of vibration.

40-3.05 TIE BAR PLACEMENT

Place tie bars in compliance with the tolerances shown in the following table:

Tie Bar Tolerance

Dimension	Tolerance
Horizontal and vertical skew	10 degrees maximum
Longitudinal translation	±2 inch maximum
Horizontal offset (embedment)	±2 inch maximum
Vertical depth	1. Not less than 1/2 inch below the saw cut depth of joints 2. When measured at any point along the bar, not less than 2 inches clear of the pavement's surface and bottom

Install tie bars at longitudinal joints by 1 of the following methods:

1. Drill concrete and bond tie bars with chemical adhesive in compliance with the manufacturer's instructions. Clean and dry drilled holes before placing chemical adhesive and tie bars. After inserting tie bars into chemical adhesive, support the bars to prevent movement during curing. If the Engineer rejects a tie bar installation, cut the tie bar flush with the joint face and coat the exposed end of the tie bar with chemical adhesive under Section 40-2, "Materials." Offset new holes 3 inches horizontally from the rejected hole's center.
2. Insert tie bars into plastic slip-formed concrete before finishing. Inserted tie bars must have full contact between the bar and the concrete. If tie bars are inserted through the plastic concrete surface, eliminate evidence of the insertion by reworking the concrete over the tie bars.
3. Use threaded tie bar splice couplers fabricated from deformed bar reinforcement free of external welding or machining.
4. Use tie bar baskets. Anchor baskets at least 200 feet in advance of concrete pavement placement activity. If you request a waiver, describe the construction limitations or restricted access preventing the advanced anchoring. After the baskets are anchored and before paving, demonstrate the tie bars do not move from their specified depth and alignment during paving. Use fasteners to anchor tie bar baskets.

If tie bars are not placed correctly, stop paving activities until you demonstrate to the Engineer correction of the cause.

40-3.06 DOWEL BAR PLACEMENT

Center dowel bars within 2 inches in the longitudinal direction on transverse contraction joints or construction joints.

If using curing compound as lubricant, apply the curing compound to dowels in 2 separate applications. Lubricate each dowel bar entirely with bond breaker before placement. The last application must be applied not more than 8 hours before placing the dowel bars. Apply each curing compound application at a rate of 1 gallon per 150 square feet.

If dowel bars are placed by mechanical insertion, eliminate evidence of the insertion by reworking the concrete over the dowel bars. If drilling and bonding dowel bars at construction joints, use a grout retention ring.

If using dowel bar baskets, anchor them with fasteners.

Use at least 10 fasteners for basket sections greater than 12 feet and less than or equal to 16 feet. Baskets must be anchored at least 200 feet in advance of the concrete placement activity unless the Engineer approves your waiver request. If requesting a waiver, describe the construction limitations or restricted access preventing the advanced anchoring. After the baskets are anchored and before the concrete is placed, cut and remove temporary spacer wires and demonstrate the dowel bars do not move from their specified depth and alignment during concrete placement.

Place dowel bars in compliance with:

Dowel Bar Tolerances

Dimension	Tolerance
Horizontal offset	±1 inch
Longitudinal translation	±2 inches
Horizontal skew	3/8 inch, max
Vertical skew	3/8 inch, max
Vertical depth	<p>The minimum distance below the concrete pavement surface must be:</p> <p style="text-align: center;">$DB = d/3 + 1/2$ inch</p> <p>where: DB = vertical distance in inches, measured from concrete pavement surface to any point along the top of dowel bar d = concrete pavement thickness in inches</p> <p>The maximum distance below the depth shown must be 5/8 inch..</p>

If dowel bars are not placed correctly, stop paving activities until you demonstrate to the Engineer correction of the cause.

Remove and replace the concrete pavement 3 feet on either side of a joint with a rejected dowel bar.

40-3.07 BAR REINFORCEMENT

Place bar reinforcement under Section 52, "Reinforcement." Bar reinforcement must be more than 1/2 inch below the saw cut depth at concrete pavement joints.

40-3.08 JOINTS

40-3.08A General

Concrete pavement joints consist of:

1. Longitudinal and transverse construction joints
2. Longitudinal and transverse contraction joints
3. Isolation joints

Construction joints must be normal to the concrete pavement surface.

Until contract acceptance and except for joint filler material, keep joints free of foreign material including soil, gravel, concrete, or asphalt mix.

Volunteer cracks are cracks not coincident with constructed joints.

Repair concrete pavement damaged during joint construction under Section 40-3.17B, "Repair of Spalls, Raveling, and Tearing."

Do not bend tie bars or reinforcement in existing concrete pavement joints.

40-3.08B Construction Joints

Construction joints form where fresh concrete is placed against hardened concrete, existing pavements, or structures.

Before placing concrete at construction joints, apply a curing compound under Section 90-7.01B, "Curing Compound Method," to the vertical surface of existing or hardened concrete and allow it to dry.

Use a metal or wooden bulkhead to form transverse construction joints. If dowel bars are specified, the bulkhead must allow dowel bar installation.

40-3.08C Contraction Joints

In multilane monolithic concrete pavement, use the sawing method to construct longitudinal contraction joints. Construct transverse contraction joints by the sawing method.

Construct transverse contraction joints within 1 foot of their specified spacing. If a slab length of less than 5 feet would be formed, adjust the transverse contraction joint spacing.

Construct transverse contraction joints across the full concrete pavement width regardless of the number or types of longitudinal joints crossed. In areas of converging and diverging pavements, space transverse contraction joints so their alignment is continuous across the full width where converging and diverging pavements are contiguous. Longitudinal contraction joints must be parallel with the concrete pavement centerline. Transverse and longitudinal contraction joints must not deviate by more than 0.1 foot from either side of a 12-foot straight line, except for longitudinal joints parallel to a curving centerline.

40-3.08D Isolation Joints

Construct isolation joints by saw cutting a minimum 1/8-inch width to full concrete pavement depth at the existing concrete pavement's edge and removing the concrete to expose a flat vertical surface. Before placing concrete, secure joint filler material that prevents new concrete from adhering to the existing concrete face.

Dispose of concrete saw cutting residue under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."

40-3.08E Sawing Method

The sawing method is cutting a groove in the concrete pavement with a power driven concrete saw. Grooves for longitudinal and transverse contraction joints must be the minimum width possible for the type of saw used. If necessary, the top of the joint must be sawn wider to provide space for joint sealant. Immediately wash slurry from the joint with water under 100 psi maximum pressure.

Saw longitudinal and transverse contraction joints before volunteer cracking occurs and after the concrete is hard enough to saw without spalling, raveling, or tearing.

To keep foreign material out of grooves before joint sealant or compression seal installation, you may use joint filler in sawed contraction joints. Joint filler must not react adversely with the concrete or cause concrete pavement damage. After sawing and washing a joint, install joint filler material that keeps moisture in the adjacent concrete during the 72 hours after paving. If you install joint filler material, the specifications for spraying the sawed joint with additional curing compound under Section 40-3.13, "Curing," do not apply. If using absorptive filler material, moisten the filler immediately before or after installation.

40-3.09 JOINT SEALANT AND COMPRESSION SEAL INSTALLATION

40-3.09A General

At least 7 days after concrete pavement placement and not more than 4 hours before installing joint sealant or compression seal materials, use dry sand blasting and other methods to clean the joint walls of objectionable material such as soil, asphalt, curing compound, paint, and rust. The maximum sand blasting nozzle diameter must be 1/4 inch. The minimum pressure must be 90 psi. Sand blast each side of the joint at least once, in at least 2 separate passes. Hold the nozzle at an angle to the joint from 1 to 2 inches from the concrete pavement. Using a vacuum, collect sand, dust, and loose material at least 2 inches on each side of the joint. Remove surface moisture and dampness at the joints with compressed air that may be moderately hot.

Before you install joint sealant or compression seal, the joint wall must be free of moisture, residue, or film.

If grinding or grooving over or adjacent to sealed joints, remove joint sealant or compression seal materials and dispose of them under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way." After grinding or grooving, replace the joint sealant or compression seal materials.

40-3.09B Liquid Sealant

Do not install liquid sealant in construction joints.

Install backer rods when the concrete pavement temperature is above the air dew point and when the air temperature is at least 40 °F.

Install liquid sealant immediately after installing the backer rod. Install sealant using a mechanical device with a nozzle shaped to introduce the sealant from inside the joint. Extrude sealant evenly and with continuous contact with the joint walls. Recess the sealant surface after placement. Remove excess sealant from the concrete pavement surface.

Do not allow traffic over sealed joints until the sealant is set.

40-3.09C Preformed Compression Seal

Install preformed compression seal in construction or isolation joints when specified in the special provisions.

Install longitudinal seals before transverse seals. Longitudinal seals must be continuous except splicing is allowed at intersections with transverse seals. Transverse seals must be continuous for the entire transverse length of concrete pavement except splices are allowed for widenings and staged construction. With a sharp instrument, cut across the longitudinal seal at the intersection with transverse construction joints. If the longitudinal seal does not relax enough to properly install the transverse seal, trim the longitudinal seal to form a tight seal between the 2 joints.

If splicing is authorized, splicing must comply with the manufacturer's written instructions.

Use a machine specifically designed for preformed compression seal installation. The machine must install the seal:

1. To the specified depth
2. To make continuous contact with the joint walls
3. Without cutting, nicking, or twisting the seal
4. With less than 4 percent stretch

Lay a length of preformed compression seal material cut to the exact length of the pavement joint to be sealed. The Engineer measures this length. After you install the length of preformed compression joint sealant, the Engineer measures the excess amount of material at the joint end. The Engineer divides the excess amount length by the original measured length to determine the percentage of stretch.

40-3.10 SHOULDER RUMBLE STRIP

If specified, construct shoulder rumble strips by rolling or grinding indentations in new concrete pavement.

Select the method and equipment for constructing ground-in indentations.

Do not construct shoulder rumble strips on structures or approach slabs.

Construct rumble strips within 2 inches of the specified alignment. Roller or grinding equipment must be equipped with a sighting device enabling the operator to maintain the rumble strip alignment.

Indentations must not vary from the specified dimensions by more than 1/16 inch in depth or more than 10 percent in length and width.

The Engineer orders grinding or removal and replacement of noncompliant rumble strips to bring them within specified tolerances. Ground surface areas must be neat and uniform in appearance.

The grinding equipment must be equipped with a vacuum attachment to remove residue.

Dispose of removed material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way."

40-3.11 PRELIMINARY FINISHING

40-3.11A General

Preliminary finishing must produce a smooth and true-to-grade finish. After preliminary finishing, mark each day's concrete pavement with a stamp. The stamp must be approved by the Engineer before paving starts. The stamp must be approximately 1' x 2' in size. The stamp must form a uniform mark from 1/8 to 1/4 inch deep. Locate the mark 20 feet ± 5 feet from the transverse construction joint formed at each day's start of paving and 1 foot ± 0.25 foot from the concrete pavement's outside edge. The stamp mark must show the month, day, and year of placement and the station of the transverse construction joint. Orient the stamp mark so it can be read from the concrete pavement's outside edge.

Do not apply more water to the concrete pavement surface than can evaporate before float finishing and texturing are completed.

40-3.11B Stationary Side Form Finishing

If stationary side form construction is used, give the concrete a preliminary finish by the machine float method or the hand method.

If using the machine float method:

1. Use self-propelled machine floats.
2. Determine the number of machine floats required to perform the work at a rate equal to the concrete delivery rate. When the time from concrete placement to machine float finishing exceeds 30 minutes, stop concrete delivery. When machine floats are in proper position, you may resume concrete delivery and paving.
3. Machine floats must run on side forms or adjacent concrete pavement lanes. If running on adjacent concrete pavement, protect the adjacent concrete pavement surface under Section 40-3.15, "Protecting Concrete Pavement."
4. Floats must be hardwood, steel, or steel-shod wood. Floats must be equipped with devices that adjust the underside to a true flat surface.

If using the hand method, finish concrete smooth and true to grade with manually operated floats or powered finishing machines.

40-3.11C Slip-Form Finishing

If slip-form construction is used, the slip-form paver must give the concrete pavement a preliminary finish. You may supplement the slip-form paver with machine floats.

Before the concrete hardens, correct concrete pavement edge slump in excess of 0.02 foot exclusive of edge rounding.

40-3.12 FINAL FINISHING

After completing preliminary finishing, round the edges of the initial paving widths to a 0.04-foot radius. Round transverse and longitudinal construction joints to a 0.02-foot radius.

Before curing, texture the pavement. Perform initial texturing with a burlap drag or broom device that produces striations parallel to the centerline. Perform final texturing with a steel-tined device that produces grooves parallel with the centerline.

Construct longitudinal grooves with a self-propelled machine designed specifically for grooving and texturing concrete pavement. The machine must have tracks to maintain constant speed, provide traction, and maintain accurate tracking along the pavement surface. The machine must have a single row of rectangular spring steel tines. The tines must be from 3/32 to 1/8 inch wide, on 3/4-inch centers, and must have enough length, thickness, and resilience to form grooves approximately 3/16 inch wide. The machine must have horizontal and vertical controls. The machine must apply constant down pressure on the pavement surface during texturing. The machines must not cause ravel.

Construct grooves over the entire pavement width in a single pass except do not construct grooves 3 inches from the concrete pavement edges and longitudinal joints. Final texture must be uniform and smooth. Use a guide to properly align the grooves. Grooves must be parallel and aligned to the pavement edge across the pavement width. Grooves must be from 1/8 to 3/16 inch deep after concrete has hardened.

For irregular areas and areas inaccessible to the grooving machine, you may hand-construct grooves in compliance with the hand method under Section 40-3.11B, "Stationary Side Form Finishing." Hand-constructed grooves must comply with the specifications for machine-constructed grooves.

Initial and final texturing must produce a coefficient of friction of at least 0.30 when tested under California Test 342. Notify the Engineer when the concrete pavement is scheduled to be opened to traffic to allow at least 25 days for the Department to schedule for test for coefficient of friction. Notify the Engineer when the pavement is ready for testing which is the latter of:

1. Seven days after concrete placement
2. When the concrete pavement has attained a modulus of rupture of 550 psi

The Department tests for coefficient of friction within 7 days of receiving notification that the pavement is ready for testing.

Do not open the concrete pavement to traffic unless the coefficient of friction is at least 0.30.

Correct concrete pavement not complying with the Engineer's acceptance criteria for coefficient of friction by grooving or grinding under Section 42, "Groove and Grind Pavement."

Do not grind before:

1. Ten days after concrete pavement placement
2. Concrete has developed a modulus of rupture of at least 550 psi

Before opening to traffic, allow at least 25 days for the Department to retest sections for coefficient of friction after corrections are made.

40-3.13 CURING

Cure the concrete pavement's exposed area with waterproof membrane or curing compound (1) or (2) under Section 90-7.01, "Methods of Curing." When side forms are removed within 72 hours of the start of curing, also cure the concrete pavement edges.

If curing compound is used, apply it with mechanical sprayers. Reapply curing compound to sawcuts and disturbed areas.

40-3.14 EARLY USE OF CONCRETE PAVEMENT

If requesting early use of concrete pavement:

1. Furnish molds and machines for modulus of rupture testing
2. Sample concrete
3. Fabricate beam specimens
4. Test for modulus of rupture under California Test 523

When you request early use, concrete pavement must have a modulus of rupture of at least 350 psi. Protect concrete pavement under Section 40-3.15, "Protecting Concrete Pavement."

40-3.15 PROTECTING CONCRETE PAVEMENT

Protect concrete pavement under Section 90-8, "Protecting Concrete."

Maintain the concrete pavement temperature at not less than 40 °F for the initial 72 hours.

Protect the concrete pavement surface from activities that cause damage and reduce texture and coefficient of friction. Do not allow soil, gravel, petroleum products, concrete, or asphalt mixes on the concrete pavement surface.

Construct crossings for traffic convenience. If the Engineer approves your request, you may use rapid strength concrete for crossings. Do not open crossings until the Department determines by California Test 523 the concrete pavement's modulus of rupture is at least 550 psi.

Do not open concrete pavement to traffic or use equipment on the concrete pavement for 10 days after paving nor before the concrete has attained a modulus of rupture of 550 psi except:

1. If the equipment is for sawing contraction joints
2. If the Engineer approves your request, one side of paving equipment's tracks may be on the concrete pavement after a modulus of rupture of 350 psi has been attained, provided:
 - 2.1. Unit pressure exerted on the concrete pavement by the paver does not exceed 20 psi
 - 2.2. You change the paving equipment tracks to prevent damage or the paving equipment tracks travel on protective material such as planks
 - 2.3. No part of the track is closer than 1 foot from the concrete pavement's edge

If concrete pavement damage including visible cracking occurs, stop operating paving equipment on the concrete pavement and repair the damage.

40-3.16 OBTAINING DRILLED CORES

Drill concrete pavement cores under ASTM C 42/ C 42M. Core drilling equipment must use diamond impregnated bits.

Clean, dry, and fill core holes with hydraulic cement grout (non-shrink) or pavement concrete. Coat the core hole walls with epoxy under the specifications for epoxy adhesive for bonding new concrete to old concrete in Section 95, "Epoxy." The backfill must match the adjacent concrete pavement surface elevation and texture.

Do not allow residue from core drilling to fall on traffic, flow across shoulders or lanes occupied by traffic, or flow into drainage facilities including gutters.

40-3.17 REPAIR, REMOVAL, AND REPLACEMENT

40-3.17A General

Working cracks are full-depth cracks essentially parallel to a planned contraction joint beneath which a contraction crack has not formed. If the Engineer orders, take 4-inch nominal diameter cores on designated cracks under Section 40-3.16, "Obtaining Drilled Cores."

40-3.17B Repair of Spalls, Raveling, and Tearing

Before concrete pavement is open to traffic, repair spalls, raveling, and tearing in sawed joints. Make repairs in compliance with the following:

1. Saw a rectangular area with a diamond-impregnated blade at least 2 inches deep.
2. Remove unsound and damaged concrete between the saw cut and the joint and to the saw cut's depth. Do not use a pneumatic hammer heavier than 15 pounds. Do not damage concrete pavement to remain in place.
3. Dispose of removed concrete pavement under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."
4. Clean the repair area's exposed surfaces with high pressure abrasive water blasting. Further clean and dry the exposed surfaces with compressed air free of moisture and oil.
5. Apply epoxy as specified for epoxy resin adhesive for bonding new concrete to old concrete under Section 95, "Epoxy." Apply the epoxy with a stiff bristle brush.
6. Apply a portland cement concrete or mortar patch immediately following the epoxy application. Install an insert to prevent bonding of the sides of planned joints.

Repair spalls if they are:

1. Deeper than 0.05 foot
2. Wider than 0.04 foot
3. Longer than 0.3 foot

40-3.17C Route and Seal Working Cracks

Treat working cracks within 0.5 foot of either side of a planned contraction joint in compliance with the following:

1. Route and seal the crack with epoxy resin in compliance with the following:
 - 1.1. Use a powered rotary router mounted on wheels, with a vertical shaft and a routing spindle that casters as it moves along the crack
 - 1.2. Form a reservoir 3/4 inch deep by 3/8 inch wide in the crack
 - 1.3. Use equipment that does not cause raveling or spalling
 - 1.4. Place liquid sealant
2. Treat the contraction joint adjacent to the working crack in compliance with the following:
 - 2.1. Use epoxy resin under ASTM C 881/C 881M, Type IV, Grade 2 for Type B joints and secondary saw cuts for Type A1 and Type A2 joints
 - 2.2. Pressure inject epoxy resin under ASTM C 881/C881M, Type IV, Grade 1 for narrow saw cuts including initial saw cuts for Type A1 and Type A2 joints

If a working crack intersects a contraction joint, route and seal the working crack and seal the contraction joint as specified for installing liquid sealant under Section 40-3.09, "Joint Seal and Joint Sealant Installation."

40-3.17D Removal and Replacement of Slabs

As specified, remove and replace slabs or partial slabs for:

1. Insufficient thickness
2. Dowel bar misalignment
3. Working cracks more than 0.5 foot from a planned contraction joint

40-4 MEASUREMENT AND PAYMENT

40-4.01 MEASUREMENT

Concrete pavement is measured by the cubic yard. The Engineer calculates the pay quantity volume based on the dimensions shown on the plans and as ordered.

The contract items for sealing joints as designated in the Verified Bid Item List are measured by the linear foot. Sealing joints are measured from field measurements for each type of sealed joint.

The contract item for shoulder rumble strips is measured by the station along each shoulder on which the rumble strips are constructed without deductions for gaps between indentations.

40-4.02 PAYMENT

The contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the concrete pavement, complete in place including bar reinforcement, tie bars, dowel bars, anchors, fasteners, tack coat, and providing the facility for and attending the prepaving conference, as shown on the plans and as specified in these specifications and the special provisions, and as directed by the Engineer.

The Engineer adjusts payment for each primary area deficient in average thickness in compliance with the following:

Average Thickness Deficiency (foot)	Deficiency Adjustment (\$/sq yd)
0.01	0.90
0.02	2.30
0.03	4.10
0.04	6.40
0.05	9.11

If the average thickness deficiency is less than 0.01 foot, the Engineer does not adjust payment for thickness deficiency. If the average thickness deficiency is more than 0.01 foot, the Engineer rounds to the nearest 0.01 foot and uses the adjustment table.

Full compensation for core drilling and backfilling the cores ordered by the Engineer for measuring concrete pavement thickness and determining full-depth cracks is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no additional compensation will be allowed therefor. The Department does not pay for additional concrete pavement thickness measurements requested by the Contractor.

The Department does not pay for the portion of concrete that penetrates treated permeable base.

Full compensation for the quality control plan is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for furnishing and applying asphaltic emulsion on cement treated permeable base is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no separate payment will be made therefor.

Full compensation for repairing joints is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for furnishing, calibrating, and operating profilograph equipment for Profile Index, for submitting profilograms, and for performing corrective work is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for grooving and grinding for final finishing is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for removing and replacing joint material for grooving and grinding is included in the contract price per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for removing and replacing slabs is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for drilling holes and bonding tie bars with chemical adhesive is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

Full compensation for repairing damage caused by operating paving equipment on new concrete pavement is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

The material and work necessary for the construction of crossings for public convenience, and their subsequent removal and disposal, will be paid for at the contract prices for the items of work involved and if there are no contract items for the work involved, payment for concrete pavement crossings will be made by extra work as specified in Section 4-1.03D, "Extra Work."

The Department will reduce payments to the Contractor by \$56.12 per square yard for concrete pavement slabs allowed to remain in place represented by cores indicating dowel bars placed with their centers from ±2 inches to ±3 inches from the saw cut of a transverse contraction joint

The Engineer will calculate the reduced payment using the slab dimensions adjacent to and inclusive of the joints with misplaced dowel bars. This reduced payment is in addition to other specified payment reductions.

The Department will reduce payments to the Contractor by \$59.56 per square yard for concrete pavement allowed to remain in place represented by cores indicating either of the following:

1. Tie bars placed outside their specified placement and position tolerances
2. Bar reinforcement placed outside their specified placement and position tolerances

The Engineer will calculate the reduced payment using the slab dimensions adjacent to and inclusive of the joints with misplaced tie bars. This reduced payment is in addition to other specified payment reductions.

Full compensation for core drilling for checking dowel or tie bar alignment and backfilling the cores is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

If the initial cores show that dowel bars or tie bars are out of tolerance for alignment and the Engineer orders additional dowel or tie bar coring, full compensation for drilling the additional cores is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

If the initial cores show that dowel bars or tie bars are within alignment tolerances and the Engineer orders more dowel or tie bar coring, the additional cores will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The Department will not pay for additional coring to check dowel or tie bar alignment you request.

Full compensation for performing profilograph tests, furnishing the profilograms and electronic files to the Engineer, and for performing corrective work is included in the contract price paid per cubic yard for the type of concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

The contract prices paid per linear foot for seal pavement joint and seal isolation joint include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in sealing pavement joints and sealing isolation joints, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per station for shoulder rumble strip includes full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the rumble strip complete in place, as shown on the plans, as specified in these Standard Specifications and as directed by the Engineer.

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SECTION 41 PAVEMENT SUBSEALING AND JACKING

(Issued 01-05-07)

In Section 41-1.02 replace the 2nd and 3rd paragraphs with:

Cement for grout shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

Fly ash shall conform to the requirements in AASHTO Designation: M 295 for either Class C or for Class F. The brand of fly ash used in the work shall conform to the provisions for approval of admixture brands in Section 90-4.03, "Admixture Approval."

In Section 50-1.05 in the 3rd paragraph, replace item E with:

- E. In addition to the requirements in Section 50-1.10, "Samples for Testing," four 4-foot-long samples of coated strand and one 5-foot-long sample of uncoated strand of each size and reel shall be furnished to the Engineer for testing. These samples, as selected by the Engineer, shall be representative of the material to be used in the work.

In Section 50-1.05 between the 3rd and 4th paragraphs, add:

The Contractor shall furnish to the Transportation Laboratory a representative 8-ounce sample from each batch of epoxy patching material to be used. Each sample shall be packaged in an airtight container identified with the manufacturer's name and batch number.

In Section 50-1.07 replace the 2nd paragraph with:

Ducts shall be fabricated with either welded or interlocked seams. Galvanizing of the welded seam will not be required. Ducts shall have sufficient strength to maintain their correct alignment during placing of concrete. Joints between sections of duct shall be positive metallic connections which do not result in angle changes at the joints. Waterproof tape shall be used at the connections. Ducts shall be bent without crimping or flattening. Transition couplings connecting the ducts to anchoring devices shall be either ferrous metal or polyolefin. Ferrous metal transition couplings need not be galvanized.

Ducts shall have an inside cross-sectional area of at least:

1. 2.5 times the net area of the prestressing steel for multistrand tendons that will be placed by the pull-through method.
2. 2.0 times the net area of the prestressing steel for multistrand tendons that will not be placed by the pull-through method.

Ducts shall have an outside diameter not exceeding 50 percent of the girder web width.

In Section 50-1.07 replace the 7th paragraph with:

All ducts having a vertical duct profile change of 6 inches or more shall be vented. Vents shall be placed within 6 feet of every high point in the duct profile. Vents shall be 1/2 inch minimum diameter standard pipe or suitable plastic pipe. Connections to ducts shall be made with metallic or plastic structural fasteners. Plastic components, if selected, shall not react with the concrete or enhance corrosion of the prestressing steel and shall be free of water soluble chlorides. The vents shall be mortar tight, taped as necessary, and shall provide means for injection of grout through the vents and for sealing the vents. Ends of vents shall be removed one inch below the roadway surface after grouting has been completed.

In Section 50-1.08 replace the 2nd paragraph with:

The maximum temporary tensile stress (jacking stress) in prestressing steel of post-tensioned members shall not exceed 75 percent of the specified minimum ultimate tensile strength of the prestressing steel.

In Section 50-1.08 delete the 4th, 5th, and 6th paragraphs.

In Section 50-1.08 replace the 11th paragraph with:

Prestressing forces shall not be applied to cast-in-place concrete until at least 10 days after the last concrete has been placed in the member to be prestressed and until the concrete compressive strength has reached the strength shown on the plans or specified in the specifications.

In Section 50-1.08 replace the 15th paragraph with:

When prestressing steel in pretensioned members is tensioned at a temperature appreciably lower than the estimated temperature of the concrete and the prestressing steel at the time of initial set of the concrete, the calculated elongation of the prestressing steel shall be increased to compensate for the loss in stress.

The maximum temporary tensile stress in the prestressing steel of pretensioned members shall not exceed 80 percent of the specified minimum ultimate tensile strength of the prestressing steel.

Pretensioned prestressing steel shall be anchored at stresses that will result in the ultimate retention of working forces at not less than those shown on the plans.

In Section 51-1.12D replace the 4th paragraph with:

Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a minimum flexural strength of 35 psi determined in conformance with the requirements in ASTM Designation: C 203 and a compressive yield strength of between 16 and 40 psi at 5 percent compression. Surfaces of expanded polystyrene against which concrete is placed shall be faced with hardboard. Hardboard shall be 1/8 inch minimum thickness, conforming to ANSI A135.4, any class. Other facing materials may be used provided they furnish equivalent protection. Boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

In Section 51-1.12F replace the 3rd paragraph with:

Type A and AL joint seals shall consist of a groove in the concrete that is filled with field-mixed silicone sealant.

In Section 51-1.12F in the 6th paragraph, replace the table with:

Movement Rating (MR)	Seal Type
MR ≤ 1 inch	Type A or Type B
1 inch < MR ≤ 2 inches	Type B
2 inches < MR ≤ 4 inches	Joint Seal Assembly (Strip Seal)
MR > 4 inches	Joint Seal Assembly (Modular Unit) or Seismic Joint

In Section 51-1.12F(3)(a) replace the 1st and 2nd paragraphs with:

The sealant must consist of a 2-component silicone sealant that will withstand up to ±50 percent movement. Silicone sealants must be tested under California Test 435 and must comply with the following:

Specification	Requirement
Modulus at 150 percent elongation	8-75 psi
Recovery	21/32 inch max.
Notch Test	Notched or loss of bond 1/4 inch, max.
Water Resistance	Notched or loss of bond 1/4 inch, max.
Ultraviolet Exposure ASTM Designation: G 154, Table X2.1, Cycle 2.	No more than slight checking or cracking.
Cone Penetration	4.5-12.0 mm

In Section 51-1.12F(3)(a) delete the 3rd and 8th paragraphs.

In Section 51-1.12F(3)(a) replace the 10th paragraph with:

A Certificate of Compliance accompanied by a certified test report must be furnished for each batch of silicone sealant in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

In Section 51-1.12F(3)(b) replace the 2nd paragraph with:

The preformed elastomeric joint seal must conform to the requirements in ASTM D 2628 and the following:

1. The seal must consist of a multichannel, nonporous, homogeneous material furnished in a finished extruded form.
2. The minimum depth of the seal measured at the contact surface must be at least 95 percent of the minimum uncompressed width of the seal as designated by the manufacturer.
3. When tested in conformance with the requirements in California Test 673 for Type B seals, joint seals must provide a movement rating (MR) of not less than that shown on the plans.

4. The top and bottom edges of the joint seal must maintain continuous contact with the sides of the groove over the entire range of joint movement.
5. The seal must be furnished full length for each joint with no more than 1 shop splice in any 60-foot length of seal.
6. The Contractor must demonstrate the adequacy of the procedures to be used in the work before installing seals in the joints.
7. One field splice per joint may be made at locations and by methods approved by the Engineer. The seals are to be manufactured full length for the intended joint, then cut at the approved splice section and rematched before splicing. The Contractor must submit splicing details prepared by the joint seal manufacturer for approval before beginning splicing work.
8. Shop splices and field splices must have no visible offset of exterior surfaces and must show no evidence of bond failure.
9. At all open ends of the seal that would admit water or debris, each cell must be filled to a depth of 3 inches with commercial quality open cell polyurethane foam or closed by other means subject to approval by the Engineer.

In Section 51-1.12F(3)(b) replace the 7th paragraph with:

The joint seal must be installed full length for each joint with equipment that does not twist or distort the seal, elongate the seal longitudinally, or otherwise cause damage to the seal or to the concrete forming the groove.

In Section 51-1.12F(3)(b) in the 11th paragraph, replace the 1st sentence with:

Samples of the prefabricated joint seals, not less than 3 feet in length, will be taken by the Engineer from each lot of material.

In Section 51-1.12H(1) in the 6th paragraph, replace the 4th and 5th sentences with:

Each ply of fabric shall have a breaking strength of not less than 800 pounds per inch of width in each thread direction when 3" x 36" samples are tested on split drum grips. The bond between double plies shall have a minimum peel strength of 20 pounds per inch.

In Section 51-1.12H(1) in the 8th paragraph in the table, replace the hardness (Type A) requirements with:

Hardness (Type A)	D 2240 with 2kg mass.	55 ±5
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In Section 51-1.12H(2) in the 1st paragraph in item A, replace the 1st and 2nd sentences with:

The bearings shall consist of alternating steel laminates and internal elastomer laminates with top and bottom elastomer covers. Steel laminates shall have a nominal thickness of 0.075 inch (14 gage).

In Section 51-1.13 replace the 2nd, 3rd, and 4th paragraphs with:

Surfaces of fresh concrete at horizontal construction joints shall be thoroughly consolidated without completely removing surface irregularities. Additionally, surfaces of fresh concrete at horizontal construction joints between girder stems and decks shall be roughened to at least a 1/4-inch amplitude.

Construction joint surfaces shall be cleaned of surface laitance, curing compound, and other foreign materials using abrasive blast methods before fresh concrete is placed against the joint surface.

Construction joint surfaces shall be flushed with water and allowed to dry to a surface dry condition immediately before placing concrete.

In Section 51-1.135 replace the 1st paragraph with:

Mortar shall be composed of cementitious material, sand, and water proportioned and mixed as specified in this Section 51-1.135.

In Section 51-1.135 replace the 3rd paragraph with:

The proportion of cementitious material to sand, measured by volume, shall be 1 to 2 unless otherwise specified.

In Section 51-1.17 in 4th paragraph, replace the 3rd sentence with:

The surfaces shall have a profile trace showing no high points in excess of 0.25 inch, and the portions of the surfaces within the traveled way shall have a profile count of 5 or less in any 100 foot section.

Add:

51-1.17A Deck Crack Treatment

The Contractor shall use all means necessary to minimize the development of shrinkage cracks.

The Contractor shall remove all equipment and materials from the deck and clean the surface as necessary for the Engineer to measure the surface crack intensity. Surface crack intensity will be determined by the Engineer after completion of concrete cure, before prestressing, and before the release of falsework. In any 500 square foot portion of deck within the limits of the new concrete deck, should the intensity of cracking be such that there are more than 50 feet of cracks whose width at any location exceeds 0.02 inch, the deck shall be treated with a high molecular weight methacrylate (HMWM) resin system. The area of deck to be treated shall have a width that extends for the entire width of new deck inside the concrete barriers and a length that extends at least 5 feet beyond the furthest single continuous crack outside the 500 square foot portion, measured from where that crack exceeds 0.02 inch in width, as determined by the Engineer.

Deck crack treatment shall include furnishing, testing, and applying the HMWM resin system, with sand and absorbent material. If grinding is required, deck crack treatment shall take place before grinding.

51-1.17A(1) Submittals

Submit a HMWM resin system placement plan. When HMWM resin is to be applied within 100 feet of a residence, business, or public space including sidewalks under a structure, also submit a public safety plan. Submit plans under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The review time is 15 days.

The HMWM resin system placement plan must include:

1. Schedule of work and testing for each bridge
2. Description of equipment for applying HMWM resin
3. Range of gel time and final cure time for HMWM resin
4. Absorbent material to be used
5. Description of equipment for applying and removing excess sand and absorbent material
6. Procedure for removing HMWM resin from the deck, including equipment
7. Storage and handling of HMWM resin components and absorbent material
8. Disposal of excess HMWM resin and containers

The public safety plan must include:

1. A public notification letter with a list of delivery and posting addresses. The letter must state HMWM resin work locations, dates, times, and what to expect. Deliver the letter to residences and businesses within 100 feet of HMWM resin work locations and to local fire and police officials at least 7 days before starting work. Post the letter at the job site.
2. An airborne emissions monitoring plan prepared and executed by a certified industrial hygienist (CIH) certified in comprehensive practice by the American Board of Industrial Hygiene. The plan must have at least 4 monitoring points including the mixing point, application point, and point of nearest public contact. Monitor airborne emissions during HMWM resin work and submit emissions monitoring results after completing the work.
3. An action plan for protection of the public when airborne emissions levels exceed permissible levels.
4. A copy of the CIH's certification.

If the measures proposed in the safety plan are inadequate to provide for public safety associated with the use of HMWM resin, the Engineer will reject the plan and direct the Contractor to revise the plan. Directions for revisions will be in writing and include detailed comments. The Engineer will notify the Contractor of the approval or rejection of a submitted or revised plan within 15 days of receipt of that plan.

51-1.17A(2) Quality Control and Assurance

Submit samples of HMWM resin components 15 days before use under Section 6-3, "Testing," of the Standard Specifications. Notify the Engineer 15 days before delivery of HMWM resin components in containers over 55 gallons to the job site.

Complete a test area before starting work. Results from airborne emissions monitoring of the test area must be submitted to the Engineer before starting production work.

The test area must:

1. Be approximately 500 square feet
2. Be placed within the project limits outside the traveled way at an approved location
3. Be constructed using the same equipment as the production work
4. Replicate field conditions for the production work
5. Demonstrate proposed means and methods meet the acceptance criteria
6. Demonstrate production work will be completed within the time allowed
7. Demonstrate suitability of the airborne emissions monitoring plan

The test area will be acceptable if:

1. The treated deck surface is tack free and non-oily
2. The sand cover adheres and resists brushing by hand
3. Excess sand and absorbent material has been removed
4. The coefficient of friction is at least 0.35 when tested under California Test 342

51-1.17A(3) Materials

HMWM resin system consists of a resin, promoter, and initiator. HMWM resin must be low odor and comply with the following:

HMWM Resin		
Property	Requirement	Test Method
Volatile Content *	30 percent, maximum	ASTM D 2369
Viscosity *	25 cP, maximum, (Brookfield RVT with UL adaptor, 50 RPM at 77°F)	ASTM D 2196
Specific Gravity *	0.90 minimum, at 77°F	ASTM D 1475
Flash Point *	180°F, minimum	ASTM D 3278
Vapor Pressure *	1.0 mm Hg, maximum, at 77°F	ASTM D 323
Tack-free Time	400 minutes, maximum, at 25°C	Specimens prepared per California Test 551
PCC Saturated Surface-Dry Bond Strength	3.5 MPa, minimum at 24 hours and 21 ± 1°C	California Test 551

* Test must be performed before adding initiator.

Sand for abrasive sand finish must:

1. Be commercial quality dry blast sand
2. Have at least 95 percent pass the No. 8 sieve and at least 95 percent retained on the No. 20 sieve when tested under California Test 205

Absorbent material must be diatomaceous earth, abrasive blast dust, or substitute recommended by the HMWM resin supplier and approved by the Engineer.

51-1.17A(4) Construction

HMWM resin system applied by machine must be:

SECTION 52 REINFORCEMENT

(Issued 06-05-09)

In Section 52-1.02(B) between the 3rd and 4th paragraphs, add:

The epoxy powder coating shall be selected from the Department's Pre-Qualified Products List.

In Section 52-1.02(B) replace the 14th paragraph with:

Except for lap splices, splices for epoxy-coated reinforcement shall be coated with a corrosion protection covering that is selected from the Department's Pre-Qualified Products List. The covering shall be installed in accordance with the manufacturer's recommendations.

In Section 52-1.07 in the 11th paragraph, replace the table with:

Height Zone (H) (Feet above ground)	Wind Pressure Value (psf)
$H \leq 30$	20
$30 < H \leq 50$	25
$50 < H \leq 100$	30
$H > 100$	35

In Section 52-1.08B(1) replace the 1st paragraph with:

Mechanical splices to be used in the work shall be selected from the Department's Pre-Qualified Products List.

In Section 52-1.08B(1) in the 2nd paragraph, replace the table with:

Reinforcing Bar Number	Total Slip
4	0.020-inch
5	0.020-inch
6	0.020-inch
7	0.028-inch
8	0.028-inch
9	0.028-inch
10	0.036-inch
11	0.036-inch
14	0.048-inch
18	0.060-inch

In Section 52-1.08B(1), in the 6th paragraph, delete item C.

In Section 52-1.08B(2) in the 6th paragraph, replace the subparagraph with:

The minimum preheat and interpass temperatures shall be 400° F for Grade 40 bars and 600° F for Grade 60 bars. Immediately after completing the welding, at least 6 inches of the bar on each side of the splice shall be covered by an insulated wrapping to control the rate of cooling. The insulated wrapping shall remain in place until the bar has cooled below 200° F.

Replace Section 52-1.08B(3) with:

52-1.08B(3) Resistance Butt Welds

Shop produced resistance butt welds shall be produced by a fabricator who is selected from the Department's Pre-Qualified Products List.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished for each shipment of splice material. The Certificate of Compliance shall include heat number, lot number and mill certificates.

In Section 52-1.08C replace the 3rd paragraph with:

Testing on prequalification and production sample splices shall be performed at an approved independent testing laboratory. The laboratory shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors who will provide other services or materials for the project.

The independent testing laboratory shall be selected from the Department's Pre-Qualified Products List.

In Section 52-1.08C replace the 5th paragraph with:

Prequalification and production sample splices and testing shall conform to California Test 670 and these specifications.

In Section 52-1.08C delete the 6th paragraph.

In Section 52-1.08C replace the 8th paragraph with:

Each sample splice, as defined herein, shall be identified as representing either a prequalification or production test sample splice.

In Section 52-1.08C in the 10th paragraph, delete the last sentence.

Replace Section 52-1.08C(1) with:

52-1.08C(1) Splice Prequalification Report

Before using any service splices or ultimate butt splices in the work, the Contractor shall submit a Splice Prequalification Report. The report shall include the following:

- A. A copy of the manufacturer's product literature giving complete data on the splice material and installation procedures.
- B. Names of the operators who will be performing the splicing.
- C. Descriptions of the positions, locations, equipment, and procedures that will be used in the work.
- D. Certifications from the fabricator for prequalification of operators and procedures based on sample tests performed no more than 2 years before submitting the report. Each operator shall be certified by performing 2 sample splices for each bar size of each splice type that the operator will be performing in the work. For deformation-dependent types of splice devices, each operator shall be certified by performing 2 additional samples for each bar size and deformation pattern that will be used in the work.

Prequalification sample splices shall be tested by an approved independent testing laboratory and shall conform to the appropriate production test criteria and slip requirements specified herein. When epoxy-coated reinforcement is required, resistance butt welded sample splices shall have the weld flash removed by the same procedure as will be used in the work, before coating and testing. The Splice Prequalification Report shall include the certified test results for all prequalification sample splices.

The QCM shall review and approve the Splice Prequalification Report before submitting it to the Engineer for approval. The Contractor shall allow 2 weeks for the review and approval of a complete report before performing any service splicing or ultimate butt splicing in the work.

In Section 52-1.08C(2)(a) replace the 1st, 2nd, 3rd, 4th, and 5th paragraphs with:

Production tests shall be performed by an approved independent testing laboratory for all service splices used in the work. A production test shall consist of testing 4 sample splices prepared for each lot of completed splices. The samples shall be prepared by the Contractor using the same splice material, position, operators, location, and equipment, and following the same procedure as used in the work.

At least one week before testing, the Contractor shall notify the Engineer in writing of the date and location where the testing of the samples will be performed.

The 4 samples from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the approved independent testing laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 samples of splices shall not be tested.

Before performing any tensile tests on production test sample splices, one of the 4 samples shall be tested for, and shall conform to, the requirements for total slip in Section 52-1.08B(1), "Mechanical Splices." Should this sample not meet the total slip requirements, one retest, in which the 3 remaining samples are tested for total slip, will be allowed. Should any of the 3 remaining samples not conform to the total slip requirements, all splices in the lot represented by this production test will be rejected.

If 3 or more sample splices from a production test conform to the provisions in this Section 52-1.08C(2), "Service Splice Test Criteria," all splices in the lot represented by this production test will be considered acceptable.

Replace Section 52-1.08C(2)(b) with:

52-1.08C(2)(b) Quality Assurance Test Requirements for Service Splices

In addition to the required production tests, the Contractor shall concurrently prepare 4 service quality assurance sample splices for:

- A. The first production test performed.
- B. One of every 5 subsequent production tests, or fraction thereof, randomly selected by the Engineer.

These service quality assurance sample splices shall be prepared in the same manner as specified herein for service production sample splices.

The service quality assurance sample splices shall be shipped to the Transportation Laboratory for quality assurance testing. Each set of 4 sample splices shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 samples of splices will not be tested. Sample splices not accompanied by the supporting documentation required in Section 52-1.08B(1), "Mechanical Splices," for mechanical splices, or in Section 52-1.08B(3), "Resistance Butt Welds," for resistance butt welds, will not be tested.

Quality assurance testing will be performed in conformance with the requirements for service production sample splices in Section 52-1.08C(2)(a), "Production Test Requirements for Service Splices."

Replace Section 52-1.08C(3) with:

52-1.08C(3) Ultimate Butt Splice Test Criteria

Ultimate production and quality assurance sample splices shall be tensile tested in conformance with the requirements described in ASTM Designation: A 370 and California Test 670.

Each sample splice shall be identified as representing a prequalification, production, or quality assurance sample splice.

The portion of hoop reinforcing bar, removed to obtain a sample splice, shall be replaced using a prequalified ultimate mechanical butt splice, or the hoop shall be replaced in kind.

Reinforcing bars, other than hoops, from which sample splices are removed, shall be repaired using ultimate mechanical butt splices conforming to the provisions in Section 52-1.08C(1), "Splice Prequalification Report," or the bars shall be replaced in kind. These bars shall be repaired or replaced such that no splices are located in any "No Splice Zone" shown on the plans.

Ultimate production and quality assurance sample splices shall rupture either: 1) in the reinforcing bar but outside of the affected zone, provided that the sample splice has visible necking or 2) anywhere, provided that the sample splice has achieved the strain requirement for necking.

When tested in conformance with the requirements in California Test 670, "Necking (Option I)," the visible necking shall be such that there is a visible decrease in the sample's cross-sectional area at the point of rupture.

When tested in conformance with the requirements in California Test 670, "Necking (Option II)," the strain requirement for necking shall be such that the largest measured strain is not less than 6 percent for No. 11 and larger bars, or not less than 9 percent for No. 10 and smaller bars.

The affected zone is the portion of the reinforcing bar where any properties of the bar, including the physical, metallurgical, or material characteristics, have been altered by fabrication or installation of the splice. The weld and one inch adjacent to the weld will be considered part of the affected zone.

In Section 52-1.08C(3)(a) replace the 1st paragraph with:

Production tests shall be performed for all ultimate butt splices used in the work. A production test shall consist of testing 4 sample splices removed from each lot of completed splices.

In Section 52-1.08C(3)(a) replace the 3rd paragraph with:

After notification has been received, the Engineer will randomly select the 4 sample splices to be removed from the lot and place tamper-proof markings or seals on them. These ultimate production sample splices shall be removed by the Contractor, and tested by an approved independent testing laboratory.

In Section 52-1.08(C)(3)(a) replace the 5th, 6th, and 7th paragraphs with:

A sample splice will be rejected if a tamper-proof marking or seal is disturbed before testing.

The 4 sample splices from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the approved independent testing laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 sample splices shall not be tested.

Before performing any tensile tests on production test sample splices, one of the 4 sample splices shall be tested for, and shall conform to, the requirements for total slip in Section 52-1.08B(1), "Mechanical Splices." Should this sample splice not meet these requirements, one retest, in which the 3 remaining sample splices are tested for total slip, will be allowed. Should any of the 3 remaining sample splices not conform to these requirements, all splices in the lot represented by this production test will be rejected.

Replace Section 52-1.08C(3)(b) with:

52-1.08C(3)(b) Quality Assurance Test Requirements for Ultimate Butt Splices

In addition to the required production tests, the Contractor shall concurrently prepare 4 ultimate quality assurance sample splices for:

- A. The first production test performed.
- B. One of every 5 subsequent production tests, or fraction thereof, randomly selected by the Engineer.

These ultimate quality assurance sample splices shall be prepared in the same manner as specified herein for ultimate production sample splices.

The ultimate quality assurance sample splices shall be shipped to the Transportation Laboratory for quality assurance testing. Each set of 4 sample splices shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 samples of splices will not be tested. Sample splices not accompanied by the supporting documentation required in Section 52-1.08B(1), "Mechanical Splices," for mechanical splices, or in Section 52-1.08B(3), "Resistance Butt Welds," for resistance butt welds, will not be tested.

Quality assurance testing will be performed in conformance with the requirements for ultimate production sample splices in Section 52-1.08C(3)(a), "Production Test Requirements for Ultimate Butt Splices."

Replace Section 52-1.08D with:

A Production Test Report for all testing performed on each lot shall be prepared by the approved independent testing laboratory performing the testing and submitted to the QCM for review and approval. The report shall be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California. The report shall include, as a minimum, the following information for each test: contract number, bridge number, lot number and location, bar size, type of splice, length of mechanical splice, length of test specimen, physical condition of test sample splice, any notable defects, total measured slip, and ultimate tensile strength of each splice. In addition, the report shall include location of visible necking area and largest measured strain for ultimate butt splices.

The QCM must review, approve, and forward each Production Test Report to the Engineer for review before the splices represented by the report are encased in concrete. The Engineer will have 3 working days to review each Production Test Report and respond in writing after a complete report has been received. Should the Contractor elect to encase any splices before receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

Quality assurance test results for each bundle of 4 samples of splices will be reported in writing to the Contractor within 3 working days after receipt of the bundle by the Transportation Laboratory. In the event that more than one bundle is received on the same day, 2 additional working days shall be allowed for providing test results for each additional bundle received. A test report will be made for each bundle received. Should the Contractor elect to encase splices before receiving notification from the Engineer, it is expressly understood that the

In Section 55-2.01 replace the Structural Steel Materials table with:

Structural Steel Materials

Material	Specification
Structural steel:	
Carbon steel	ASTM: A 709/A 709M, Grade 36 or {A 36/A 36M} ^a
High strength low alloy columbium vanadium steel	ASTM: A 709/A 709M, Grade 50 or {A 572/A 572M, Grade 50} ^a
High strength low alloy structural steel	ASTM: A 709/A 709M, Grade 50W, Grade HPS 50W, or {A 588/A 588M} ^a
High strength low alloy structural steel plate	ASTM: A 709/A 709M, Grade HPS 70W
High-yield strength, quenched and tempered alloy steel plate suitable for welding	ASTM: A 709/A 709M, Grade 100 and Grade 100W, or {A 514/A 514M} ^a
Steel fastener components for general applications:	
Bolts and studs	ASTM: A 307
Anchor bolts	ASTM: F 1554 or A 307, Grade C
High-strength bolts and studs	ASTM: A 449, Type 1
High-strength threaded rods	ASTM: A 449, Type 1
High-strength nonheaded anchor bolts	ASTM: F 1554, Grade 105, Class 2A
Nuts	ASTM: A 563, including Appendix X1 ^b
Washers	ASTM: F 844
Components of high-strength steel fastener assemblies for use in structural steel joints:	
Bolts	ASTM: A 325, Type 1
Tension control bolts	ASTM: F 1852, Type 1
Nuts	ASTM: A 563, including Appendix X1 ^b
Hardened washers	ASTM : F 436, Type 1, Circular, including S1 supplementary requirements
Direct tension indicators	ASTM: F 959, Type 325, zinc-coated
Carbon steel for forgings, pins and rollers	ASTM: A 668/A 668M, Class D
Alloy steel for forgings	ASTM: A 668/A 668M, Class G
Pin nuts	ASTM: A 36/A 36M
Carbon-steel castings	ASTM: A 27/A 27M, Grade 65-35, Class 1
Malleable iron castings	ASTM: A 47/A 47M, Grade 32510 (Grade 22010)
Gray iron castings	ASTM: A 48, Class 30B
Carbon steel structural tubing	ASTM: A 500, Grade B or A 501
Steel pipe (Hydrostatic testing will not apply)	ASTM: A 53, Type E or S, Grade B; A 106, Grade B; or A 139, Grade B
Stud connectors	AASHTO/AWS D1.5

a Grades that may be substituted for the equivalent ASTM Designation: A 709 steel, at the Contractor's option, subject to the modifications and additions specified and to the requirements of A 709.

b Zinc-coated nuts that will be tightened beyond snug or wrench tight shall be furnished with a dry lubricant conforming to Supplementary Requirement S2 in ASTM Designation: A 563.

In Section 55-2.04 delete the 1st paragraph.

Delete Section 55-2.05.

In Section 55-3.05 replace the 1st paragraph with:

Surfaces of bearing and base plates and other metal surfaces that are to come in contact with each other or with ground concrete surfaces shall be flat to within 1/32-inch tolerance in 12 inches and to within 1/16-inch tolerance overall. Surfaces of bearing and base plates and other metal bearing surfaces that are to come in contact with preformed fabric pads, elastomeric bearing pads, or mortar shall be flat to within 1/8-inch tolerance in 12 inches and to within 3/16-inch tolerance overall.

In Section 56-1.02E replace the 1st paragraph with:

Pipe posts shall be welded or seamless steel pipe conforming to the requirements in ASTM Designation: A 53/A 53M, Grade B; ASTM Designation: A 106/A 106M, Grade B; or API Specification 5L PSL2 Grade B or Grade X42R or Grade X42M. At the option of the Contractor, posts may be fabricated from structural steel conforming to the requirements in ASTM Designation: A 36/A 36M.

Pipe posts shall not be spiral seam welded.

In Section 56-1.02F replace item B of the 1st paragraph with:

- B. Material for gratings shall be structural steel conforming to the requirements in ASTM Designation: A 1011/A 1011M, Designation CS, Type B or Designation SS, Grade 36, Type 1.

In Section 56-1.03 replace the 5th paragraph with:

Clips, eyes, or removable brackets shall be affixed to all signs and all posts and shall be used to secure the sign during shipping and for lifting and moving during erection as necessary to prevent damage to the finished galvanized or painted surfaces. Brackets on tubular sign structures shall be removed after erection. Details of the devices shall be shown on the working drawings.

In Section 56-1.03 delete the 12th paragraph.

In Section 56-1.05 replace the 1st paragraph with:

Excepting tubular type, all ferrous metal parts of sign structures shall be galvanized and not painted, unless otherwise specified in the special provisions.

In Section 56-1.05 replace the 2nd paragraph with:

Except as herein provided, all exterior surfaces including those areas to be covered by sign panels of tubular type of sign structures shall be cleaned and painted as provided in Section 59-5, "Painting Sign Structures," and as provided in the special provisions. There shall be no chemical treatment of galvanized surfaces prior to cleaning and painting. Walkway gratings, walkway brackets, gutters, safety railings, steel mountings for light fixtures, and all nuts, bolts, and washers for sign structures shall be galvanized after fabrication and shall not be painted.

In Section 56-1.05 replace the 3rd paragraph with:

Galvanizing shall conform to the provisions in Section 75-1.05, "Galvanizing," except that when permission is granted by the Engineer, surfaces may be coated with zinc by the metalizing process. Metalizing shall be performed in conformance with the AWS requirements. The thickness of the sprayed zinc coat shall be 10 ± 2 mils. The thickness of the sprayed zinc coat on faying surfaces shall not be more than 10 mils.

In Section 56-1.05, add:

Zinc solders or zinc alloys that contain tin shall not be used to repair a damaged galvanized surface.

In Section 56-1.07, add:

Bridge-mounted signs shall not be fastened to concrete elements of bridges or railings before the concrete attains a compressive strength of 2,500 psi.

In Section 56-1.10 replace the 4th paragraph with:

The contract price paid per pound for install sign structure of the type or types designated in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in installing sign structures, complete in place, including installing anchor bolt assemblies, removable sign panel frames, and sign panels and performing any welding, painting or galvanizing required during installation, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

SECTION 75 MISCELLANEOUS METAL
(Issued 07-01-11)

In Section 75-1.02 replace the 6th paragraph with:

Manhole frames and covers shall conform to AASHTO M 306.

In Section 75-1.02 replace the 10th paragraph with:

Unless otherwise specified, materials shall conform to the following specifications:

Material	Specification
Steel bars, plates and shapes	ASTM Designation: A 36/A 36M or A 575, A 576 (AISI or M Grades 1016 through 1030)
Steel fastener components for general applications:	
Bolts and studs	ASTM Designation: A 307
Headed anchor bolts	ASTM Designation: A 307, Grade B, including S1 supplementary requirements
Nonheaded anchor bolts	ASTM Designation: F 1554 or A 307, Grade C, including S1 supplementary requirements and S1.6 of AASHTO Designation: M 314 supplementary requirements, or AASHTO Designation: M 314, Grade 36 or 55, including S1 supplementary requirements
High-strength bolts and studs, threaded rods, and nonheaded anchor bolts	ASTM Designation: A 449, Type 1
Nuts	ASTM Designation: A 563, including Appendix X1*
Washers	ASTM Designation: F 844
Components of high-strength steel fastener assemblies for use in structural steel joints:	
Bolts	ASTM Designation: A 325, Type 1
Tension control bolts	ASTM Designation: F 1852, Type 1
Nuts	ASTM Designation: A 563, including Appendix X1*
Hardened washers	ASTM Designation: F 436, Type 1, Circular, including S1 supplementary requirements
Direct tension indicators	ASTM Designation: F 959, Type 325, zinc-coated
Stainless steel fasteners (Alloys 304 & 316) for general applications:	
Bolts, screws, studs, threaded rods, and nonheaded anchor bolts	ASTM Designation: F 593 or F 738M
Nuts	ASTM Designation: F 594 or F 836M
Washers	ASTM Designation: A 240/A 240M and ANSI B 18.22M
Carbon-steel castings	ASTM Designation: A 27/A 27M, Grade 65-35, Class 1
Malleable iron castings	ASTM Designation: A 47, Grade 32510 or A 47M, Grade 22010
Gray iron castings Inside a roadbed Outside a roadbed	AASHTO M 306 AASHTO M306 except only AASHTO M105, Class 35B is allowed
Ductile iron castings	ASTM Designation: A 536, Grade 65-45-12
Cast iron pipe	Commercial quality
Steel pipe	Commercial quality, welded or extruded
Other parts for general applications	Commercial quality

*Zinc-coated nuts that will be tightened beyond snug or wrench tight shall be furnished with a dyed dry lubricant conforming to Supplementary Requirement S2 in ASTM Designation: A 563.

In Section 75-1.03 replace the 13th paragraph with:

Concrete anchorage devices shall be mechanical expansion or resin capsule types installed in drilled holes or cast-in-place insert types. The anchorage devices shall be selected from the Department's Pre-Qualified Products List. The qualification requirements for concrete anchorage devices may be obtained from the Pre-Qualified Products List Web site.

The anchorage devices shall be a complete system, including threaded studs, hex nuts, and cut washers. Thread dimensions for externally threaded concrete anchorage devices prior to zinc coating shall conform to the requirements in ASME Standard: B1.1 having Class 2A tolerances or ASME Standard: B1.13M having Grade 6g tolerances. Thread dimensions for internally threaded concrete anchorage devices shall conform to the requirements in ASTM A 563.

In Section 75-1.03 replace the 18th paragraph with:

Mechanical expansion anchors shall, when installed in accordance with the manufacturer's instructions and these specifications and tested in conformance with the requirements in California Test 681, withstand the application of a sustained tension test load of at least the following values for at least 48 hours with a movement not greater than 0.035 inch:

Stud Diameter (inches)	Sustained Tension Test Load (pounds)
*3/4	5,000
5/8	4,100
1/2	3,200
3/8	2,100
1/4	1,000

* Maximum stud diameter permitted for mechanical expansion anchors.

Resin capsule anchors shall, when installed in accordance with the manufacturer's instructions and these specifications and tested in conformance with the requirements in California Test 681, withstand the application of a sustained tension test load of at least the following values for at least 48 hours with a movement not greater than 0.010 inch:

Stud Diameter (inches)	Sustained Tension Test Load (pounds)
1-1/4	31,000
1	17,900
7/8	14,400
3/4	5,000
5/8	4,100
1/2	3,200
3/8	2,100
1/4	1,000

At least 25 days before use, the Contractor shall submit one sample of each resin capsule anchor per lot to the Transportation Laboratory for testing. A lot of resin capsule anchors is 100 units, or fraction thereof, of the same brand and product name.

In Section 75-1.03 replace the 20th paragraph with:

A Certificate of Compliance for concrete anchorage devices shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

SECTION 83 RAILINGS AND BARRIERS

(Issued 07-01-11)

In Section 83-1.02 replace the 7th paragraph with:

Mortar shall conform to the provisions in Section 51-1.135, "Mortar," and shall consist of one part by volume of cementitious material and 3 parts of clean sand.

In Section 83-1.02B in the 24th paragraph in the 8th subparagraph, replace the 1st sentence with:

Anchor cable shall be 3/4 inch preformed, 6 x 19, wire strand core or independent wire rope core (IWRC), galvanized in conformance with the requirements in Federal Specification RR-W-410, right regular lay, manufactured of improved plow steel with a minimum breaking strength of 23 tons.

In Section 83-1.02E in the 6th paragraph, replace the 2nd sentence with:

Cable shall be galvanized in conformance with the requirements in Federal Specification RR-W-410.

In Section 83-1.02I replace the 5th paragraph with:

Where shown on the plans, cables used in the frame shall be 5/16 inch in diameter, wire rope, with a minimum breaking strength of 5,000 pounds and shall be galvanized in conformance with the requirements in Federal Specification RR-W-410.

In Section 83-1.02I replace the 14th paragraph with:

Chain link fabric shall be 11-gage conforming to one of the following:

1. AASHTO Designation: M181, Type I, Class C
2. AASHTO Designation: M181, Type IV, Class A
3. ASTM F 1345, Class 2

In Section 83-2.02D(1) replace the 5th paragraph with:

When concrete barriers are to be constructed on existing structures, the dowels shall be bonded in holes drilled in the existing concrete. Drilling of holes and bonding of dowels shall conform to the following:

1. The bonding materials shall be either magnesium phosphate concrete, modified high alumina based concrete or portland cement based concrete. Magnesium phosphate concrete shall be either single component (water activated) or dual component (with a prepackaged liquid activator). Modified high alumina based concrete and portland cement based concrete shall be water activated. Bonding materials shall conform to the following requirements:

Property	Test Method	Requirements
Compressive Strength		
at 3 hours, MPa	California Test 551	21 min.
at 24 hours, MPa	California Test 551	35 min.
Flexure Strength		
at 24 hours, MPa	California Test 551	3.5 min.
Bond Strength: at 24 hours		
SSD Concrete, MPa	California Test 551	2.1 min.
Dry Concrete, MPa	California Test 551	2.8 min.
Water Absorption, %	California Test 551	10 max.
Abrasion Resistance		
at 24 hours, grams	California Test 550	25 max.
Drying Shrinkage at 4 days, %	ASTM Designation: C 596	0.13 max.
Soluble Chlorides by weight, %	California Test 422	0.05 max.
Water Soluble Sulfates by weight, %	California Test 417	0.25 max.

2. Magnesium phosphate concrete shall be formulated for minimum initial set time of 15 minutes and minimum final set time of 25 minutes at 70° F. The materials, prior to use, shall be stored in a cool, dry environment.
3. Mix water used with water activated material shall conform to the provisions in Section 90-2.03, "Water."
4. The quantity of water for single component type or liquid activator (for dual component type) to be blended with the dry component, shall be within the limits recommended by the manufacturer and shall be the least amount required to produce a pourable batter.
5. Addition of retarders, when required and approved by the Engineer, shall be in conformance with the manufacturer's recommendations.
6. Before using concrete material that has not been previously approved, a minimum of 45 pounds shall be submitted to the Engineer for testing. The Contractor shall allow 45 days for the testing. Each shipment of concrete material that has been previously approved shall be accompanied by a Certificate of Compliance as provided in Section 6-1.07, "Certificates of Compliance."
7. Magnesium phosphate concrete shall not be mixed in containers or worked with tools containing zinc, cadmium, aluminum or copper metals. Modified high alumina based concrete shall not be mixed in containers or worked with tools containing aluminum.
8. The surface of any dowel coated with zinc or cadmium shall be coated with a colored lacquer before installation of the dowel. The lacquer shall be allowed to dry thoroughly before embedment of the dowels.
9. The holes shall be drilled by methods that will not shatter or damage the concrete adjacent to the hole. The diameter of the drilled hole shall be 1/2 inch larger than the nominal diameter of the dowels.
10. The drilled holes shall be clean and dry at the time of placing the bonding material and the steel dowels. Bonding material and dowel shall completely fill the drilled hole. The surface temperature shall be 40° F or above when the bonding material is placed.
11. After bonding, dowels shall remain undisturbed for a minimum of 3 hours or until the bonding material has reached a strength sufficient to support the dowels. Dowels that are improperly bonded, as determined by the Engineer, shall be removed. The holes shall be cleaned or new holes shall be drilled and the dowels replaced and securely bonded to the concrete. Removing, redrilling and replacing improperly bonded dowels shall be performed at the Contractor's expense. Modified high alumina based concrete and portland cement based concrete shall be cured in conformance with the provisions in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications. Magnesium phosphate concrete shall not be cured.

In Section 83-2.02D(1) replace the 8th paragraph with:

Granular material for backfill between the 2 walls of concrete barrier (Types 50E, 60F, 60GE and 60SF), as shown on the plans, shall be placed without compaction.

In Section 83-2.02D(2) in the 1st paragraph, replace item b with:

- b. If the 3/8-inch maximum size aggregate grading is used to construct extruded or slip-formed concrete barriers, the cementitious material content of the minor concrete shall be not less than 675 pounds per cubic yard.

Replace Section 86 with:
SECTION 86 ELECTRICAL SYSTEMS
86-1 GENERAL

86-1.01 DESCRIPTION

Section 86 includes specifications for installing, modifying, and removing:

1. Traffic signal
2. Interconnect system
3. Ramp metering system
4. Flashing beacon system
5. Lighting system
6. Sign illumination system
7. Traffic monitoring station
8. Communication system
9. Electrical equipment in structure
10. Falsework lighting

Comply with Part 4 of the California MUTCD. Nothing in this Section 86 is to be construed as to reduce the minimum standards in this manual.

The locations of electrical system elements are approximate; the Engineer will approve final location.

86-1.015 DEFINITIONS

Definitions pertain only to Section 86, "Electrical Systems."

actuation: As defined in the California MUTCD.

channel: Discrete information path.

controller assembly: Controller unit and auxiliary equipment housed in a rainproof cabinet to control a system's operations.

controller unit: Part of the controller assembly performing the basic timing and logic functions.

detector: As defined in the California MUTCD.

electrolier: Complete assembly of lighting standard and luminaire.

flasher: Device to open and close signal circuits at a repetitive rate.

flashing beacon control assembly: Switches, circuit breakers, terminal blocks, flasher, wiring, and necessary electrical components all housed in a single enclosure to properly operate a beacon.

inductive loop detector: Detector capable of being actuated by inductance change caused by vehicle passing or standing over the loop.

lighting standard: Pole and mast arm supporting the luminaire.

luminaire: Assembly that houses the light source and controls the light emitted from the light source.

magnetic detector: Detector capable of being actuated by induced voltage caused by vehicle passing through the earth's magnetic field.

powder coating: A coating applied electrostatically using UV-stable polymer exterior grade powder.

pre-timed controller assembly: Operates traffic signals under a predetermined cycle length.

signal face: As defined in the California MUTCD.

signal head: As defined in the California MUTCD.

signal indication: As defined in the California MUTCD.

signal section: As defined in the California MUTCD.

signal standard: Pole and mast arm supporting one or more signal faces with or without a luminaire mast arm.

traffic-actuated controller assembly: Operates traffic signals under the varying demands of traffic as registered by detector actuation.

traffic phase: Signal phase as defined in the California MUTCD.

vehicle: As defined in the California Vehicle Code.

86-1.02 REGULATIONS AND CODE Electrical equipment must comply with one or more of the following:

1. ANSI
2. ASTM
3. 8 CA Code of Regs § 2299 et seq.
4. EIA
5. NEMA

6. NETA
7. UL

Materials and workmanship must comply with:

1. FCC
2. ITE
3. NEC
4. NRTL
5. Public Utilities Commission, General Order No. 95, "Rules for Overhead Electrical Line Construction"
6. Public Utilities Commission, General Order No. 128, "Rules for Construction of Underground Electric Supply and Communication Systems"

86-1.03 COST BREAK-DOWN

Determine quantities required to complete work. Submit the quantities as part of the cost breakdown.

The sum of the amounts for the units of work listed in the cost breakdown must equal the contract lump sum price bid for the work. Include overhead and profit for each unit of work listed in the cost breakdown. If mobilization is a bid item, include bond premium, temporary construction facilities, and material plants into the mobilization bid item, otherwise, include in each unit of work listed in the cost breakdown. Do not include costs for traffic control system in the cost breakdown.

The cost breakdown may be used to determine partial payment and to calculate payment adjustments for additional costs incurred due to a change order. If a change order increases or decreases the quantities, payment adjustment may be determined under Section 4-1.03B, "Increased or Decreased Quantities."

The cost breakdown must include type, size, and installation method for:

1. Foundations
2. Standards and poles
3. Conduit
4. Pull boxes
5. Conductors and cables
6. Service equipment enclosures
7. Telephone demarcation cabinet
8. Signal heads and hardware
9. Pedestrian signal heads and hardware
10. Pedestrian push buttons
11. Loop detectors
12. Luminaires and lighting fixtures

86-1.04 EQUIPMENT LIST AND DRAWINGS

Within 15 days of contract approval, submit for review a list of equipment and materials that you propose to install. Comply with Section 5-1.02, "Plans and Working Drawings." The list must include:

1. Name of manufacturer
2. Dimension
3. Item identification number
4. List of components

The list must be supplemented by other data as required, including:

1. Schematic wiring diagrams
2. Scale drawings of cabinets showing location and spacing of shelves, terminal blocks, and equipment, including dimensioning
3. Operation manual

Submit 2 copies of the above data. The Engineer will review within 15 days.

Electrical equipment that is manufactured as detailed on the plans will not require detailed drawings and diagrams.

Furnish 3 sets of computer-generated cabinet schematic wiring diagrams.

The cabinet schematic wiring diagram must be placed in a heavy duty plastic envelope and attached to the inside of the door of each cabinet.

Prepare diagrams, plans, and drawings using graphic symbols in IEEE 315, "Graphic Symbols for Electrical and Electronic Diagrams."

86-1.05 CERTIFICATE OF COMPLIANCE

Submit a Certificate of Compliance for all electrical material and equipment to the Engineer under Section 6-1.07, "Certificates of Compliance."

86-1.06 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS

Keep existing electrical system or approved temporary replacement in working order during the progress of the work. Shutdown is allowed for alteration or removal of the system. Traffic signal shutdown must be limited to normal working hours. Lighting system shutdown must not interfere with the regular lighting schedule.

Notify the Engineer before performing work on the existing system.

Notify the local traffic enforcement agency before traffic signal shutdown.

If existing or temporary system must be modified, work not shown on the plans or specified in the special provisions, but required to keep the system in working order will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The State or local agency will:

1. Continue the operation and maintenance of existing electrical facilities
2. Continue to provide electrical energy to operate existing electrical facilities
3. Repair or replace existing facilities damaged by public traffic
4. Pay for electrical energy to operate existing or new facilities undergoing the functional tests described in Section 86-2.14C, "Functional Testing"

Verify location and depth of existing detectors, conduits, pull boxes, and other electrical facilities before using tools or equipment that may damage those facilities or interfere with an electrical system.

Notify the Engineer immediately if existing facility is damaged by your activities. Repair or replace damaged facility promptly. If you fail to complete the repair or replacement, promptly, the State will repair or replace and deduct the costs.

Damaged detectors must be replaced within 24 hours at your expense. If you fail to complete the repair within 24 hours, the State will repair and deduct the repair costs.

If roadway remains open to traffic while an existing lighting system is modified:

1. Keep existing system in working order
2. Make final connection so the modified circuit is in operation by nightfall

Keep temporary electrical installations in working order until no longer required. Remove temporary installations as specified in Section 86-7, "Removing, Reinstalling or Salvaging Electrical Equipment."

These provisions do not void your responsibilities as specified in Section 7-1.12, "Indemnification and Insurance," and Section 7-1.16, "Contractor's Responsibility for the Work and Materials."

During traffic signal system shutdown, place W3-1a, "STOP AHEAD," and R1-1, "STOP," signs in each direction to direct traffic through the intersection. For 2-lane approaches, place 2 R1-1 signs.

W3-1a and R1-1 signs must comply with Section 12-3.06, "Construction Area Signs." Use a minimum size of 30 inches for the R1-1 sign.

Cover signal faces when the system is shut down overnight. Cover temporary W3-1a and R1-1 signs when the system is turned on.

86-1.07 SCHEDULING OF WORK

Except service installation and service equipment enclosure, do not work above ground until all materials are on hand to complete electrical work at each location. Schedule work to allow each system to be completed and ready for operation before opening the corresponding section of the roadway to traffic.

If street lighting exists or is installed in conjunction with traffic signals, do not turn on the signals until the street lighting is energized.

Traffic signals will not be placed in operation until the roadways to be controlled are open to public traffic.

Lighting and traffic signals, including flashing operation, will not be placed in operation before starting the functional test period specified in Section 86-2.14, "Testing."

Do not pull conductors into conduit until:

1. Pull boxes are set to grade
2. Metallic conduit is bonded

In vehicular undercrossings, soffit lights must be in operation as soon as practicable after falsework has been removed from the structure. Lighting for pedestrian structures must be in operation before opening the structure to pedestrian traffic.

If the Engineer orders soffit lights or lighting for pedestrian structures to be activated before permanent power service is available, the cost of installing and removing temporary power service will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The initial traffic signal turn-on must be made between 9:00 a.m. and 2:00 p.m. Before the initial turn-on, all equipment, including pedestrian signals, pedestrian push buttons, vehicle detectors, lighting, signs, and pavement delineation must be installed and in working order. Direct louvers, visors, and signal faces to maximize visibility.

Start functional tests on any working day except Friday or the day before a legal holiday. You must notify the Engineer 48 hours before the start of functional test.

86-1.08 (BLANK)

86-2 MATERIALS AND INSTALLATION

86-2.01 EXCAVATING AND BACKFILLING

Dispose of surplus excavated material under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."

Backfill as specified in Section 19-3, "Structure Excavation and Backfill." Compact backfill in conduit trenches outside the hinge point of slopes and not under pavement to a minimum relative compaction of 90 percent. Compact backfill within hinge points and in areas where pavement is to be constructed to a minimum relative compaction of 95 percent.

Backfill trenches and restore sidewalk, pavement, and landscaping at one intersection before starting excavation at another intersection.

If excavating on a street or highway, restrict closure to 1 lane at a time.

86-2.02 REMOVING AND REPLACING IMPROVEMENTS

Replace or reconstruct sidewalk, curb, gutter, concrete pavement, asphalt concrete pavement, underlying material, lawn, plant, and other facilities damaged by your activities. Replacement material must be of equal or better quality than the material replaced. Work must be in a serviceable condition.

If a part of a square or slab of concrete sidewalk, curb, gutter, or driveway is broken or damaged, the entire square or slab must be removed and reconstructed.

Cut outline of PCC sidewalk or driveway to be removed:

1. Using a power-driven saw
2. On a neat line
3. To a 0.17-foot minimum depth

86-2.03 FOUNDATIONS

Except for concrete for cast-in-drilled-hole concrete pile foundation, PCC must comply with Section 90-10, "Minor Concrete."

Construct concrete foundation on firm ground.

After each post, standard, and pedestal is properly positioned, place mortar under the base plate. Finish exposed portion to present a neat appearance. Mortar must comply with Section 51-1.135, "Mortar," except mortar must have:

1. 1 part by volume of cementitious material
2. 3 parts by volume of clean sand

Reinforced cast-in-drilled-hole concrete pile foundation must comply with Section 49, "Piling," except:

1. Material resulting from drilling holes must be disposed of as specified in Section 86-2.01, "Excavating and Backfilling"

2. Concrete for cast-in-drilled-hole concrete pile will not be considered as designated by compressive strength

Form exposed portion of the foundation to present a neat appearance and true to line and grade. The top of a foundation for post and standard must be finished to curb or sidewalk grade. Forms must be rigid and securely braced in place. Conduit ends and anchor bolts must be placed at proper height and position. Anchor bolts must be installed a maximum of 1:40 from vertical and held in place by rigid top and bottom templates. Use a steel bottom template at least 1/2 inch thick that provides proper spacing and alignment of anchor bolts near the embedded bottom end. Install bottom template before placing footing concrete.

Provide new foundation and anchor bolts of the proper type and size for relocated standards.

Steel parts must be galvanized as specified in Section 75-1.05, "Galvanizing."

Provide 2 nuts and washers for the upper threaded part of each anchor bolt. Provide 3 nuts and washers for each anchor bar or stud.

Do not weld high-strength steel used for anchor bolt, anchor bar, or stud.

Before placing concrete, moisten forms and ground. Keep forms in place until the concrete sets for at least 24 hours and is strong enough to prevent damage to surface.

Except if located on a structure, construct foundation for post, standard, and pedestal monolithically.

Apply ordinary surface finish as specified in Section 51-1.18A, "Ordinary Surface Finish."

If a foundation must be extended for additional depth, the extension work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

Do not erect post, pole, standard, pedestal, or cabinet until the foundation is set for a minimum of 7 days.

The Engineer will choose the plumbing or raking technique for posts, standards, and pedestals. Plumb or rake by adjusting the leveling nuts before tightening nuts. Do not use shims or similar devices. After final adjustments of both top nuts and leveling nuts on anchorage assemblies have been made, and each post, standard, and pedestal on structure is properly positioned, tighten nuts as follows:

1. Tighten leveling nuts and top nuts, following a crisscross pattern, until bearing surfaces of all nuts, washers, and base plates are in firm contact.
2. Use an indelible marker to mark the top nuts and base plate with lines showing relative alignment of the nut to the base plate.
3. Tighten top nuts, following a crisscross pattern, an additional 1/6th of a turn.

In unpaved areas, construct a raised PCC pad in front of each controller cabinet.

Completely remove foundations not to be reused or abandoned.

If abandoning a foundation, remove the top of foundation, anchor bolts, and conduits to a minimum depth of 0.5 foot below sidewalk surface or original ground. Backfill the resulting hole with material equivalent to the surrounding material.

86-2.04 STANDARDS, STEEL PEDESTALS AND POSTS

Bolts, including anchor bolts, nuts, and washers for signal and lighting support structures must comply with Section 55-2, "Materials." Except for bearing-type connection or slip-base, high-strength bolted connection must comply with Section 55-3.14, "Bolted Connections." Welding, nondestructive testing of welds, and acceptance and repair criteria for steel member nondestructive testing must comply with American Welding Society (AWS) D1.1.

Using stainless steel rivets, attach rectangular corrosion-resistant metal identification tag on all standards and poles, except Type 1:

1. Above the hand hole, near the base of standards and poles
2. On the underside of mast arms near the arm plate

The lettering on each identification tag must be depressed or raised, 1/4 inch tall, legible, and include the following information:

1. Name of the manufacturer
2. Date of manufacture
3. Identification number
4. Contract number
5. Unique identification code that is:
 - 5.1. Assigned by the manufacturer
 - 5.2. Traceable to a particular contract and the welds on that component

5.3. Readable after the support structure is coated and installed

Type 1 standard and steel pedestal for controller cabinet must be manufactured of one of the following:

1. 0.12-inch or thicker galvanized steel
2. 4-inch standard weight galvanized steel pipe as specified in ASTM A 53
3. 4-inch Type 1 conduit with the top designed for post-top slip-fitter

Ferrous metal parts of a standard that has a shaft length of 15 feet or longer must comply with the provisions in Section 55-2, "Materials," and the following:

1. Standard must be manufactured from sheet steel of weldable grade having a minimum yield strength of 40,000 psi after manufacturing.
2. Certified test report verifying compliance with minimum yield strength requirements must be submitted. Test report may be the mill test report for the as-received steel or if the as-received steel has a lower yield strength than required you must provide test data assuring that your method of cold forming will consistently increase the tensile properties of the steel to meet the specified minimum yield strength. Test data must include tensile properties of the steel after cold forming for specific heats and thicknesses.
3. If a single-ply 5/16-inch thick pole is specified, a 2-ply pole with equivalent section modulus may be substituted.
4. Standard may be manufactured of full-length sheets or shorter sections. Each section must be manufactured from 1 or 2 pieces of sheet steel. If 2 pieces are used, the longitudinal welded seams must be directly opposite from one another. If the sections are butt-welded together, the longitudinal welded seams of adjacent sections must be placed to form continuous straight seams from base to top of standard.
5. Butt-welded circumferential joints of tubular sections requiring CJP groove welds must be made using a metal sleeve backing ring inside each joint. The sleeve must be 1/8 inch nominal thickness, or thicker, and manufactured from steel having the same chemical composition as the steel in the tubular sections to be joined. If the sections to be joined have different specified minimum yield strengths, the steel in the sleeve must have the same chemical composition as the tubular section having the higher minimum yield strength. The width of the metal sleeve must be consistent with the type of nondestructive testing selected and must be a minimum width of 1 inch. At fitting time, the sleeve must be centered at the joint and in contact with the tubular section at the point of the weld.
6. Welds must be continuous.
7. Weld metal at the transverse joint must extend to the sleeve, making the sleeve an integral part of the joint.
8. During manufacturing, longitudinal seams on vertical tubular members of cantilevered support structures must be centered on and along the side of the pole that the pole plate is located. Longitudinal seams on horizontal tubular members, including signal and luminaire arms, must be within ± 45 degrees of the bottom of the arm.
9. Longitudinal seam weld in steel tubular section may be made by the electric resistance welding process.
10. Longitudinal seam weld must have 60 percent minimum penetration, except:
 - 10.1. Within 6 inches of circumferential weld, longitudinal seam weld must be CJP groove weld.
 - 10.2. Longitudinal seam weld on lighting support structure having telescopic pole segment splice must be CJP groove weld on the female end for a length on each end equal to the designated slip-fit splice length plus 6 inches.
11. Exposed circumferential weld, except fillet and fatigue-resistant weld, must be ground flush with the base metal before galvanizing or painting. Ground flush is specified as -0, +0.08-inch.
12. Circumferential weld and base plate-to-pole weld may be repaired only one time.
13. Exposed edges of the plates that make up the base assembly must be finished smooth and exposed corners of the plates must be broken. Provide shafts with slip-fitter shaft caps.
14. Surface flatness requirements of ASTM A 6 apply to plates:
 - 14.1. In contact with concrete, grout, or washers and leveling nuts
 - 14.2. In high-strength bolted connections
 - 14.3. In joints, where cap screws are used to secure luminaire and signal arms
 - 14.4. Used for breakaway slip-base assemblies
15. Standard must be straight with a maximum variation of:

- 15.1. 1 inch measured at the midpoint of a 30-foot to 35-foot standard
 - 15.2. 3/4 inch measured at the midpoint of a 17-foot to 20-foot standard
 - 15.3. 1 inch measured 15 feet above the base plate for Type 35 and Type 36 standards
16. Zinc-coated nuts used on fastener assemblies having a specified preload obtained by specifying a prescribed tension, torque value, or degree of turn must be provided with a colored lubricant, clean and dry to the touch. The lubricant color must contrast the zinc coating color on the nut so the presence of the lubricant is visually obvious. Lubricant must be insoluble in water or the fastener components must be shipped to the job site in a sealed container.
 17. Do not make additional holes in structural members.
 18. Standard with an outside diameter of 12 inches or less must be round. Standard with an outside diameter greater than 12 inches must be round or multisided. Multisided standard must be convex with a minimum of 12 sides and have a minimum bend radius of 4 inches.
 19. Manufacture mast arm from material specified for standard.
 20. Manufacture cast steel option for slip base from material of Grade 70-40, as specified in ASTM A 27/A 27M. Other comparable material may be used if approved by the Engineer. The casting tolerances must comply with the Steel Founders' Society of America's recommendations for green sand molding.
 21. One casting from each lot of a maximum of 50 castings must be radiographed as specified in ASTM E 94. Casting must comply with the acceptance criteria for severity level 3 or better for the types and categories of discontinuities in ASTM E 186 and E 446. If the casting fails the inspection, 2 additional castings must be radiographed. If the 2 additional castings fail the inspection, the entire lot will be rejected.
 22. Material certification, consisting of physical and chemical properties, and radiographic film of the casting must be filed at the manufacturer's office. Certification and film must be available for inspection.
 23. High-strength bolts, nuts, and flat washers used to connect slip-base plate must comply with ASTM A 325 or A 325M and be galvanized as specified in Section 75-1.05, "Galvanizing."
 24. Plate washers must be manufactured by saw cutting and drilling steel plate. Steel plate must comply with AISI 1018 and be galvanized as specified in Section 75-1.05, "Galvanizing." Before galvanizing, remove burrs and sharp edges and chamfer both sides of holes to allow the bolt head to make full contact with the washer without tension.
 25. High-strength cap screws for attaching arms to standards must comply with ASTM A 325, A 325M, or A 449, and the mechanical requirements in ASTM A 325 or A 325M after galvanizing. Cap screws must be galvanized as specified in Section 75-1.05, "Galvanizing." Coat threads of cap screws with a colored lubricant, clean and dry to the touch. Lubricant color must contrast the zinc-coating color on the cap screw so the presence of the lubricant is visually obvious. Lubricant must be insoluble in water or the fastener components must be shipped to the job site in a sealed container.
 26. Bolted connection attaching signal or luminaire arm to pole must be considered slip critical. Galvanized faying surfaces of plates on luminaire, signal arm, and pole must be roughened by hand using a wire brush before assembly and must comply with requirements for Class C surface conditions for slip-critical connections in "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts," a specification approved by the Research Council on Structural Connections (RCSC). Paint for faying surfaces must be as specified in the RCSC specification for Class B coating.
 27. The Engineer will randomly take samples of fastener components from each production lot and submit to the Transportation Laboratory with test reports as specified in ASTM fastener specifications for QA testing and evaluation. The Engineer will determine sample sizes for each fastener component.

Change in mast arm configuration is allowed as long as the mounting height and stability are maintained.

Before manufacturing, details must be adjusted to ensure that cap screw heads can be turned using conventional installation tools. During manufacturing process, to avoid interference with the cap screw heads, the position of the luminaire arm on the arm plate must be properly located.

Configure mast arm as a smooth curving arm.

Push button post, pedestrian barricade, and guard post must comply with ASTM A 53.

Assemble and tighten slip base when pole is on the ground. Threads of heavy hex nuts for each slip-base bolt must be coated with additional lubricant that is clean and dry to the touch. Tighten high strength slip-base bolts to within ± 10 foot-pounds of the following:

Slip-Base Bolt-Tightening Requirements

Standard Type	Torque (foot-pounds)
15-SB	150
30	150
31	200
36-20A	165

Hole in shaft of existing standard, due to removal of equipment or mast arms, must be sealed by fastening a galvanized steel disk to cover the hole. Fasten using a single central galvanized steel fastener. Seal edges of disk and hole with polysulfide or polyurethane sealing compound of Type S, Grade NS, Class 25, and Use O, as specified in ASTM C 920.

If existing standard is ordered to be relocated or reused, remove large dents, straighten shafts, and replace parts that are in poor condition. You must furnish anchor bolts or bars and nuts required for relocating or reusing standard. Repair and replacement work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

New nuts, bolts, cap screws, and washers must be provided if:

1. Standard or mast arm is relocated
2. Used standard or mast arm is State furnished

If the standard has a slip base, a new keeper plate must be provided.

86-2.05 CONDUIT

Run conductors in conduit except for overhead and where conductors are run inside poles.

You may use a larger size conduit than specified as long as you use it for the entire length between outlets. Do not use reducing coupling.

New conduit must not pass through existing foundations for standards.

86-2.05A Material

Conduit and conduit fitting must be UL or NRTL listed and comply with the following:

Conduit and Conduit Fitting Requirements

Type 1	Hot-dip galvanized rigid steel conduit and conduit couplings must comply with UL 6 and ANSI C80.1. Zinc coating testing must comply with copper sulfate test requirements in UL 6. Conduit couplings for rigid steel conduit must be electrogalvanized.
Type 2	Hot-dip galvanized rigid steel conduit must comply with requirements for Type 1 conduit and be coated with polyvinyl chloride (PVC) or polyethylene. Exterior thermoplastic coating must have a minimum thickness of 35 mils. Internal coating must have a minimum thickness of 2 mils. Coated conduit must comply with UL 6; NEMA RN 1; or NRTL PVC-001.
Type 3	Rigid nonmetallic PVC conduit must comply with UL 651. Type A extruded rigid PVC conduit and extruded rigid HDPE conduit must comply with UL 651A. Coilable, smooth-wall, continuous length HDPE conduits must comply with UL 651B. Install at underground locations only.
Type 4	Waterproof flexible metal conduit must consist of conduit with a waterproof non-metallic sunlight-resistant jacket over an inner flexible metal core. Type 4 conduit must be UL listed for use as the grounding conductor.
Type 5	Intermediate steel conduit and conduit couplings must comply with UL 1242 and ANSI C80.6. Zinc coating testing must comply with copper sulfate test requirements in UL 1242. Conduit couplings for intermediate rigid steel conduit must be electrogalvanized. Type 5 conduit must only be used if specified.

Bonding bushings to be installed on metal conduit must be insulated and either galvanized or zinc alloy type. Fittings for steel conduit and for watertight flexible metal conduit must be UL listed at UL 514B.

86-2.05B Use

Install Type 1 conduit on all exposed surfaces and at the following locations:

- 1. In concrete structures
- 2. Between a structure and nearest pull box

Exposed conduit installed on painted structure must be painted the same color as the structure.

Change or extend existing conduit runs using the same material. Install pull box if an underground conduit changes from the metallic type to Type 3.

Minimum trade size of conduit must be:

- 1. 1-1/2 inches from electrolier to adjacent pull box
- 2. 1 inch from pedestrian push button post to adjacent pull box
- 3. 2 inches from signal standard to adjacent pull box
- 4. 3 inches from controller cabinet to adjacent pull box
- 5. 2 inches from overhead sign to adjacent pull box
- 6. 2 inches from service equipment enclosure to adjacent pull box
- 7. 1-1/2 inches if unspecified

Two conduits must be installed between controller cabinet and adjacent pull box.

86-2.05C Installation

Whether shop or field cut, ream ends of conduit to remove burrs and rough edges. Make cuts square and true. Slip joints and running threads are not allowed for coupling conduit. If a standard coupling cannot be used for coupling metal type conduit, use a threaded union coupling that is UL or NRTL listed. Tighten couplings for metal conduit to maintain a good electrical connection through conduit run.

Cut Type 3 conduit with tools that will not deform the conduit. Use solvent weld for connections.

Cut Type 2 conduit with pipe cutters; do not use hacksaws. Coated conduit must be threaded with standard conduit-threading dies. Tighten conduit into couplings or fittings using strap wrenches or approved groove-joint pliers.

Protect shop-cut threads from corrosion as follows:

Shop-Cut Thread Protection

Steel conduit and conduit couplings	ANSI C80.1
Electrical intermediate metal conduit and conduit couplings	ANSI C80.6

Paint conduits as specified in Section 91, "Paint." Apply 2 coats of approved unthinned zinc-rich primer of organic vehicle type. Do not use aerosol cans. Paint the following parts of conduits:

- 1. All exposed threads
- 2. Field-cut threads before installing conduit couplings to steel conduit
- 3. Damaged surfaces on metal conduit

Do not remove shop-installed conduit couplings.

Damaged Type 2 conduit or conduit coupling must be wrapped with at least 1 layer of 2 inch wide, 20 mil minimum thickness PVC tape, as specified in ASTM D 1000, with a minimum tape overlap of 1/2 inch. Before applying the tape, conduit or fitting must be cleaned and painted with 1 coat of rubber-resin based adhesive as recommended by the tape manufacturer. You may repair damaged spots in the thermoplastic coating by painting over with a brushing type compound supplied by the conduit manufacturer instead of the tape wrap.

The ends of Types 1, 2, or 5 conduit must be threaded and capped with standard pipe caps until wiring is started. The ends of Types 3 and 4 conduit must be capped until wiring is started. If caps are removed, replace with conduit bushings. Fit insulated bonding bushings on the end of metal conduit ending in pull box or foundation. Bell or end bushings for Type 3 conduit must be non-metallic type.

Conduit bends, except factory bends, must have a radius of not less than 6 times the inside diameter of the conduit. If factory bends are not used, bend the conduit without crimping or flattening using the longest radius practicable. Bend conduits as follows:

Conduit-Bending Requirements

Type 1	By methods recommended by the conduit manufacturer and with equipment approved for the purpose.
Type 2	Use standard bending tool designed for use on thermoplastic coated conduit. Conduit must be free of burrs and pits.
Type 3	By methods recommended by the conduit manufacturer and with equipment approved for the purpose. Do not expose conduit to direct flame.
Type 4	--
Type 5	By methods recommended by the conduit manufacturer and with equipment approved for the purpose.

Install pull tape in conduit that is to receive future conductors. The pull tape must be a flat woven lubricated soft-fiber polyester tape with a minimum tensile strength of 1,800 pounds and have printed sequential measurement markings every 3 feet. At least 2 feet of pull tape must be doubled back into the conduit at each end.

Existing underground conduit to be incorporated into a new system must be cleaned with a mandrel or cylindrical wire brush and blown out with compressed air.

Install conduit to a depth of not less than 30 inches below finished grade, except in sidewalk and curbed paved median areas, where it must be at least 18 inches below grade. You may lay conduit on existing pavement within new curbed median.

Conduit coupling must be a minimum of 6 inches from face of foundation.

Place a minimum of 2 inches of sand bedding in the trench before installing Type 2 or Type 3 conduit. Place a minimum of 4 inches of same material over conduit before placing additional backfill material.

Obtain approval from the Engineer before disturbing pavement. If obstruction is encountered, obtain approval from Engineer to cut small holes in the pavement to locate or remove obstruction. If jacking or drilling method is used, keep jacking or drilling pit 2 feet away from edge of pavement. Pavement must not be weakened or subgrade softened from excess water use.

Conduit used for drilling or jacking must be removed; install new conduit for completed work. If a hole larger than the conduit is pre-drilled and you install conduit by hand or by method recommended by the conduit manufacturer with equipment approved for purpose, you may install Type 2 or Type 3 conduit under pavement.

If trenching in pavement method is specified, conduit installation under pavement that is not a freeway lane or freeway to freeway connector ramp, must comply with the following:

1. Use Type 3 conduit. Place conduit under pavement in a trench approximately 2 inches wider than the outside diameter of conduit, but not exceeding 6 inches in width. Trench depth must not exceed the greater of 12 inches or conduit trade size plus 10 inches, except that at pull boxes the trench may be hand dug to required depth. The top of the installed conduit must be a minimum of 9 inches below finished grade.
2. Trenching installation must be completed before placing final pavement layer.
3. Cut pavement to be removed with a rock cutting excavator. Minimize shatter outside the removal area.
4. Place conduit in bottom of trench and backfill with minor concrete as specified in Section 90-10, "Minor Concrete.". Minor concrete must contain a minimum of 590 pounds of cementitious material per cubic yard. If the trench is in asphalt concrete pavement and pavement overlay is not placed, backfill the top 0.10 foot of trench with minor HMA.
5. Before spreading HMA, apply tack coat as specified in Section 39, "Hot Mix Asphalt."
6. Backfill trenches, except for the top 0.10 foot, by the end of each day. The top 0.10 foot must be filled within 3 days after trenching.

Conduit installed beneath railroad tracks must be:

1. Type 1 or 2
2. 1-1/2-inch minimum diameter
3. Placed a minimum depth of 42 inches below bottom of the rail

If jacking or drilling method is used, construct jacking pit to a minimum of 13 feet from the centerline of track at the near side of jacking pit. Cover jacking pit with substantial planking if left overnight.

Conduit ending in standard or pedestal must not extend more than 3 inches vertically above the foundation and must be sloped toward the handhole opening. Conduit entering through the side of non-metallic pull box must end inside the box within 2 inches of the wall and 2 inches above the bottom and be sloped toward the top of box to facilitate pulling of conductors. Conduit entering through the bottom of a pull box must end 2 inches above the bottom and be located near the end walls to leave the major portion of the box clear. At outlet, conduit must enter from the direction of the run.

Underground conduit runs, including under sidewalks, that are adjacent to gasoline service stations or other underground gasoline or diesel storage, piping, or pumps and that lead to a controller cabinet, circuit breaker panel, service, or enclosure where an arc may occur during normal operations must be sealed if the conduit is within the limits specified in the NEC for Class 1, Division 1. Use Type 1 or Type 2 conduit for these runs.

Conduit for future use in structures must be threaded and capped. Conduit leading to soffit, wall, or other lights or fixtures below pull box grade must be sealed and made watertight, except where conduit ends in a No. 9 or No. 9A pull box.

Support for conduit in or on wall or bridge superstructure must comply with the following:

1. Steel hangers, steel brackets, and other fittings must comply with Section 75-1.03, "Miscellaneous Bridge Metal."
2. Construct precast concrete conduit cradles using minor concrete and commercial quality welded wire fabric. Minor concrete must comply with Section 90-10, "Minor Concrete," and contain a minimum of 590 pounds of cementitious material per cubic yard.. The cradles must be moist cured for a minimum of 3 days. Bond precast concrete cradles to structure with epoxy adhesives specified in one of the following:
 - 2.1. Section 95-2.03, "Epoxy Resin Adhesive for Bonding New Concrete to Old Concrete"
 - 2.2. Section 95-2.04, "Rapid Set Epoxy Adhesive for Pavement Markers"
 - 2.3. Section 95-2.05, "Standard Set Epoxy Adhesive for Pavement Markers"
3. Use pipe sleeve or form opening for conduit through bridge superstructure concrete. Sleeve or opening through either prestressed member or conventionally reinforced precast member must be:
 - 3.1. Transverse to the member
 - 3.2. Through the web
 - 3.3. Not more than 3 inches maximum gross opening in concrete
4. Where conduits pass through the abutment concrete, wrap conduit with 2 layers of asphalt-felt building paper securely taped or wired in place. Fill space around conduit that runs through bridge abutment wall with mortar as specified in Section 51-1.135, "Mortar," except the proportion of cementitious material to sand must be 1 to 3. Fill the space around conduits that run through abutments after prestressing is completed.
5. Run surface-mounted conduit straight and true, horizontal or vertical on the wall, and parallel to wall on ceiling or other similar surfaces. Support conduit at a maximum of 5-foot intervals or closer where necessary to prevent vibration or unsightly deflection. The supports must include galvanized malleable iron conduit clamps and clamp backs secured with expansion anchorage devices as specified for concrete anchorage devices in Section 75-1.03, "Miscellaneous Bridge Metal." Threaded studs must be galvanized and be of the largest diameter that will pass through the mounting hole in conduit clamp.
6. Where pull boxes are placed in conduit runs, conduit must be fitted with threaded bushings and bonded.
7. Mark location of conduit end in structure, curb, or wall with a "Y" that is a minimum of 3 inches tall, directly above conduit.

86-2.05D Expansion Fittings

Install expansion fitting where the conduit crosses an expansion joint in structure. Each expansion fitting for metal conduit must include a copper bonding jumper having the ampacity specified in NEC.

Each expansion-deflection fitting for expansion joints of 1-1/2-inch movement rating must be watertight and include a molded neoprene sleeve, a bonding jumper, and 2 silicon bronze or zinc-plated iron hubs. Each fitting must allow a minimum of 3/4-inch expansion, contraction, and lateral deflection.

86-2.06 PULL BOXES

86-2.06A (Blank)

86-2.06B Cover Marking

Marking must be clearly defined, uniform in depth, and parallel to either the long or short sides of cover.

Marking letters must be 1 inch to 3 inches high.

Before galvanizing steel or cast iron cover, apply marking by one of the following methods:

1. Use cast iron strip at least 1/4 inch thick with letters raised a minimum of 1/16 inch. Fasten strip to cover with 1/4 inch flathead stainless steel machine bolts and nuts. Peen bolts after tightening.
2. Use sheet steel strip at least 0.027-inch thick with letters raised a minimum of 1/16 inch. Fasten strip to cover by spot welding, tack welding, or brazing, with 1/4 inch stainless steel rivets or 1/4 inch roundhead stainless steel machine bolts and nuts. Peen bolts after tightening.
3. Bead weld the letters on cover so that letters are raised a minimum of 3/32 inch.

86-2.06C Installation and Use

Space pull boxes no more than 200 feet apart. You may install additional pull boxes to facilitate the work.

You may use a larger standard size pull box than that shown on the plans or specified.

A pull box in ground or sidewalk area must be installed as follows:

1. Embed bottom of pull box in crushed rock.
2. Place a layer of roofing paper on the crushed rock.
3. Place mortar over the layer of roofing paper. Mortar must be 0.50 inch to 1 inch thick and sloped toward the drain hole.
4. Make a 1-inch drain hole in center of pull box through mortar and roofing paper.
5. Place mortar between pull box and pull box extension, and around conduits.

The top of the pull box must be flush with the surrounding grade or the top of an adjacent curb, except in unpaved areas where the pull box is not immediately adjacent to and protected by a concrete foundation, pole, or other protective construction. Place the pull box 1-1/4 inches above the surrounding grade. Where practical, place a pull box shown in the vicinity of curbs or adjacent to a standard on the side of the foundation facing away from traffic, unless otherwise directed. If a pull box is installed in a sidewalk area, adjust the depth of the pull box so that the top of the pull box is flush with the sidewalk.

Reconstruct the sump of an existing pull box if it is disturbed by your operations. Remove old grout and replace with new if the sump was grouted.

86-2.07 TRAFFIC PULL BOXES

Comply with Sections 86-2.06B, "Cover Marking," and 86-2.06C, "Installation and Use."

Traffic pull box and cover must comply with ASTM C857, "Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures," for HS20-44 loading. You must be able to place the load anywhere on box and cover for 1 minute without causing cracks or permanent deformations.

Frame must be anchored to the box with 1/4" x 2-1/4" concrete anchors. Four concrete anchors must be included for No. 3-1/2(T) pull box; one placed in each corner. Six concrete anchors for must be included for No. 5(T) and No. 6(T) pull boxes; one placed in each corner and one near the middle of each of the longer sides.

Nuts must be zinc plated carbon steel, vibration resistant, and have a wedge ramp at the root of the thread.

After installation of traffic pull box, install steel cover and keep bolted down when your activities are not in progress at the pull box. When steel cover is placed for final time, cover and Z bar frame must be cleaned of debris and tightened securely.

Steel cover must be countersunk approximately 1/4 inch to accommodate bolt head. When tightened, bolt head must not exceed more than 1/8 inch above the top of cover.

Concrete placed around and under traffic pull box must be minor concrete as specified in Section 90-10, "Minor Concrete."

86-2.08 CONDUCTORS AND CABLES

Conductor must be copper wire that complies with ASTM B 3 and B 8.

Wire size must comply with the following:

Wire Size Requirements

Conductor usage	Requirement
In loop detector lead-in cable	ASTM B 286
Everywhere except in loop detector lead-in cable	American Wire Gage (AWG) ^a

^aExcept conductor diameter must not be less than 98 percent of specified AWG diameter.

Single conductor and cable, except detector lead-in cable, must have clear, distinctive, and permanent markings on the outer surface throughout its length. The markings must include the manufacturer's name or trademark, insulation type letter designation, conductor size, voltage, and temperature rating, and for cables, it must also include number of conductors.

86-2.08A Conductor Identification

Conductor insulation must be a solid color with a permanent stripe as specified below. The solid color must be homogeneous through the full depth of insulation. Identification stripe must be continuous throughout the length of conductor. For conductor sizes No. 2 and larger, the insulation may be black and the ends of the conductors must be taped for a minimum length of 20 inches with electrical insulating tape of the required color.

Conductor Identification

Circuit	Signal Phase or Function	Identification			Size
		Insulation Color ⁱ		Band Symbols ^f	
		Base	Stripe ^a		
Vehicle Signals ^{a,b,d}	2,6	Red, Yel, Brn	Blk	2,6	14
	4,8	Red, Yel, Brn	Ora	4,8	14
	1,5	Red, Yel, Brn	None	1,5	14
	3,7	Red, Yel, Brn	Pur	3,7	14
	Ramp Meter 1	Red, Yel, Brn	None	NBR	14
	Ramp Meter 2	Red, Yel, Brn	Blk	NBR	14
Pedestrian Signals ^d	2p,6p	Red, Brn	Blk	2p,6p	14
	4p,8p	Red, Brn	Ora	4p,8p	14
	1p,5p	Red, Brn	None	1p,5p	14
	3p,7p	Red, Brn	Pur	3p,7p	14
Pedestrian Push Buttons ^d	2p,6p	Blu	Blk	P-2,P-6	14
	4p,8p	Blu	Ora	P-4,P-8	14
	1p,5p	Blu	None	P-1,P-5	14
	3p,7p	Blu	Pur	P-3,P-7	14
Traffic Signal Controller Cabinet	Ungrounded Circuit Conductor	Blk	None	CON-1	6
	Grounded Circuit Conductor	Wht	None	CON-2	6
Highway Lighting Pull Box to Luminaire	Ungrounded-Line 1	Blk	None	NBR	14
	Ungrounded-Line 2	Red	None	NBR	14
	Grounded	Wht	None	NBR	14
Multiple Highway Lighting	Ungrounded-Line 1	Blk	None	ML1	10
	Ungrounded-Line 2	Red	None	ML2	10
Lighting Control	Ungrounded to PEU	Blk	None	C1	14
	Switching leg from PEU unit or SM transformer	Red	None	C2	14

Service	Ungrounded-Line 1 (Signals)	Blk	None	NBR ^c	6
	Ungrounded-Line 2 (Lighting)	Red ^h	None	NBR ^c	8
Sign Lighting	Ungrounded-Line 1	Blk	None	SL-1	10
	Ungrounded-Line 2	Red	None	SL-2	10
Flashing Beacons ^e	Ungrounded between Flasher and Beacons	Red or Yel	None	F-Loc. ^c	14
Grounded and Common	Pedestrian Push Buttons	Wht	Blk	NBR	14
	Signals and Multiple Lighting	Wht	None	NBR	10
	Flashing Beacons and Sign Lighting	Wht	None	NBR	12
	Lighting Control	Wht	None	C-3	14
	Multiple Service	Wht	None	NBR	14
Railroad Preemption		Blk	None	R	14
Spares		Blk	None	NBR	14

NBR = No Band Required PEU=Photoelectric unit

^aOn overlaps, insulation is striped for 1st phase in designation. e.g., phase (2+3) conductor is striped as for phase 2.

^bBand for overlap and special phases as required.

^cFlashing beacons having separate service do not require banding.

^dThese requirements do not apply to signal cable.

^e"S" if circuit is switched on line side of service equipment by utility.

^fBand conductors in each pull box and near ends of termination points. On signal light circuits, a single band may be placed around 2 or 3 ungrounded conductors comprising a phase.

^gUngrounded conductors between service switch and flasher mechanism must be black and banded.

^hBlack acceptable for size No. 2 and larger. Tape ends for 20 inches with indicated color.

ⁱColor Code: Yel-Yellow, Brn-Brown, Blu-Blue, Blk-Black, Wht-White, Ora-Orange, Pur-Purple.

86-2.08B Multiple Circuit Conductors

Conductor for multiple circuit must be UL or NRTL listed and rated for 600 V(ac) operation. Insulation for No. 14 to No. 4 conductors must be one of the following:

1. Type TW PVC as specified in ASTM D 2219
2. Type THW PVC
3. Type USE, RHH, or RHW cross-linked polyethylene

Minimum insulation thickness must comply with the following:

Insulation Thickness		
Insulation Type	Conductor Size	Insulation Thickness (mils)
USE, RHH, or RHW	No. 14 to No. 10	39
	No. 8 to No. 2	51
THW or TW	No. 14 to No. 10	27
	No. 8	40
	No. 6 to No. 2	54

Insulation for No. 2 and larger conductor must be one of the types listed above or Type THWN.

Conductor for wiring wall and soffit luminaire must be stranded copper with insulation rated for use at temperatures up to 125 °C.

86-2.08C Signal Cable

Signal cable, except for the 28-conductor type, must:

1. Not be spliced

2. Be marked in each pull box with the signal standard information it is connecting to

Signal cable must comply with the following:

1. Cable jacket must be:
 - 1.1. Black polyethylene with an inner polyester binder sheath
 - 1.2. Rated for 600 V(ac) and 75 °C
2. Filler material, if used, must be polyethylene material.
3. Conductor must be solid copper with Type THWN insulation as specified in Section 86-2.08, "Conductors and Cables," and ASTM B 286. The minimum thickness of Type THWN insulation must be 12 mils for conductor sizes No. 14 to No. 12 and 16 mils for conductor size No. 10. The minimum thickness of nylon jacket must be 4 mils.

Conductor Signal Cable Requirements

Cable Type ^a	Conductor Quantity and Type	Cable Jacket Thickness (mils)		Maximum Nominal Outside Diameter (inch)	Conductor Color Code	Remarks
		Average	Minimum			
3CSC	3 - No. 14	44	36	0.40	blue/black, blue/orange, white/black stripe	Use for pedestrian push buttons and spare
5CSC	5 - No. 14	44	36	0.50	red, yellow, brown, black, white	
9CSC	8 - No. 14 1 - No. 12	60	48	0.65	No. 12 - white No. 14 - red, yellow, brown, black, and red/black, yellow/black, brown/black, white/black stripe	
12CSC	11 - No. 14 1 - No. 12	60	48	0.80	No. 12 - white No. 14 - see "12CSC Color Code and Functional Connection" table	Use for vehicle signals, pedestrian signals, spares, and signal common
28CSC	27 - No. 14 1 - No. 10	80	64	0.90	No. 10 - white No. 14 - see "28CSC Color Code and Functional Connection" table	Keep signal commons in each cable separate except at the signal controller. Label each cable as "C1" or "C2" in pull box. Use "C1" for signal phases 1, 2, 3, and 4. Use "C2" for phases 5, 6, 7, and 8.

^aConductor signal cable description starts with the number of conductors, followed by "CSC". (e.g., a signal cable with 3 conductors is labeled "3CSC.")

12CSC Color Code and Functional Connection

Color Code	Termination	Phase
Red	Vehicle signal red	2, 4, 6, or 8
Yellow	Vehicle signal yellow	2, 4, 6, or 8
Brown	Vehicle signal green	2, 4, 6, or 8
Red/black stripe	Vehicle signal red	1, 3, 5, or 7
Yellow/black stripe	Vehicle signal yellow	1, 3, 5, or 7
Brown/black stripe	Vehicle signal green	1, 3, 5, or 7
Black/red stripe	Spare, or use as required for red or DONT WALK	
Black/white stripe	Spare, or use as required for yellow	
Black	Spare, or use as required for green or WALK	
Red/white stripe	Ped signal DONT WALK	
Brown/white stripe	Ped signal WALK	

28CSC Color Code and Functional Connection

Color Code	Termination	Phase
Red/black stripe	Vehicle signal red	2 or 6
Yellow/black stripe	Vehicle signal yellow	2 or 6
Brown/black stripe	Vehicle signal green	2 or 6
Red/orange stripe	Vehicle signal red	4 or 8
Yellow/orange stripe	Vehicle signal yellow	4 or 8
Brown/orange stripe	Vehicle signal green	4 or 8
Red/silver stripe	Vehicle signal red	1 or 5
Yellow/silver stripe	Vehicle signal yellow	1 or 5
Brown/silver stripe	Vehicle signal green	1 or 5
Red/purple stripe	Vehicle signal red	3 or 7
Yellow/purple stripe	Vehicle signal yellow	3 or 7
Brown/purple stripe	Vehicle signal green	3 or 7
Red/2 black stripes	Ped signal DONT WALK	2 or 6
Brown/2 black stripes	Ped signal WALK	2 or 6
Red/2 orange stripes	Ped signal DONT WALK	4 or 8
Brown/2 orange stripes	Ped signal WALK	4 or 8
Red/2 silver stripes	Overlap A, C red	OLA, OLC
Brown/2 silver stripes	Overlap A, C green	OLA, OLC
Red/2 purple stripes	Overlap B, D red	OLB, OLD
Brown/2 purple stripes	Overlap B, D green	OLB, OLD
Blue/black stripe	Ped push button	2 or 6
Blue/orange stripe	Ped push button	4 or 8
Blue/silver stripe	Overlap A, C yellow	OLA(y), OLC(y)
Blue/purple stripe	Overlap B, D yellow	OLB(y), OLD(y)
White/black stripe	Ped push button common	
Black/red stripe	Railroad preemption	
Black	Spare	

86-2.08D Signal Interconnect Cable (SIC)

Signal interconnect cable must be a 3-pair or 6-pair type with stranded tinned copper No. 20 conductors. Each conductor insulation must be 13 mils minimum nominal thickness, color-coded, polypropylene material. Conductors must be in twisted pairs. Color coding distinguishes each pair. Each pair must be wrapped with an aluminum polyester shield and must have a No. 22 or larger stranded tinned copper drain wire inside the shielded pair.

Cable jacket must be black, high density polyethylene, rated for a minimum of 300 V(ac) and 60 °C, and must have a minimum nominal wall thickness of 40 mils. Cable jacket or moisture-resistant tape directly under the outer jacket must be marked as specified in Section 86-2.08.

You must have a minimum of 6 feet of slack at each controller cabinet. Splicing is allowed only if shown on the plans.

Insulate conductor splice with heat-shrink tubing and overlap at least 0.6 inch. Cover overall cable splice with heat-shrink tubing and overlap the cable jacket at least 1-1/2 inch.

86-2.09 WIRING

Run conductors in conduit, except for overhead and temporary installations and where conductors are run inside poles.

Solder by hot iron, pouring, or dipping method, connectors and terminal lugs for conductor sizes No. 8 and smaller. Do not perform open-flame soldering.

86-2.09A Circuitry

Do not run traffic signal indication conductors to a terminal block on a standard unless connected to a mounted signal head.

Use only 1 conductor to connect to each terminal of a pedestrian push button.

The common for pedestrian push button circuit must be separate from traffic signal circuit grounded conductor.

86-2.09B Installation

Use a UL- or NRTL-listed inert lubricant for placing conductors in conduit.

Pull conductors into conduit by hand using pull tape specified in Section 86-2.05C, "Installation." Do not use winches or other power-actuated pulling equipment.

If adding new conductors or removing existing conductors, remove all conductors, clean conduit as specified in Section 86-2.05C, "Installation," and pull all conductors in conduit as 1 unit.

If traffic signal conductors are run in lighting standard containing street lighting conductors from a different service point, you must encase the traffic signal conductors or the lighting conductors with a flexible or rigid metal conduit for a length until the 2 types of conductors are no longer in the same raceway.

If less than 10 feet above grade, enclose temporary conductors in flexible or rigid metal conduit.

Leave slack for each conductor as follows:

Conductor Slack Requirements

Location	Slack (feet)
Signal standard	1
Lighting standard	1
Signal and lighting standard	1
Pull box	3
Splice	3
Standards with slip base	0

After conductors are installed, seal ends of conduits with an approved sealing compound.

To form a watertight seal, tape ends of spare conductors and conductors ending in pull boxes.

Conductors and cables inside fixture or cabinet must be neatly arranged and tied together by function with self-clinching nylon cable ties or enclosed in plastic tubing or raceway.

Identify conductors for signal overlap phase as specified for vehicle signals in the table titled "Conductor Identification."

Permanently identify conductors by function. Place identification on each conductor, or each group of conductors forming a signal phase, at each pull box and near the end of conductors.

Label, tag, or band conductors by mechanical methods. Identification must not move along the conductors.

86-2.09C Connectors and Terminals

Connectors and terminals must be UL- or NRTL-listed crimp type. Use manufacturer-recommended tool for connectors and terminals to join conductors. Comply with MIL-T-7928.

Terminate stranded conductors smaller than No. 14 in crimp style terminal lugs.

86-2.09D Splicing and Terminations

Splices are allowed for:

1. Grounded conductors in pull box.
2. Pedestrian push button conductors in pull box.
3. Conductors in pull box adjacent to each electrolier or luminaire.
4. Ungrounded traffic signal conductors in pull box, if traffic signals are modified.

5. Ungrounded traffic signal conductors to a terminal compartment or signal head on a standard with conductors of the same phase in the pull box adjacent to the standard.
6. Ungrounded lighting circuit conductors in pull box, if lighting circuits are modified.

86-2.09E Splice Insulation

Splice must function under continuous submersion in water.

Multi-conductor cable must be spliced and insulated to form a watertight joint and to prevent moisture absorption by the cable.

Low-voltage tape must be:

1. UL or NRTL listed
2. Self-fusing, oil and flame-resistant, synthetic rubber
3. PVC, pressure-sensitive adhesive of 6 mils minimum thickness

Insulating pad must be a combination of an 80-mils thick electrical grade PVC laminate and a 120-mils thick butyl splicing compound with removable liner.

Heat-shrink tubing must comply with the following:

1. Be medium or heavy wall thickness, irradiated polyolefin tubing with an adhesive mastic inner wall.
2. Before contraction, minimum wall thickness must be 40 mils.
3. Heating must be as recommended by the manufacturer. Do not perform open-flame heating.
4. When heated, the inner wall must melt and fill crevices and interstices of the covered object and the outer wall must shrink to form a waterproof insulation.
5. After contraction, each end of the heat-shrink tubing or the open end of end cap of heat-shrink tubing must overlap the conductor insulation at least 1-1/2 inches. Coat ends and seams with electrical insulation coating.
6. Comply with requirements for extruded insulated tubing at 600 V(ac) in UL Standard 468D and ANSI C119.1, and the following requirements:

Heat-Shrink Tubing Requirements

Shrinkage Ratio	33 percent, maximum, of supplied diameter when heated to 125 °C and allowed to cool to 25 °C
Dielectric Strength	350 kV per inch, minimum
Resistivity	25 ¹³ Ω per inch, minimum
Tensile Strength	2,000 psi, minimum
Operating Temperature	-40 °C to 90 °C (135 °C in emergency)
Water Absorption	0.5 percent, maximum

7. If 3 or more conductors are to be enclosed in 1 splice, place mastic around each conductor before placing inside tubing. Use mastic type recommended by heat-shrink tubing manufacturer.

You may use "Method B" as an alternative method for splice insulation. Use at least 2 thicknesses of electrical insulating pad. Apply pad to splice as recommended by manufacturer.

86-2.095 FUSED SPLICE CONNECTORS

Install a fused disconnect splice connector in each ungrounded conductor, between the line and the ballast, in the pull box adjacent to each luminaire. Connector must be accessible in the pull box.

For 240 and 480 V(ac) circuits, each connector must simultaneously disconnect both ungrounded conductors. Connector must not have exposed metal parts, except for the head of stainless steel assembly screw. Recess head of stainless steel assembly screw a minimum of 1/32 inch below top of plastic boss that surrounds the head.

Splice connector must protect fuse from water or weather damage. Contact between fuse and fuseholder must be spring loaded. Splice connector terminals must be:

1. Rigidly crimped, using a tool recommended by manufacturer of fused splice connector, onto ungrounded conductors
2. Insulated
3. Watertight

Fuses must be standard midget ferrule type, with "Non-Time-Delay" feature, and 13/32" x 1-1/2".

86-2.10 BONDING AND GROUNDING

Secure all metallic components, mechanically and electrically, to form a continuous system that is effectively grounded.

Bonding jumper must be copper wire or copper braid of the same cross sectional area as a No. 8 or larger to match the load. Equipment grounding conductors must be color coded as specified in NEC or be bare.

Attach bonding jumper to standard as follows:

Bonding Jumper Attachment	
Standard type	Requirements
Standard with handhole and traffic pull box lid cover	Use UL-listed lug and 3/16-inch diameter or larger brass or bronze bolt. Run jumper to conduit or bonding wire in adjacent pull box. Grounding jumper must be visible after the standard is installed and mortar pad is placed on foundation.
Standard without handhole	Use UL-listed ground clamp on each anchor bolt.
Slip-base standard	Use UL-listed ground clamp on each anchor bolt or attach UL-listed lug to bottom slip-base plate with 3/16-inch diameter or larger brass or bronze bolt.

Ground one side of secondary circuit of step-down transformer.

Ground metal conduit, service equipment, and grounded conductor at service point as specified by NEC and service utility, except grounding electrode conductor must be No. 6 or larger.

Equipment bonding and grounding conductors are required in conduit. Run a No. 8 minimum bare copper wire continuously in conduit system. The bonding wire must be sized as specified in the NEC.

Ground electrode must be:

1. 1 piece
2. 10-foot minimum length of one of the following:
 - 2.1. Galvanized steel rod or pipe not less than 3/4 inch in diameter
 - 2.2. Copper clad steel rod not less than 5/8 inch in diameter
3. Installed as specified in NEC
4. Bonded to service equipment using one of the following:
 - 4.1. Ground clamp
 - 4.2. Exothermic weld
 - 4.3. No. 6 or larger copper conductor

On wood pole, metallic equipment mounted less than 8 feet above ground surface must be grounded.

Bond metallic conduit in non-metallic pull box using bonding bushing or bonding jumper.

Bond metallic conduit in metal pull box using bonding bushings and bonding jumpers connected to bonding wire running in the conduit system.

86-2.11 SERVICE

Electrical service installation and materials must comply with service utility requirements.

If service equipment is to be installed on utility-owned pole, you must furnish and install conduit, conductors, and other necessary material to complete service installation. Service utility will decide riser and equipment position.

Install service equipment early on to allow service utility to schedule its work before project completion.

Furnish each service with a circuit breaker that simultaneously disconnects all ungrounded service entrance conductors.

Circuit breakers must:

1. Be quick-break on either automatic or manual operation.
2. Have operating mechanism that is enclosed and trip-free from operating handle on overload.

3. Be trip indicating.
4. Have frame size plainly marked.
5. Have trip rating clearly marked on operating handle.
6. Have overload tripping of breakers not influenced by ambient temperature range of -18 °C to 50 °C.
7. Be internal trip type.
8. Be UL or NRTL listed and comply with UL 489 or equal.
9. Have minimum interrupting capacity of 10,000 A, rms, if used as service disconnect.

Service equipment enclosure must be a NEMA 3R enclosure with dead-front panel and a hasp with a 7/16-inch hole for a padlock. Enclosure must be field marked as specified in the NEC to warn qualified persons of potential electric arc flash hazards.

Service equipment enclosure, except Types II and III, must be galvanized or have a factory-applied rust-resistant prime coat and finish coat.

Types II and III service equipment enclosures must be manufactured from one of the following:

1. Galvanized sheet steel
2. Sheet steel plated with zinc or cadmium after manufacturing
3. Aluminum

Manufacture service equipment enclosure as specified in Section 86-3.04A, "Cabinet Construction." Overlapping exterior seams and doors must comply with requirements for NEMA 3R enclosures in the NEMA Enclosure Standards.

If an alternative design is proposed for Type II or III service equipment enclosure, submit plans and shop drawings to the Engineer for approval before manufacturing.

Except for falsework lighting and power for your activities, when you submit a written request, the Engineer will arrange:

1. With the service utility to complete service connections for permanent installations and the Department will pay all costs and fees required by the service utility. Submit request at least 15 days before service connections are required.
2. For furnishing electrical energy. Energy used before contract completion will be charged to you, except cost of energy used for public benefit as ordered by the Engineer will be paid by the Department or local authorities.

Full compensation for furnishing and installing State-owned or permanent service poles, service equipment, conduit, conductors, and pull boxes, including equipment, conduit, and conductors placed on utility-owned poles, is included in the contract item of electrical work involved and no additional compensation will be allowed therefor.

If the service point is indeterminate and is shown on the plans as "approximate location" or "service point not yet established," the labor and materials required for making the connection between the service point, when established, and the nearest pull box shown on the plans will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

86-2.12 WOOD POLES

Wood poles must comply with the following:

1. Class 5 or larger as specified in ANSI O 5.1
2. Less than 180-degree twist in grain over the full length
3. 4-inch or less sweep
4. Beveled top
5. Placed in ground at least 6 feet
6. Length must be:
 - 6.1. 25 feet for service pole
 - 6.2. 35 feet for other

After each pole is set in ground, backfill space around pole with selected earth or sand, free of rocks and other deleterious material, placed in 4-inch thick layers. Moisten each layer and thoroughly compact.

Manufacture mast arm from standard pipe, free from burrs. Each mast arm must have an insulated wire inlet and wood pole mounting brackets for mast arm and tie-rod cross arm. Manufacture tie rod from structural steel and pipe.

Mount mast arm for luminaire to provide a 34-foot mounting height for a 200 W high pressure sodium luminaire and 40-foot mounting height for 310 W high pressure sodium luminaire. Traffic signals and flashing beacons on mast arm must provide a minimum vertical clearance of 17 feet from bottom of equipment to pavement.

After manufacturing, pressure-treat pole as specified in Section 58, "Preservative Treatment of Lumber, Timber and Piling," and AWPAs Use Category System: UC4B, Commodity Specification D.

If specified, treat pole with waterborne wood preservative.

86-2.13 LIGHTING AND SIGN ILLUMINATION CONTROL

Enclosure for the circuit breaker for lighting and sign illumination control must:

1. Be NEMA 3R
2. Be galvanized, cadmium plated, or powder-coated
3. Include dead front panel and a hasp with a 7/16 inch diameter hole for padlock

86-2.14 TESTING

86-2.14A Materials Testing

Deliver material and equipment to be tested to either the Transportation Laboratory or a testing location ordered by the Engineer.

Allow 30 days for acceptance testing from the time material or equipment is delivered to test site. You must pay for all shipping, handling, and related transportation costs associated with testing. If equipment is rejected, you must allow 30 days for retesting. Retesting period starts when corrected equipment is delivered to test site. You must pay for all retesting costs. Delays resulting from submittal of non-compliant materials do not relieve you from executing the contract within the allotted time.

If equipment submitted for testing does not comply with specifications, remove the equipment within 5 business days after notification that the equipment is rejected. If equipment is not removed within that period, it may be shipped to you at your expense.

When testing is complete, you will be notified. You must pick up the equipment at the test site and deliver it to the job site.

Testing and quality control procedures for all other traffic signal controller assemblies must comply with NEMA TS Standards for Traffic Control Systems.

86-2.14B Field Testing

Before starting functional testing, perform the following tests in the presence of the Engineer:

86-2.14B(1) Continuity

Test each circuit for continuity.

86-2.14B(2) Ground

Test each circuit for grounds.

86-2.14B(3) Insulation Resistance

Perform insulation resistance test at 500 V(dc) on each circuit between the circuit and a ground. Insulation resistance must be 10 MΩ minimum on all circuits, except for inductive loop detector circuits that must have an insulation resistance value at least 100 MΩ.

86-2.14C Functional Testing

Test periods must comply with Section 86-1.07, "Scheduling of Work."

Acceptance of new or modified traffic signal will be made only after all traffic signal circuits have been thoroughly tested.

Perform functional test to show that each part of the system functions as specified.

Functional test for each new or modified system must include at least 5 business days of continuous, satisfactory operation. If unsatisfactory performance of the system occurs, the condition must be corrected and the system retested until the 5 business days of continuous, satisfactory operation is obtained.

Except for new or modified parts of existing lighting circuit and sign illumination system, the State or local agency will maintain the system during test period and pay the electrical energy cost. Except for electrical energy, you must pay the cost of necessary maintenance performed by the State or local agency on new circuits or on the portions of existing circuits modified under the contract.

Shutdown of electrical system caused by traffic from a power interruption or from unsatisfactory performance of State-furnished materials does not constitute discontinuity of the functional test.

86-2.15 GALVANIZING

Galvanize as specified in Section 75-1.05, "Galvanizing." Cabinet material may be galvanized before manufacturing as specified in ASTM A 653/653M, Coating Designation G 90.

Steel pipe standard and pipe mast arm must be hot-dip galvanized after manufacturing and must comply with Section 75-1.05, "Galvanizing." . Remove spikes from galvanized surfaces.

A minimum of 10 inches of upper end of anchor bolts, anchor bars or studs, and nuts and washers must be galvanized as specified in Section 75-1.05, "Galvanizing."

After galvanizing, bolt threads must accept galvanized standard nuts without requiring tools or causing removal of protective coatings.

Galvanizing existing materials in an electrical installation will not be required.

86-2.16 PAINTING

Paint electrical equipment and material as specified in Section 59, "Painting," and the following:

1. Use paint material specified in Section 91, "Paint."
2. Factory or shop cleaning methods for metals are acceptable if equal to the methods specified.
3. Instead of temperature and seasonal restrictions for painting as specified in Section 59, "Painting," paint may be applied to equipment and materials for electrical installations if ordered by the Engineer.
4. Ungalvanized ferrous surface to be painted must be cleaned before applying prime coat. Blast cleaning is not required.
5. If an approved prime coat is applied by manufacturer, and in good condition, the 1st primer application is not required.
6. Existing equipment to be painted in the field, including State-furnished equipment, must be washed with a stiff bristle brush using a solution of water containing 2 tablespoons of heavy duty detergent powder per gallon. After rinsing, surface must be wire-brushed with a coarse, cup-shaped, power-driven brush to remove badly bonded paint, rust, scale, corrosion, grease, or dirt. Dust or residue remaining after wire brushing must be removed before priming.
7. Do not paint galvanized metal guard post, galvanized equipment, State-furnished controller cabinet, and wood poles for traffic signal or flashing beacon.
8. New galvanized metal surface to be painted in the field must be cleaned as specified for existing equipment before applying the prime coat. Do not wire brush new galvanized surface.
9. After erection, examine exterior surface for damaged primer, clean, and spot coat with primer.
10. Paint Types II and III steel service equipment enclosures with a polymeric or an enamel coating system matching Color No. 14672, light green, of Federal Standard 595B. Coating must be commercially smooth and free of flow lines, paint washout, streaks, blisters, and other defects that would impair serviceability or detract from general appearance. Coating must comply with the following:
 - 10.1. Coating hardness - Finish must have pencil lead hardness of HB, minimum, using an Eagle Turquoise pencil.
 - 10.2. Salt spray resistance - Undercutting coating system's film must not exceed 1/8-inch average, from lines scored diagonally and deep enough to expose the base metal, after 336 hours of exposure in a salt spray cabinet complying with ASTM B 117.
 - 10.3. Adherence - Must not have coating loss when tested as specified in California Test 645. Perform testing by applying coating to 4" x 8" x 0.024" test specimens of the same material as the cabinet, using the same application method.
11. Finish interior of metal signal visor, louver, and front face of back plates with 2 applications of lusterless black exterior grade latex paint formulated for application to properly prepared metal surface. Good condition factory finish will be acceptable.
12. Finish metal signal section, signal head mounting, brackets and fittings, outside of visor, pedestrian push button housing, pedestrian signal section and visor, and back face of back plate with 2 applications of

- lusterless black or dark olive green exterior grade latex paint formulated for application to properly prepared metal surface. Match dark olive green color to Color Chip No. 68 filed at the Transportation Laboratory.
13. Prepare and finish conduit and conduit fitting above ground the same as adjacent standard or post.
 14. Relocated, reset or modified equipment previously finished as specified in this section, except for previously-finished galvanized standard with traffic signal yellow enamel, must be given a spot finishing application on newly primed areas and 1 finishing application over the entire surface. If signal face or mounting brackets are required to be painted under this section, all signal faces and mounting brackets on the same mounting must be repainted.
 15. Small rusted or repaired areas of relocated or reset galvanized equipment must be cleaned and painted as specified in Section 75-1.05, "Galvanizing," for repairing damaged galvanized surfaces.
 16. Stencil equipment number neatly on the standard or adjacent structure. Obtain number from the Engineer.
 17. Perform painting neatly. The Engineer reserves the right to require use of brushes if the work performed by paint spraying machine is unsatisfactory.

86-3 CONTROLLER ASSEMBLIES

86-3.01 CONTROLLER ASSEMBLIES

A controller assembly houses a complete mechanism for controlling the operation of traffic signals or other systems.

Model 170 and Model 2070, specified as a Model 170/2070 controller assembly, includes a Model 170, 170E or 2070 controller unit, a wired cabinet, and all auxiliary equipment required to control the system.

86-3.02 (BLANK)

86-3.03 (BLANK)

86-3.04 CONTROLLER CABINETS

Controller cabinets for controller assemblies other than Model 170/2070 must comply with the following:

86-3.04A Cabinet Construction

Cabinet must be rainproof and the top crowned 1/2 inch or slanted toward the back to prevent standing water. Cabinet and door must be manufactured from one of the following:

1. 0.073-inch minimum thickness cold-rolled steel with continuously-welded exterior seams
2. 0.073-inch minimum thickness stainless steel with overlapping exterior seams complying with Type 4 enclosures of the NEMA Enclosure Standards
3. 0.125-inch minimum thickness aluminum with continuously-welded exterior seams

Exterior welds must be ground smooth and edges filed to a radius of at least 0.03 inch.

Cabinet manufactured from cold-rolled steel must comply with Section 86-2.16, "Painting," and the following:

1. Cabinet manufactured from cold-rolled steel must be finished with a polymeric or an enamel coating system conforming to Color No. 14672 of Federal Standard 595B.
2. Cabinet must not have coating loss when 2 test specimens, 4" x 8", of the same material and coating as the cabinet are tested. Two 9-inch-diagonal scratches exposing bare metal will be made on a specimen. Soak specimen in demineralized water for 192 hours. Tightly affix a 1-inch wide strip of masking tape to the surface and remove with one quick motion. Specimen showing evidence of blistering, softening, or peeling of paint or coating from the base metal will be rejected. Testing must comply with California Test 645, except passing 180 Degree Bend Test is not required.
3. Metal must be prepared by the 3-step, iron phosphate conversion coating bonderizing technique.
4. Inside walls, doors, and ceiling of the housing must be the same as the outside finish.

Cabinet manufactured from stainless steel must comply with the following:

1. Use annealed or quarter-hard stainless steel that complies with ASTM A 666 for Type 304, Grades A or B.
2. Use gas tungsten arc welding (GTAW) process with bare stainless steel welding electrodes. Electrodes must comply with AWS A5.9 for ER308 chromium-nickel bare arc welding electrodes.

3. Procedures, welder, and welding operator must comply with requirements and practices recommended in AWS C5.5.
4. Ground or brush exposed, exterior surfaces of stainless steel cabinet to a 25 to 50-microinch finish using iron-free abrasives or stainless steel brushes.
5. After grinding or brushing, cabinet must not show rust discoloration when:
 - 5.1. Exposed for 48 hours in a salt spray cabinet as specified in ASTM B 117
 - 5.2. Exposed 24 hours in a tap water spray cabinet with the water temperature between 38 °C and 45 °C
6. After the test, cabinet showing rust discoloration anywhere on its surface will be rejected. Rejected cabinets may be cleaned, passivated, and resubmitted for testing.

Cabinet manufactured from aluminum sheet must comply with ASTM B 209 or B 209M for 5052-H32 aluminum sheet, and the following:

1. Use gas metal arc welding (GMAW) process with bare aluminum welding electrodes. Electrodes must comply with AWS A5.10 for ER5356 aluminum alloy bare welding electrodes.
2. Procedures, welder, and welding operator for welding must comply with requirements in AWS B3.0, "Welding Procedure and Performance Qualification," and to practices recommended in AWS C5.6.
3. Surface finish of each aluminum cabinet must comply with MIL-A-8625 for a Type II, Class I coating, except anodic coating must have a minimum thickness of 0.0007 inch and a minimum coating weight of 0.001 ounce per square inch. The anodic coating must be sealed in a 5 percent aqueous solution of nickel acetate, pH 5.0 to 6.5, for 15 minutes at 97 °C. Before applying anodic coating, clean and etch cabinets using the steps below:
 - 3.1. Clean by immersing into inhibited alkaline cleaner, Oakite 61A, Diversey 909, or equal, 6 to 8 ounces per gallon at 71 °C for 5 minutes.
 - 3.2. Rinse in cold water.
 - 3.3. Etch in solution of 1-1/2 ounce of sodium fluoride and 4 to 6 ounces of sodium hydroxide per gallon of distilled water at 60 °C to 65 °C for 5 minutes.
 - 3.4. Rinse in cold water.
 - 3.5. Immerse in 50 percent by volume nitric acid solution at room temperature for 2 minutes.
 - 3.6. Rinse in cold water.

Cabinet must have:

1. Single front door with:
 - 1.1. 44-inch maximum door width.
 - 1.2. Lock, when closed and latched, that is locked.
 - 1.3. Police panel mounted on door, equipped with a keyed lock and 2 police keys. Each police key must have a shaft at least 1-3/4 inch in length.
2. Dust-tight gasketing on all door openings, permanently bonded to the metal. Mating surface of the gasketing must be covered with silicone lubricant to prevent sticking.
3. Handle that:
 - 3.1. Allows padlocking in closed position
 - 3.2. Has a minimum length of 7 inches
 - 3.3. Has a 5/8-inch, minimum, steel shank
 - 3.4. Is manufactured of cast aluminum, or zinc-plated or cadmium-plated steel
4. Cabinet door frame with:
 - 4.1. Latching mechanism that:
 - 4.1.1. Holds tension on and forms a firm seal between door gasketing and frame.
 - 4.1.2. Is a 3-point cabinet latch with nylon rollers that have a minimum diameter of 3/4 inch and equipped with ball bearings.

4.1.3. Has a center catch and a pushrod made of zinc-plated or cadmium-plated steel. Pushrod must be at least 1/4" x 3/4" and turned edgewise at outer supports. Cadmium plating must comply with MIL-QQ-416. Zinc plating must comply with MIL-QQ-325.

4.2. Hinging that:

4.2.1. Has 3-bolt butt hinges, each having a stainless steel fixed pin. Hinges must be stainless steel or may be aluminum for aluminum cabinet.

4.2.2. Is bolted or welded to the cabinet. Hinge pins and bolts must not be accessible when door is closed.

4.2.3. Has a catch to hold the door open at 90 degrees and 180 degrees, ± 10 degrees, if a door is larger than 22 inches in width or 6 square feet in area. Catch must be at least 3/8-inch diameter, stainless steel plated rod capable of holding door open at 90 degrees in a 60 mph wind at an angle perpendicular to the plane of the door.

5. Lock that:

5.1. Is solid brass, 6-pin tumbler, rim type

5.2. Has rectangular, spring-loaded bolts

5.3. Is left hand and rigidly mounted with stainless steel machine screws approximately 2 inches apart

5.4. Extends 1/8 to 3/8 inch beyond the outside surface of door

6. 2 keys that are removable in the locked and unlocked positions.

Submit alternative design details for review and approval before manufacturing cabinet.

Use metal shelves or brackets that will support controller unit and auxiliary equipment.

Machine screws and bolts must not protrude outside the cabinet wall.

86-3.04B Cabinet Ventilation

Each controller cabinet must have:

1. 8 screened, 1/2-inch diameter or larger, raintight vent holes, in lower side or bottom of cabinet. You may use louvered vents with a permanent metal mesh or 4-ply woven polypropylene air filter held firmly in place, instead.

2. Electric fan with ball or roller bearings and capacity of at least 100 cubic feet per minute. Fan must be thermostatically controlled and manually adjustable to turn on between 32 °C and 65 °C with a differential of not more than 6 °C between automatic turn on and turn off. Fan circuit must be fused at 125 percent of ampacity of installed fan motor.

Fan and cabinet vent holes must be positioned to direct bulk of airflow over controller unit or through ventilating holes of controller unit.

86-3.04C Cabinet Wiring

Conductors used in controller cabinet wiring must:

1. Be neatly arranged and laced, or enclosed in plastic tubing or raceway.

2. End with properly sized captive or spring-spade terminal or be soldered to a through-panel solder lug on the back side of the terminal block. Apply crimp-style connector with proper tool to prevent opening of handle until crimp is completed.

Controller cabinet must have an equipment grounding conductor bus that is grounded to the cabinet and connected to metal conduit system or other approved ground with a No. 8, or larger, grounding conductor.

With all cabinet equipment in place and connected, resistance between grounded conductor terminal bus and equipment grounding conductor bus must be 50 M Ω , minimum, when measured with an applied voltage of 150 V(dc).

If direct current is to be grounded, connect to equipment ground only.

Use two or more terminal blocks for field connection. Install field terminal within 22 inches from front of cabinet and orient for screwdriver operation. Terminal must be a minimum of 5 inches above foundation.

No more than 3 conductors per terminal are allowed. Two flat metal jumpers, straight or U shaped, may be placed under terminal screw. At least 2 full threads of terminal screws must be fully engaged when screw is tightened. Live parts must not extend beyond the barrier.

86-3.05 CABINET ACCESSORIES

86-3.05A Labels

Include permanently printed, engraved, or silk-screened label for equipment and removable items of equipment. Labeling must match cabinet wiring diagram. Label for shelf-mounted equipment must be on shelf face below item. Label for wall-mounted equipment must be below item.

86-3.05B Convenience Receptacle

Mount convenience receptacle in a readily accessible location inside the cabinet.

Convenience receptacle must be a duplex, 3-prong, NEMA 5-15R grounding type outlet that complies with UL Standard 943.

86-3.05C Surge Arrestor

Surge arrestor must reduce effects of power line voltage transients and have ratings as follows:

Recurrent peak voltage	184 V(ac)
Energy rating, maximum	20 J
Power dissipation, average	0.85 W
Peak current for pulses less than 7 μ s	1,250 A

Standby current must be 1 mA or less for 120 V(ac), 60 Hz sinusoidal input.

86-3.05D Terminal Blocks

Terminal block must be rated 600 V(ac), minimum, and have nickel-, silver-, or cadmium-plated brass binder head screw terminal.

Heavy duty terminal block must be rated at 20 A and have 12 position with No. 10 x 5/16-inch nickel-plated brass binder head screws and nickel-plated brass inserts. Each position must have 2 screw-type terminals. Terminal block must be barrier type with shorting bars in each of the 12 positions, and must have integral type marking strips.

Light duty terminal block must be rated at 5 A and have 12 positions with No. 6 x 1/8 inch binder head screws. Each position must have 1 screw-type terminal.

86-3.06 COMPONENTS

86-3.06A Toggle Switches

Toggle switch must:

1. Have poles as required
2. Be rated at 200 percent of circuit current for circuits of 10 A or less and 125 percent of circuit current for circuits over 10 A

86-3.06B Cartridge Fuses

Install cartridge fuse in panel-mounted fuseholder. Fuse type and rating must be as recommended by the fuse manufacturer for protecting the load.

86-3.06C Circuit Breakers

Circuit breaker must comply with Section 86-2.11, "Service," except breaker must have a minimum interrupting capacity of 5,000 A, rms.

86-3.06D Connectors

Use connector designed to interconnect various parts of circuit together and constructed for the application involved. Design connector for positive connection of circuit and easy insertion and removal of mating contacts. Connector must be permanently keyed to prevent improper connection of circuit.

Connector, or device plugging into connector, must have positive connection to prevent a circuit from breaking due to vibration, a pull on connecting cable, or similar disruptive force.

86-4 TRAFFIC SIGNAL FACES AND FITTINGS

86-4.01 VEHICLE SIGNAL FACES

Each vehicle signal face must:

1. Be adjustable and allow for 360-degree rotation about vertical axis
2. Comply with ITE publication ST-017B, "Vehicle Traffic Control Signal Heads"
3. Comply with California Test 604, except for arrow and "X" faces
4. Have 3 sections arranged vertically: red at top, yellow at center, and green at bottom
5. Be of the same manufacturer and material, if more than 1 is installed at an intersection, except for programmed visibility type
6. Be sealed with neoprene gasket at top opening
7. Be LED modules

86-4.01A Signal Sections

Each signal section must comply with the following:

1. Maximum height must be 10-1/4 inches for an 8-inch section and 14-3/4 inches for a 12-inch section.
2. Housing must:
 - 2.1. Be either die-cast or permanent mold-cast aluminum, or if specified, be structural plastic.
 - 2.2. Comply with ITE publication ST-017B if die-cast or permanent mold-cast aluminum is used.
 - 2.3. Have a 1-piece, hinged, square-shaped door designed to allow access for relamping without the use of tools. Door must be secured to hold the door closed during loading tests. Module or lens must be watertight and mounted in the door.
3. Hinge pins, door latching devices, and other exposed hardware must be Type 304 or 305 stainless steel. Interior screws and fittings must be stainless steel, or steel with a corrosion resistant plating or coating.
4. Opening must be placed on top and bottom to receive 1-1/2-inch pipe. The 8-inch and 12-inch sections of an individual manufacturer must be capable of joining to form a signal face in any combination. This interchangeability is not required between metal and plastic sections.
5. Gaskets must be made of a material that is not affected if installed in a section with metal or plastic housing that is continuously operated for 336 hours.

Structural failure is described as follows:

Signal Section Structural Failure

Signal Section Type	Requirements	Description of Structural Failure
Metal	California Test 666	Fracture within housing assembly or deflection of more than half the lens diameter of signal section during wind load test
Plastic	California Test 605	Fracture within housing assembly or deflection of more than 10 degrees in either the vertical or horizontal plane after wind load has been removed from front of signal face, or deflection of more than 6 degrees in either the vertical or horizontal plane after wind load has been removed from back of signal face

86-4.01A(1) Metal Signal Sections

Each metal signal section must have a metal visor. Metal signal faces requiring backplates must have metal backplates.

86-4.01A(2) Plastic Signal Sections

Housing must be molded in 1 piece, or fabricated from 2 or more pieces and joined into a single piece. Plastic must have ultraviolet stability, be unaffected by lamp heat, and be self-extinguishing. Housing and door must be colored throughout and be black, matching Color No. 17038, 27038, or 37038 of Federal Standard 595B.

Each face section must be joined to adjacent section by one of the following:

1. Minimum of 3 machine screws for 8-inch sections and 4 machine screws for 12-inch sections, installed through holes near front and back of housing. Each screw must be a No. 10 and have a nut, flat washer, and lock washer.
2. Two machine screws, each with a nut, flat washer, and lock washer, installed through holes near the front of the housing, and a fastening through the 1-1/2-inch pipe opening. Fastening must have 2 large flat washers to distribute the load around the pipe opening and 3 carriage bolts, each with a nut and lock washer. Minimum screw size must be No. 10. Minimum carriage bolt size must be 1/4 inch.

Supporting section of each signal face supported only at top or bottom must have reinforcement.

Reinforcement plate must be either sheet aluminum, galvanized steel, or cast aluminum. Each plate must be a minimum of 0.11-inch thick and have a hole concentric with 1-1/2-inch pipe-mounting hole in the housing. Place reinforcement plate as follows:

Reinforcement Plate Placement

Type of Reinforcement Plate	Placement
Sheet aluminum	Inside and outside of housing
Galvanized steel	Inside of housing
Cast aluminum	Outside of housing

Reinforcement plates placed outside of the housing must be finished to match signal housing color and be designed to allow proper serrated coupling between signal face and mounting hardware. Minimum of 3 No. 10 machine screws must be installed through holes in each plate and matching holes in the housing. Each screw must have a round or binder head, a nut, and lock washer.

If signal face is supported by a Type MAS side attachment slip-fitter inserted between 2 sections, place spacers between the 2 sections. Vertical dimension of spacers must allow proper seating of serrations between the slip-fitter and the 2 sections. In addition to the fastening through the large openings in housing, the 2 sections must join with at least 2 machine screws through holes near the front of housing and the spacers, and through matching holes in a reinforcing plate installed in housing. Machine screws must be No. 10 minimum size. Spacers must be made of same material as signal housing.

If reinforcing webs are used to connect back of housing to top, bottom, and sides, reinforcing plates are not required.

Holes for machine screws must be either cast or drilled during signal section manufacturing. Surround each hole with a 1/8-inch minimum width boss to allow contact between signal sections about axis of hole.

Each plastic signal section must have a plastic or metal visor. Plastic signal faces requiring backplates must have plastic backplates.

Serrated nylon washer must be inserted between each plastic signal section and metal mounting assembly. Each washer must be between 3/16- and 1/4-inch thick. Serrations must match those on signal section and mounting assembly.

86-4.01B Electrical Components

Conductors must be connected to a terminal block mounted inside, at the back of housing. Terminal block must have enough screw type terminals or NEMA type tab connectors to end all field and module or lamp conductors independently. Permanently identify terminal with field conductors attached or color code conductors to facilitate field wiring.

86-4.01C Visors

Include removable visor with each signal section. Comply with ITE publication ST-017B. Visors are classified by lens enclosure as full circle, tunnel or cap. Bottom opens for tunnel type and both, bottom and lower sides open for cap type. Visors must be tunnel type.

Visor must have a downward tilt between 3 and 7 degrees with a length of:

1. 9-1/2-inch minimum for nominal 12-inch round lenses
2. 7 inch for nominal 8-inch round lenses

Metal visor must be formed from 0.050-inch, minimum thickness, aluminum alloy sheet.

Plastic visor must be either formed from sheet plastic or assembled from one or more injection, rotational, or blow-molded plastic sections. Material must be of a black homogeneous color with lusterless finish. Sections must be joined using thermal, chemical, or ultrasonic bonding, or with aluminum rivets and washers permanently colored to match visor.

Secure each visor to its door and prevent removal or permanent deformation when wind load specified in California Test 605 for plastic visors or 666 for metal visors is applied to its side for 24 hours.

If directional louvers are used, fit louvers snugly into full-circular signal visors. Outside cylinder must be constructed of 0.030-inch nominal thickness, or thicker, sheet steel and vanes must be constructed of 0.016-inch nominal thickness, or thicker, sheet steel, or the cylinder and vanes must be constructed of 5052-H32 aluminum alloy of equal thickness.

86-4.02 (BLANK)

86-4.03 (BLANK)

86-4.04 BACKPLATES

Background light must not be visible between backplate and signal face or between sections.

Plastic backplates must be either formed from sheet plastic or assembled from extruded, molded, or cast sections. Sections must be factory joined using one of the following:

1. Appropriate solvent cement
2. Aluminum rivets and washers painted or permanently colored to match backplate
3. No. 10 machine screws with washers, lock washers, and nuts, painted to match backplate

Backplate material must be of black homogeneous color with a lusterless finish. Secure each plastic backplate to the plastic signal face in a manner that prevents its removal or permanent deformation when the wind-load test is applied to either the front or back of signal face. Permanent deformation of any portion of backplate must not exceed 5 degrees forward or backward after wind loading is applied for 24 hours.

If plastic backplate requires field assembly, join with at least 4 No. 10 machine screws at each field-assembled joint. Each machine screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and either a locking nut or a nut and lockwasher. Machine screws, nuts, and washers must be stainless steel or steel with a zinc or black-oxide finish.

If a metal backplate has 2 or more sections, fasten sections with rivets or aluminum bolts peened after assembly to avoid loosening.

Instead of the screws shown on the plans, you may use self-threading No. 10 steel screws to fasten plastic backplates to plastic signal face. Each screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and is stainless steel or steel with a zinc or black-oxide finish.

86-4.05 PROGRAMMED VISIBILITY VEHICLE SIGNAL FACES

Programmed visibility signal face and its installation must comply with Section 86-4.01, "Vehicle Signal Faces," Section 86-4.04, "Backplates," and Section 86-4.08, "Signal Mounting Assemblies."

Each programmed visibility signal section must:

1. Have a nominal 12-inch diameter circular or arrow indication
2. Comply with ITE publication ST-017B for color and arrow configuration
3. Have a cap visor
4. Have an adjustable connection that provides incremental tilting from 0 to 10 degrees above or below horizontal while maintaining a common vertical axis through couplers and mountings

Terminal connection must allow external adjustment about the mounting axis in 5-degree increments.

Signal must be mountable with ordinary tools and capable of servicing without tools. Preset adjustment at 4 degrees below horizontal.

Visibility of each programmed visibility signal face must be capable of adjustment or programming, within the face. When programmed, each signal face's indication must be visible only in those areas or lanes to be controlled, except that during dusk and darkness a faint glow to each side is allowed.

You must program the head as recommended by the manufacturer.

86-4.06 PEDESTRIAN SIGNAL FACES

Message symbols for pedestrian signal faces must be white "WALKING PERSON" and Portland orange "UPRAISED HAND." Comply with ITE Standards: "Pedestrian Traffic Control Signal Indications" and California MUTCD. Each symbol's height must be at least 10 inches and width must be at least 6-1/2 inches.

Luminance of "UPRAISED HAND" symbol must be 1,100 foot-lamberts, minimum, and luminance of "WALKING PERSON" symbol must be 1,550 foot-lamberts, minimum, when tested as specified in California Test 606.

Uniformity ratio of an illuminated symbol must not exceed 4 to 1 between the highest luminance area and the lowest luminance area.

Luminance difference between a nonilluminated symbol and the background around the symbol must be less than 30 percent when viewed with the visor and front screen in place and at a low sun angle.

Each housing, including front screen, must have maximum overall dimensions of 18-1/2-inch width, 19-inch height, and 11-1/2-inch depth.

All new pedestrian signal faces installed at an intersection must be the same make and type.

86-4.06A Type A

Each Type A pedestrian signal face must include a housing, 1 LED pedestrian signal combo module and a front screen.

86-4.06B Front Screen

Front screen installation for each Type A signal must comply with one of the following:

1. Install, tilting downward, at an angle of 15 ± 2 degrees out from the top, an aluminum honeycomb screen with 0.2-inch cells, 3/8-inch thick, or a plastic screen of 3/8-inch squares, 1/2-inch thick with wall thickness of 1/16-inch. Completely cover message plate. Include a clear front cover of 1/8-inch minimum thickness acrylic plastic sheet or 1/16-inch minimum thickness polycarbonate plastic. Hold screen and cover firmly in place with stainless steel or aluminum clips or stainless steel metal screws.
2. Install a 1-1/2-inch deep eggcrate or Z crate type screen of 1/32-inch nominal thickness polycarbonate. Mount screening in a frame constructed of 0.040-inch minimum thickness aluminum alloy or polycarbonate. Install screen parallel to face of message plate and hold in place with stainless steel screws.

The Department will test screens in a horizontal position with its edges supported. When a 3-inch diameter, 4-pound steel ball is dropped on the screen from a height of 4 feet above, the front screen must not fracture, separate at the welds, or compress more than 1/8-inch. When pedestrian housing is used to support front screen during test, remove message plate from pedestrian signal housing, so there is no back support for the screen.

Screen and frame must be one of the following:

1. Manufactured from aluminum anodized flat black
2. Finished with lusterless black exterior grade latex paint formulated for application to properly prepared metal surfaces
3. Manufactured from flat black plastic

86-4.06C Housing

Pedestrian signal housing must comply with Section 86-4.01A, "Signal Sections."

86-4.06D Finish

Paint exterior of each housing as specified in Section 86-2.16, "Painting."

86-4.06E Control

Pedestrian signals must be controllable by solid-state switching devices specified for traffic signal controller assemblies.

86-4.06F Terminal Blocks

Include light duty terminal block, as specified in Section 86-4.01B, "Electrical Components," with each pedestrian signal face.

86-4.07 (BLANK)

86-4.08 SIGNAL MOUNTING ASSEMBLIES

Signal mounting assembly must include:

1. 1-1/2-inch standard steel pipe or galvanized conduit
2. Pipe fitting made of ductile iron, galvanized steel, aluminum alloy Type AC-84B No. 380, or bronze
3. Mast arm and post top slip-fitters, and terminal compartments made of cast bronze or hot-dip galvanized ductile iron

After installation, clean and paint exposed threads of galvanized conduit brackets and bracket areas damaged by wrench or vise jaws. Use wire brush to clean and apply 2 coats of approved unthinned zinc-rich primer, organic vehicle type, as specified in Section 91, "Paint." Do not use aerosol can.

Fit each terminal compartment with a terminal block having a minimum of 12 positions, each with 2 screw-type terminals. Each terminal must accommodate at least five No. 14 conductors. Include a cover on compartment for ready access to terminal block. Terminal compartment used to bracket mount signals must be bolted securely to pole or standard.

Horizontal dimension of mounting assembly members between vertical centerline of terminal compartment or slip-fitter, and the vertical centerline of each signal face must not exceed 11 inches, except where required for proper signal face alignment or to allow programming of programmed visibility signal faces.

Mounting assembly members must be plumb or level, symmetrically arranged, and securely assembled.

Mounting assembly must be watertight, and free of sharp edges or protrusions that might damage conductor insulation. Include positive locking serrated fittings that, if mated with similar fittings on signal faces, will prevent faces from rotating.

Orient each mounting assembly to allow maximum horizontal clearance to adjacent roadway.

Use slip-fitter for post-top mounting of signals. Fit slip-fitter over a 4-1/2-inch outside diameter pipe or tapered standard end. Include cadmium-plated steel set screws. Include an integral terminal compartment for each slip-fitter used to post-top mount signals with brackets.

Do not install signal faces at an intersection until all other signal equipment, including complete controller assembly, is in place and ready for operation. You may mount signal faces if covered or not directed toward traffic.

86-4.09 FLASHING BEACONS

Flashing beacon must include:

1. Single section traffic signal face with yellow or red LED module indications
2. Backplate
3. Tunnel visor
4. Flashing beacon control assembly

Beacon flasher unit must be independent of intersection flasher unit.

86-4.09A Flashing Beacon Control Assembly

86-4.09A(1) Enclosure

Enclosure must be:

1. NEMA 3R with a dead front panel and a hasp with a 7/16-inch hole for a padlock
2. Powder coated, hot-dip galvanized, or factory-applied rust resistant prime coat and finish coat

86-4.09A(2) Circuit Breakers and Switches

Circuit breakers must comply with Section 86-2.11, "Service."

Switch for manually operating sign lighting circuit must be a single-hole-mounting toggle type with a single pole and throw and rated at 12 A, 120 V(ac). Furnish switch with an indicating nameplate reading "Auto-Test."

86-4.09A(3) Flasher

Comply with Section 8, "Solid-State Flashers," of NEMA Standards publication No. TS 1. Flasher must be a solid-state device with no contact points or moving parts.

Include 2 output circuits to allow alternate flashing of signal faces. Flasher must be able to carry a minimum of 10 A per circuit at 120 V(ac).

86-4.09A(4) Wiring

Conductors and wiring in the enclosure must comply with Section 86-2.09B(1), "Cabinet and Enclosure Installation."

86-4.09A(5) Terminal Blocks

Terminal blocks must be:

1. Rated 25 A, 600 V(ac)
2. Molded phenolic or nylon material
3. Barrier type with plated brass screw terminals and integral marking strips

86-5 DETECTORS

86-5.01 VEHICLE DETECTORS

Sensor unit and isolator must comply with TEES.

86-5.01A Inductive Loop Detectors

86-5.01A(1) General

Inductive loop detector includes a completely installed loop or group of loops, in the roadway, lead-in cable, and a sensor unit, with power supply installed in a controller cabinet.

86-5.01A(2) (Blank)

86-5.01A(3) Construction Materials

Conductor for each inductive loop detector must be continuous, unspliced, and one of the following:

Conductor Options for Inductive Loop Detector

Option	Specifications
Type 1 loop wire	Type RHW-USE neoprene-jacketed or Type USE cross-linked polyethylene insulated, No. 12, stranded copper wire with a 40 mils minimum thickness at any point.
Type 2 loop wire	Type THWN or Type XHHW, No. 14, stranded copper wire in a plastic tubing. Plastic tubing must be polyethylene or vinyl, rated for use at 105 °C, and resistant to oil and gasoline. Outside diameter of tubing must be 0.27 inch maximum with a wall thickness of 0.028 inch minimum.

Conductor for loop detector lead-in cable must be two No. 16, 19 x 29, stranded, tinned copper wires, comply with the calculated cross sectional area of ASTM B 286, Table 1, and be one of the following:

Conductor Options for Loop Detector Lead-In Cable

Option	Specifications
Type B lead-in cable	Insulated with 20 mils of high-density polyethylene. Conductors must be twisted together with at least 2 turns per foot and the twisted pair must be protected with a copper or aluminum polyester shield. A No. 20, minimum, copper drain wire must be connected to equipment ground within cabinet. Cable must have a high-density polyethylene or high-density polypropylene outer jacket with a nominal thickness of 32 mils. Include an amorphous interior moisture penetration barrier of nonhydroscopic polyethylene or polypropylene fillers.
Type C lead-in cable	Comply with International Municipal Signal Association (IMSA) Specification No. 50-2. A No. 20, minimum, copper drain wire must be connected to equipment ground within cabinet.

86-5.01A(4) Installation Details

Install loop conductors without splices and end in nearest pull box. Seal open end of cable jacket or tubing similar to splicing requirements to prevent water from entering. Do not make final splices between loops and lead-in cable until loop operations under actual traffic conditions is approved.

Splice all loop conductors for each direction of travel for same phase of a traffic signal system, in same pull box, to a detector lead-in cable that runs from pull box adjacent to loop detector to a sensor unit mounted in controller cabinet.

End all loop conductors in a pull box or terminal strip in the cabinet.

Identify and band conductors for inductive loop installations. Band, in pairs, by lane, in the pull box adjacent to the loops and near the end of conductors in the cabinet. Bands must comply with Section 86-2.09, "Wiring."

If HMA surfacing is to be placed, install loop conductors before placing uppermost layer of HMA. Install conductors in compacted layer of HMA immediately below the uppermost layer. Install conductors as shown on the plans, except fill slot with sealant flush to the surface.

When cutting loops:

1. Residue from slot cutting activities must not be allowed to flow across shoulders or lanes occupied by public traffic and must be removed from the pavement surface before residue flows off. Dispose of residue from slot cutting activities under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."
2. Surplus sealant must be removed from adjacent road surface without using solvents before setting.

Sealant for filling slots must comply with one of the following:

Elastomeric Sealant

Polyurethane material that will, within stated shelf life, cure only in the presence of moisture. Sealant must be suitable for use in both HMA and PCC.

The cured sealant must have the following performance characteristics:

Performance Characteristics of Cured Sealant

Specification	ASTM	Requirement
Hardness (indentation) at 25 °C and 50% relative humidity. (Type A, Model 1700 only)	D 2240 Rex.	65-85
Tensile Strength: Pulled at 508 mm per minute	D 412 Die C	3.45 MPa, min.
Elongation: Pulled at 508 mm per minute	D 412 Die C	400%, min.
Flex at -40 °C: 0.6-mm free film bend (180°) over 13-mm mandrel	--	No cracks
Weathering Resistance: Weatherometer 350 h, cured 7 days at 25 °C @ 50% relative humidity	D 822	Slight chalking
Salt Spray Resistance: 28 days at 38 °C with 5% NaCl, Die C & pulled at 508 mm per minute	B 117	3.45 MPa, min. tensile 400%, min. elongation
Dielectric Constant over a temperature range of -30 °C to 50 °C	D 150	Less than 25% change

Asphaltic Emulsion Sealant

Comply with State Specification 8040-41A-15. Use for filling slots in HMA pavement that are a maximum of 5/8 inch in width. Do not use where the slope causes the material to run from the slot. Material must not be thinned beyond manufacturer's recommendations. Place material when air temperature is at least 7 °C.

Hot-Melt Rubberized Asphalt Sealant

Hot-melt rubberized asphalt must be:

1. In solid form at room temperature and fluid at application temperature of 190 °C to 205 °C. Fumes must be non-toxic.

2. Suitable for use in both HMA and PCC.
3. Melted in a jacketed, double-boiler type melting unit. Temperature of heat transfer medium must not exceed 245 °C.
4. Applied with a pressure feed applicator or pour pot, when the pavement surface temperature is greater than 4 °C.
5. Packaged in containers clearly marked "Detector Loop Sealant" and specifying manufacturer's batch and lot number.

The cured sealant must have the following performance characteristics:

Performance Characteristics of Cured Sealant

Specification	ASTM	Requirement
Cone Penetration, 25 °C, 150 g, 5 s	D 5329, Sec. 6	3.5 mm, max
Flow, 60 °C	D 5329, Sec. 8	5 mm, max
Resilience, 25 °C	D 5329, Sec. 12	25%, min
Softening Point	D 36	82 °C, min
Ductility, 25 °C, 50 mm/min	D 113	300 mm, min
Flash Point, COC, °C	D 92	288 °C, min
Viscosity, Brookfield Thermosel, No. 27 Spindle, 20 rpm, 190 °C	D 150	Less than 25% change

86-5.01B Magnetic Detectors

Cable from pull box, adjacent to magnetic detector sensing element, to the field terminals in the controller cabinet must be the type specified for inductive loop detectors.

86-5.02 PEDESTRIAN PUSH BUTTON ASSEMBLIES

Housing must be either die-cast or permanent mold-cast aluminum, or ultraviolet stabilized, self-extinguishing structural plastic, if specified. Plastic housing must be black matching Color No. 17038, 27038 or 37038 of Federal Standard 595B, and colored throughout. Assembly must be rainproof and shockproof in any weather condition.

Switch must be a single-pole, double-throw, switching unit, with screw type terminals, rated 15 A at 125 V(ac), and must have:

1. Plunger actuator and a U frame to allow recessed mounting in push button housing
2. Operating force of 3.5 pounds
3. 1/64-inch maximum pretravel
4. 7/32-inch minimum overtravel
5. 0.0004- to 0.002-inch differential travel
6. 2-inch minimum diameter actuator

Where pedestrian push button is attached to a pole, shape housing to fit the pole curvature and secure. Include saddles to make a neat fit if needed.

Where a pedestrian push button is mounted on top of a 2-1/2-inch diameter post, fit housing with a slip-fitter and use screws for securing rigidly to post.

Pedestrian push button signs must be porcelain enameled metal or structural plastic.

Install push button and sign on crosswalk side of pole.

Point arrows on push button signs in the same direction as the corresponding crosswalk.

Attach sign on Type B push button assembly.

For Type C pedestrian push button assembly, mount instruction sign on the same standard as the push button assembly, using 2 straps and saddle brackets. Straps and saddle brackets must be corrosion-resisting chromium nickel steel and comply with ASTM A 167, Type 302B. Theft-proof bolts must be stainless steel with a chromium content of at least 17 percent and a nickel content of at least 8 percent.

86-6 LIGHTING

86-6.01 HIGH PRESSURE SODIUM LUMINAIRES

High pressure sodium luminaires must be the enclosed cutoff type.

Housing must be manufactured from aluminum. Painted or powder-coated housing must withstand a 1,000-hour salt spray test as specified in ASTM B 117.

Other metal parts must be corrosion resistant.

Each housing must include a slip-fitter that can be mounted on a 2-inch pipe tenon and can be adjusted 5 degrees from the axis of the tenon. Clamping brackets of slip-fitter must not bottom out on housing bosses when adjusted within the ± 5 degree range.

The slip-fitter mounting bracket must not permanently set in excess of 0.020-inch when the 3/8-inch diameter cap screw used for mounting is tightened to 10 foot-pounds.

Luminaire to be mounted horizontally on mast arm, when tested as specified in California Test 611, must be capable of withstanding cyclic loading for a minimum of 2 million cycles without failure of any luminaire parts as follows:

Cyclic Loading

Plane	Internal Ballast	Minimum Peak Acceleration Level ^a
Vertical	Removed	3.0 G peak-to-peak sinusoidal loading (same as 1.5 G peak)
Horizontal ^b	Installed	1.5 G peak-to-peak sinusoidal loading (same as 0.75 G peak)
Vertical	Installed	1.0 G peak-to-peak sinusoidal loading (same as 0.5 G peak)

^aG = Acceleration of gravity

^bPerpendicular to direction of mast arm

If a photoelectric unit receptacle is included, a raintight shorting cap must be installed. If luminaire housing has a hole for the receptacle, hole must be permanently closed, covered, and sealed with weatherproof material.

Optical system must be in a sealed chamber and include:

1. Reflector shaped so that a minimum of light is reflected through the arc tube of the lamp. Reflector surface must be specular and protected by either an anodized finish or a silicate film on its specular surface.
2. Refractor or lens mounted in a door frame that is hinged to the housing and secured with a spring-loaded latch. Refractor must be made of glass or polycarbonate plastic. Lens must be made of heat- and impact-resistant glass.
3. Lamp socket that is a porcelain enclosed mogul-multiple type. Shell must include integral lamp grips to assure electrical contact under conditions of normal vibration. Socket must be mounted in the luminaire to allow presetting a variety of specified light distribution patterns. Socket must be rated for 1,500 W and 600 V(ac), and a 4 kV pulse.
4. Lamp.

Sealing must be provided by a gasket between the reflector and:

1. Refractor or lens
2. Lamp socket

Chamber must allow for filtered flow of air in and out of the chamber from lamp heat. Filtering must be accomplished by either a separate filter or a filtering gasket.

If components are mounted on a down-opening door, door must be hinged and secured to luminaire housing separately from refractor or flat lens frame. Door must be easily removable and replaceable, and secured to housing to prevent accidental opening when refractor or flat lens frame is opened.

Field wires connected to luminaire must terminate on a barrier-type terminal block secured to the housing. Terminal screws must be captive and equipped with wire grips for conductors up to No. 6. Each terminal positions must be clearly identified.

Minimum light distribution for each luminaire must meet the isolux diagrams.

Maximum brightness of each cutoff luminaire, with the lamp indicated, must be as follows:

Cutoff Type

Lamp ANSI Code No.	Lamp Wattage	Maximum Brightness foot-lamberts
S55	150	40
S66	200	40
S50	250	50
S67	310	60
S51	400	75

Brightness readings will be taken using a brightness meter with an acceptance angle of 1.5 degrees. When measured on the 90-degree and 270-degree lateral angle line, maximum brightness must not exceed above specified brightness when meter is located at a horizontal distance of 120 feet and a vertical distance of 7.5 feet between luminaire and meter, or at an angle of 3 degrees 35 minutes from the horizontal to the line between luminaire and meter. Measurements must be made from 90-degree line and 270-degree line, and averaged. Lamp used for each test must operate at wattage necessary to produce the following light output:

Light Output

Lamp Wattage	Lumens
150	16,000
200	22,000
250	27,000
310	37,000
400	50,000

86-6.01A High Pressure Sodium Lamp Ballasts

Each ballast must:

1. Operate the lamp for its rated characteristics and wattage
2. Continuously operate at ambient air temperatures from -20 °C to 25 °C without reduction in ballast life
3. Operate for at least 180 cycles of 12 hours on and 12 hours off, with the lamp circuit in an open or short-circuited condition and without measurable reduction in operating requirements
4. Have a design life of not less than 60,000 hours
5. Provide proper starting and operating waveforms, voltage, and current
6. Provide reliable lamp starting and operation at ambient temperature down to -20 °C for the rated life of lamp

Ballast must be tested as specified in ANSI C82.6-1980, "Methods of Measurement of High-Intensity-Discharge Lamp Ballasts."

Starting aids for ballast of a given lamp wattage must be interchangeable between ballasts of same wattage and manufacturer, without adjustment.

Each integral ballast must consist of separate components that can be easily replaced. An encapsulated starting aid will be counted as a single component. Each component must include screw terminals, NEMA tab connectors, or a single multi-circuit connector. Conductors and terminals must be identified.

Mount heat-generating component so as to use the portion of the luminaire it is mounted to as a heat sink. Place capacitor a maximum practicable distance from heat-generating components or thermally shield to limit the case temperature to 75 °C.

Transformer and inductor must be resin-impregnated for protection against moisture. Capacitors, except those in starting aids, must be metal cased and hermetically sealed.

The Department will test high-pressure sodium lamp ballast. High-pressure sodium lamp ballast must have a characteristic curve that will intersect both of the lamp-voltage limit lines between the wattage limit lines and remain between the wattage limit lines throughout the full range of lamp voltage. This requirement must be met at the rated input voltage of the ballast and at the lowest and highest rated input voltage of the ballast.

Throughout the lifetime of the lamp, ballast curve must fall within the specified limits of the lamp voltage and wattage.

Ballast for luminaires must be located in the luminaire housing.

86-6.01A(1) Regulator Type Ballasts

Regulator type ballast must comply with the following:

1. For nominal input voltage and lamp voltage, ballast design center must not vary more than 7.5 percent from rated lamp wattage.
2. Ballast must be designed for a capacitance variance of ± 6 percent that will not cause more than ± 8 percent variation in lamp wattage regulation during rated lamp life.
3. Lamp current crest factor must not exceed 1.8 for input voltage variation of ± 10 percent at any lamp voltage during lamp life.

Regulator-type ballast must be one of the following:

Regulator-Type Ballast

Ballast Type	Power Factor	Lamp Regulation
Lag-type ^a	Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than 18 percent for ± 10 percent input voltage variation from nominal through life
Lead-type ^b	Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than 30 percent for ± 10 percent input voltage variation from nominal through life

^aPrimary and secondary windings must be electrically isolated

^bConstant wattage autoregulator (CWA)

86-6.01A(2) Nonregulator Type Ballasts

Each nonregulator type ballast must comply with the following:

1. For nominal input voltage and lamp voltage, ballast design center must not vary more than 7.5 percent from rated lamp wattage.
2. Lamp current crest factor must not exceed 1.8 for input voltage variation of ± 5 percent at any lamp voltage during lamp life.

Nonregulator-Type Ballast

Ballast Type	Power Factor	Lamp Regulation
Autotransformer or High-Reactance	Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than 25 percent for ± 5 percent input voltage variation from nominal through life

86-6.01B High Pressure Sodium Lamps

High pressure sodium lamps must comply with ANSI C 78.42, "High Pressure Sodium Lamps," when tested as specified in ANSI C 78.389, "American National Standard for Electric Lamps - High Intensity Discharge-Methods of Measuring Characteristics." High pressure sodium lamps must have a minimum average rated life of 24,000 hours.

86-6.02 LOW PRESSURE SODIUM LUMINAIRES

Each low pressure sodium luminaire must be completely assembled with a lamp and ballast, and must:

1. Be the enclosed type, either semi-cutoff or cutoff type.
2. Include housing, reflector, refractor or lens, lamp socket, integral ballast, removable ballast tray, lamp support, terminal strip, capacitor, and slip fitter. Reflector may be an integral part of the housing.

Luminaire housing must be minimum 1/16-inch thick, corrosion resistant die cast aluminum sheet and plate with concealed continuous welds, or minimum nominal wall thickness of 3/32-thick acrylonitrile-butadiene-styrene sheet material, on a cast aluminum frame that provides mounting for all electrical components and slip fitter.

Housing must be divided into optical and power compartments that are individually accessible for service and maintenance. Position and clamp luminaire to pipe tenon by tightening mounting bolts.

Painted exterior surface of luminaire must be finished with a fused coating of electrostatically applied polyester powder paint or other ultraviolet inhibiting film. Color must be aluminum gray.

High temperature neoprene, or equal, sealing ring must be installed in pipe tenon opening to prevent entry of water and insects into power and optical compartments.

Access to power unit assembly must be through a weathertight hinged cover, secured with spring type latches or captive screws, to luminaire housing.

Hardware must be stainless steel or cadmium plated. Use machine screws or bolts to secure removable components. Do not use sheet metal screws.

Semi-cutoff luminaires and molded refractor style cutoff luminaires must include a refractor. Other cutoff luminaires must include a flat lens.

Refractor must be 1-piece injection molded polycarbonate of 3/32 inch minimum thickness, or 1-piece injection molded acrylic of 1/8 inch minimum thickness. Flat lens must be 1-piece polycarbonate of 3/32 inch minimum thickness, mounted to metal frame. Refractor assembly and flat lens assembly must be constructed to rigidly maintain its shape, and hinged and secured with spring type latches to luminaire housing. Alternate methods of manufacturing refractor may be approved provided minimum specified thicknesses are maintained.

Lamp socket must be high temperature, flame retardant thermoset material with self-wiping contacts or equivalent. Socket must be rated for 660 W and 1,000 V(ac). Position of socket and support must maintain the lamp in correct relationship with reflector and refractor for designed distribution pattern.

Isofootcandle distribution must be ANSI Type III, short or Type IV, medium distribution, for cutoff or semi-cutoff luminaires.

With a 40-foot mounting height, each type of luminaire must maintain a minimum of 0.2 footcandle at least 60 feet each side, along the longitudinal roadway line below the luminaire, and a minimum of 0.35 footcandle at a transverse roadway distance from luminaire location equal to 1.5 times the luminaire mounting height.

Certified luminaire performance data must be provided. This data must include complete photometric test data in isofootcandle charts at a scale of 1 inch equals 20 feet, for the luminaire and lamp sizes shown on the plans.

Alternate data may be in horizontal footcandle values recorded on a 15' x 15' area extending 90 feet longitudinally each side of the light source, and 15 feet behind and 90 feet in front of the light source, for luminaire and lamp sizes, and mounting height shown on the plans. Horizontal footcandle levels in data submitted must equal or exceed levels specified. Failure to meet referenced values will be justification for rejection of the luminaires.

Photometric testing must be performed and certified by an independent and recognized testing laboratory.

Low pressure sodium lamps must:

1. Be 180 W, single-ended, bayonet base, tubular gas discharge lamp
2. Maintain a minimum of 93 percent of initial lumens during rated life and must comply with the following minimum performance requirements:

Performance Requirements

Lamp Designation	ANSI L74-RF-180
Initial Lumens	33,000 lumens
Rated Ave. Life (@ 10 hrs/Start)	18,000 hours
Operating Position	Horizontal ±20 degrees

3. Reach 80 percent of light output within 10 minutes and must restrike within 1 minute after an outage due to power interruption or voltage drop at the lamp socket
4. Identify the month and year of installation.
5. Have an autotransformer or high-reactance type ballast. The ballast must comply with the following:
 - 5.1. Lamp current crest factor must not exceed 1.8 at nominal line voltage
 - 5.2. Ballast loss must not exceed 24 percent for 180 W ballast at nominal line voltage

Autotransformer or High-Reactance Type Ballast

Ballast Type	Power Factor	Lamp Operation
Autotransformer or High-Reactance	Not less than 90 percent when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than ± 6 percent for ± 10 percent input voltage variation from nominal through life

A multi-circuit connector must be included for quick disconnection of ballast tray.

86-6.03 SOFFIT AND WALL LUMINAIRES

Soffit and wall luminaire must be weatherproof and corrosion resistant.

Each flush-mounted soffit luminaire must consist of:

1. Metal body with two 1-inch minimum conduit hubs and provisions for anchoring into concrete
2. Prismatic refractor made of heat-resistant polycarbonate mounted in a door frame and clearly identified as to street side
3. Specular anodized aluminum reflector
4. Ballast located either within housing or in a ceiling pull box as shown on the plans
5. Lamp socket

The door frame assembly must be hinged, gasketed, and secured to body by at least 3 machine screws.

Each pendant soffit luminaire must be enclosed and gasketed, have an aluminum finish, and include:

1. Reflector with a specular anodized aluminum finish
2. Refractor made of heat-resistant polycarbonate
3. Optical assembly hinged and latched for lamp access and a device to prevent dropping
4. Ballast designed for operation in a raintight enclosure
5. Galvanized metal box with a gasketed cover, 2 captive screws, and 2 chains to prevent dropping and for luminaire mounting

Each wall-mounted luminaire must consist of:

1. Cast metal body
2. Prismatic refractor, made of glass, mounted in a door frame
3. Aluminum reflector with a specular anodized finish
4. Integral ballast
5. Lamp socket
6. Gasket between refractor and body
7. At least two 5/16-inch minimum diameter mounting bolts

Cast-aluminum bodies to be cast into or mounted against concrete must have a thick application of alkali-resistant bituminous paint on all surfaces to be in contact with concrete.

Each soffit luminaire and wall luminaire must include a 70 W high-pressure sodium lamp with a minimum average rated life of 24,000 hours. Each lamp socket must be positioned to locate the light center of the lamp within 1/2 inch of light center location of the luminaire design.

Ballast must comply with Section 86-6.01A, "High Pressure Sodium Lamp Ballasts." Wall luminaire ballast must be located in luminaire housing or, if shown on the plans, in a pull box adjacent to luminaire.

86-6.04 PEDESTRIAN CROSSING FIXTURES

Before starting fixture manufacturing, submit fixture design for approval. If requested, submit 1 complete prototype fixture for approval at least 30 days before manufacturing the fixtures. The prototype fixture will be returned to you, and if permitted, the fixture may be installed in the work.

Lens unit in door section must be formed of 1-1/2-inch methyl methacrylate rod cut and fire-glazed for a clear finish or a cast unit with equivalent tolerances and finish.

Lens must be secured to door section with an extruded lens retainer of 6063-T5 aluminum alloy that fits the lens shape. Lens retainer must fit the full length of lens on both sides. Continuous lens retainer for the full length of 3 lenses is allowed. Z bars of 5052-H32 or 5005-H14 aluminum alloy, 1/16 inch minimum thickness may be substituted for extruded lens retainer.

A captive positive-keyed screw-type latching device requiring a special socket wrench must be installed at upper edge to secure door in the closed position as shown on the plans. Furnish 2 special wrenches to the Engineer.

Each fixture must include a F48T12/CW rapid start fluorescent lamp with recessed, double contact base installed on back side of door directly behind lens.

Each lampholder must be UL listed for outdoor use without an enclosure and with 1,500 mA rapid start fluorescent lamp. Lampholder must be spring-loaded type.

For each lamp, the distance from face of lampholder to the lamp must be designed to provide a compression of at least 0.10-inch on the spring-type lampholder when lamp is in place. Lamp must have positive mechanical and electrical contact when lamp is in place. Socket on spring-type lampholder must have enough travel to allow lamp installation. Spring must not be a part of current-carrying circuit.

Ballast must be high-power-factor type with weatherproof leads for operation of one 48-inch rapid-start lamp. Ballast must be UL listed for outdoor operation on 110 to 125 V(ac) 60 Hz circuit and rated at 1,500 mA.

Conductors from ballast leads to lampholder must be minimum size of No. 16, stranded, and UL-listed copper AWM. Splicing of lampholder conductors to ballast leads must be performed by using mechanically secure connectors.

Conductors in fixture except ballast leads and entrance line conductors, must be UL-listed AWM.

Provide sufficient slack in the conductors to allow the fixture door to fully open.

Circuit conductors entering the fixture must be terminated on molded phenolic barrier-type terminal blocks rated at 15 A and 600 V(ac) and must have integral-type white waterproof-marking strips. Current-carrying parts of terminal blocks must be insulated from fixture with integral plugs or strips to provide protection from line-to-ground flashover voltage. Terminal blocks must be attached to wireway cover in top section. If you use sectionalized terminal blocks, each section must include an integral barrier on each side and be capable of rigid mounting and alignment.

Exposed surfaces of fixture must be uniform in appearance and free from significant defects, including improper fit, dents, deep scratches and abrasions, burrs, roughness, off-square ends, holes off-center or jagged, and surface irregularities. Screws for attaching components to fixture door, including Z bars, ballasts, and terminal block, must be tapped into door from the inside only. Screwheads, nuts, or other fasteners must not be removable from the outside.

86-6.04A Pedestrian Undercrossing Fixtures

Fixture shell must be cast aluminum alloy, industrial type or Federal Class 18 aluminum of 1/4 inch minimum thickness.

Door must be 1 piece of 6061-T6 aluminum alloy of 1/8 inch minimum thickness.

Continuous piano hinge must be Type 1100 aluminum alloy. The piano hinge must be welded or riveted to door section with 1/8 inch aluminum rivets. Matching holes must be drilled in the hinge and lower edge of fixture. After shell is in place, door assembly must be attached by minimum 3/8-inch No. 8 stainless steel self-tapping screws.

A neoprene gasket must be attached to frame to provide a cushion between the shell and the door.

Chain or other device must be included to prevent the door, when fully opened, from coming in contact with the undercrossing wall.

Fixture must be held in place by three 3/8" x 8" anchor bolts with 2 nuts each.

Fixture surfaces in contact with concrete, and with anchor bolts and nuts must be painted with a thick application of alkali-resistant bituminous paint. Paint must comply with MIL-P-6883.

Circuit conductor entering the fixture must be terminated on 2-position terminal blocks.

Both ends of fixture must have holes for 1-inch conduit. Unused holes must be plugged with pressed metal closures.

86-6.04B Pedestrian Overcrossing Fixtures

Fixture shell must consist of:

1. Top section and a door section of extruded 6063-T5 aluminum alloy, each with a nominal 1/8 inch wall thickness
2. 2 cast-end sections of 319 aluminum alloy
3. Internal wireway cover of 505-H32 aluminum alloy

Top section and door section must be joined together on one side by a continuous hinge formed as part of the 2 extrusions and must overlay to allow locking on the other side. Hinge must be treated with a silicone grease that will prevent the entrance of water by capillary action.

Wireway cover with 3/16 inch hemmed ends up and terminal blocks and circuit conductors must be inserted before welding end sections and must provide clearance at both ends for conductors. Cover must be fastened by at least two 1/4 inch No. 4 self-threading sheet metal screws with binding head and blunt point. You may substitute blind rivets of equivalent strength.

One or more bronze sash chains or other device must be included to prevent door from opening to an extent that will damage the hinge.

Lampholder must include heat-resistant circular cross section neoprene sealing gasket, silver-coated contacts, and waterproofed lead entrance for use with a 1,500 mA rapid start fluorescent lamp.

Ballast must be at most 13-1/4 inches long.

Circuit conductors entering the fixture must be terminated on 3-position terminal blocks.

Electrical system of pedestrian overcrossing must be grounded by a No. 8 copper wire installed in conduit from fixture to fixture, from end fixture to conduit fitting on end post and from conduit fitting on end post to grounding bushing in nearest pull box.

Ground wire must be secured to inside of telescoping sleeve end casting where conductors are carried and to the inside of Type LB conduit fitting on end post by a connecting lug and a No. 8 self-threading pan screw.

Lamp, lampholder, ballast, and fixture wire, must be attached to door section. Terminal blocks must be attached to top section or wireway cover.

Three No. 10, solid copper circuit conductors must be installed between terminal blocks as part of each completed fixture.

Before shipment to job site, fixture must be completely manufactured and assembled in the shop.

86-6.05 INDUCTION SIGN LIGHTING FIXTURES

Each induction sign lighting fixture must include housing with door, reflector, refractor or lens, lamp, power coupler, high frequency generator, socket assembly, fuse block, and fuses.

Each induction sign lighting fixture must:

1. Be designed for mounting near the bottom of sign panel on an overhead sign structure.
2. Be an enclosed design and be raintight and corrosion resistant.
3. Have a minimum average rating of 60,000 hours.
4. Be for a wattage of 87 W, 120/240 V(ac).
5. Have a power factor greater than 90 percent and total harmonic distortion less than 10 percent.
6. Be UL approved for wet locations and be FCC Class A-listed.
7. Not exceed 44 pounds in weight.
8. Include the manufacturer's brand name, trademark, model number, serial number, and date of manufacture on packaged assembly. Same information must be permanently marked on the outside and inside of housing.
9. Comply with minimum horizontal footcandle requirement shown on the plans.
10. Be a maximum height of 12 inches above the top of the mounting rails.

If fixture is located so that the light center of the lamp is 55 inches in front of, 1 foot below, and centered on a 10-foot high by 20-foot wide sign panel, the ratio of maximum to minimum illuminance level on the panel must not exceed 12 to 1 in 95 percent of the points measured. Illuminance gradient must not exceed 2 to 1 and is defined as the ratio of minimum illuminance on a 1-foot square of panel to that on an adjacent 1-foot square of panel.

Each fixture must have a mounting assembly that will allow fixture to be mounted on continuous slot channels. Mounting assembly must be either cast aluminum, hot-dip galvanized steel plate, or steel plate that has been galvanized and finished with a polymeric coating system or same finish that is used for housing.

Housing must have a door designed to hold a refractor or lens, and to open without the use of special tools. Housing and door must be manufactured of sheet or cast aluminum, and have a powder coat or polyester paint finish of a gray color resembling unfinished manufacturing. Sheet aluminum must comply with ASTM B 209 or B 209M for 5052-H32 aluminum sheet. External bolts, screws, hinges, hinge pins, and door closure devices must be corrosion resistant.

Housing must include weep holes.

Door must be hinged to housing on side of fixture away from the sign panel and include 2 captive latch bolts or other latching device. Door must be designed to lock in the open position, 50 degrees minimum from the plane of the door opening, with an 85-mph 3-second-wind-gust load striking the door from either side.

Door and housing must be gasketed to be raintight and dusttight. Thickness of gasket must be 1/4 inch, minimum.

Fixture height must be less than 12 inches above the top of mounting rails.

Reflector must be 1 piece, made from specularly finished aluminum protected with an electrochemically applied anodized finish or a chemically applied silicate film, and designed so deposited water due to condensation will drain away. Reflector must be secured to housing with a minimum of 2 screws and removable without removing any fixture parts. Do not attach reflectors to outside of housing.

Refractor or lens must have a smooth exterior and must be manufactured from the material as follows:

Refractor and Lens Material Requirements	
Component	Manufactured From
Flat lens	Heat-resistant glass
Convex lens	Heat resistant, high-impact resistant tempered glass
Refractor	Borosilicate heat resistant glass

Refractor and convex lens must be designed or shielded so no fixture luminance is visible if fixture is approached directly from the rear and viewing level is the bottom of the fixture. If a shield is used, it must be an integral part of the door casting.

Each fixture must include an 85 W induction lamp with an interior wall that is fluorescent phosphor-coated. Light output must be at least 70 percent at 60,000 hours. Lamp must have a minimum color-rendering index of 80, be rated at a color temperature of 4,000K and be removable without the use of tools.

Lamp socket must be a porcelain enclosed mogul type with a shell that contains integral lamp grips to assure electrical contact under normal vibration conditions. Center contact must be spring-loaded. Shell and center contact must be nickel-plated brass. Socket must be rated for 1,500 W and 600 V(ac).

Power coupler must include a construction base with antenna, heat sink, and electrical connection cable, and be designed so it can be removed with common hand tools.

High frequency generator must:

1. Start and operate lamps at an ambient temperature of -25 °C or greater for the rated life of the lamp
2. Operate continuously at ambient air temperatures from -25 °C to 25 °C without reduction in generator life
3. Have a design life of at least 100,000 hours at 55 °C
4. Have an output frequency of 2.65 MHz ± 10 percent
5. Have radio frequency interference that complies with FCC Title 47, Part 18, regulations regarding harmful interference
6. Be replaceable with common hand tools
7. Mounted so the fixture can be used as a heat sink

Conductor terminal must be identified by the component terminal the conductor connects to.

Submit a copy of the high frequency generator test methods and results from the manufacturer with each lot of fixtures.

Each fixture must include a barrier-type fuse block for terminating field connections. Fuse block must:

1. Be secured to housing and be accessible without removal of any fixture parts
2. Be mounted to leave a minimum of 1/2 inch air space from sidewalls of housing
3. Be designed for easy removal of fuses with a fuse puller, be rated at 600 V(ac), and have box terminals.

Fuses must be 13/32-inch diameter, 1-1/2 inch long ferrule type and UL or NRTL listed. For 120 V(ac) input fixture, only the ungrounded conductor must be fused and there must be a solid link between the neutral and the high frequency generator.

If shown on the plans, include a wire guard to prevent damage to the refractor or lens. Guard must be constructed of 1/4-inch minimum diameter galvanized steel wire, and either hot-dip galvanized or electroplated-zinc coated as specified in ASTM B 633, Service Condition SC4 with a clear chromate dip treatment. Guard elements must be spaced to prevent rocks larger than 1-1/2-inch diameter from passing through.

86-6.06 SIGN LIGHTING FIXTURES FOR FLASHING BEACON

Sign lighting fixture must:

1. Be UL or NRTL listed for outdoor installation

2. Include a hood with side outlet tapped for conduit, a symmetrical 10-inch steel reflector with a white porcelain-enamel finish, and a medium base socket
3. Be rated at 150 W minimum

86-6.07 INTERNALLY ILLUMINATED STREET NAME SIGNS

Sign fixture must be:

1. Designed and constructed to prevent deformation or failure when subjected to an 85 mph 3-second-wind-gust load as specified in AASHTO publication, "Standard Specifications for Structural Supports of Highway Signs, Luminaires and Traffic Signals," and its interim revisions
2. Manufactured from all new material and all ferrous parts must be galvanized or cadmium-plated
3. Type A or B signs

Top and bottom must be formed or extruded aluminum and must be attached to formed or cast aluminum end fittings. Housing must be designed for continuous sealing between top and bottom assemblies, and end fittings, and be constructed to resist torsional twist and warp. Opening or removing 1 panel must allow access to the interior of the sign for lamp, ballast, and fuse replacement.

Photoelectric unit sockets are not allowed.

For Type A sign, both sides must be hinged at the top to allow installation or removal of sign panel, and to allow access to interior of sign.

For Type B sign, sign panel must be slide-mounted into housing.

Reflectors may be used to obtain required sign brightness. Reflectors must be formed aluminum with acrylic baked white enamel surface having a minimum reflectance of 0.85.

Sign panel must be slide-mounted or rigid-mounted in a frame, with white legend, symbols, arrows, and border on each face. Background must be green.

Sign panels surface must be evenly illuminated. Average of brightness readings for letters must be 150 foot-lamberts, minimum. Light transmission factor of sign panel must provide a letter to background brightness ratio between 10 to 1 and 20 to 1. Background luminance must not vary by more than 40 percent from the average background brightness reading. Luminance of letters, symbols, and arrows must not vary by more than 20 percent from their average brightness readings.

Sign panels must be translucent, high impact, resistant plastic panels of one of the following:

1. Glass fiber reinforced acrylated resin
2. Polycarbonate resin
3. Cellulose acetate butyrate plastic

Paint on the outside of plastic must be protected by a plastic film that seals the front surface of panel and filters out ultraviolet radiation. Paint must be acrylic plastic type.

Surface must be free of blemishes in the plastic or coating that may impair the serviceability or detract from the general appearance and color matching of sign.

White or green color must not fade or darken when sign is exposed to an accelerated test of ultraviolet light equivalent to 2 years of outdoor exposure. Green color of sign, when not illuminated, must match Color No. 14109 of Federal Standard 595B.

Sign panel must not crack or shatter when a 1-inch diameter, steel ball with a weight of 2.4 ounces is dropped from a height of 8.5 feet above the sign panel to any point of sign panel. For this test, sign panel must be lying in a horizontal position and supported within its frame.

For Type A sign, gasket must be installed between sign panel frame and fixture housing to prevent water entry between frame and fixture housing. Gasket must be uniform and even-textured, and be the closed-cell, sponge-neoprene type, designed for use at temperatures between -20 °C and +74 °C.

Gasket must be neatly applied to thoroughly degreased, clean surface with a suitable heat-resistant adhesive that will not allow the gasket to slip at temperatures between -20 °C and +74 °C.

Ballast must be high power factor type and capable of starting the lamp at -20 °C and above.

Ballast for Type A sign must be rated at 200 mA. Ballasts for Type B sign must be rated at 430 mA. Ballast must be UL or NRTL listed for operation on 110 to 125 V(ac), 60 Hz circuits, and comply with ANSI C 82.1 and ANSI C 82.2.

Lampholder must be UL or NRTL listed for outdoor use and of the spring-loaded type. Lampholder must have silver-coated contacts and waterproofed entrance leads for use with a rapid-start fluorescent lamp. Removal of lamp from socket must de-energize the primary of ballast. Each lampholder must include heat-resistant, circular cross

section, partially-recessed neoprene ring to seal against lamp ends and protect electrical contacts from moisture, dirt or other injurious elements.

Distance between face of lampholders must be designed to provide compression of at least 0.10 inch on the spring-type lampholder when lamp is in place. Lamp must have positive mechanical and electrical contact when lamp is in place. Socket on spring-type lampholder must have sufficient travel to allow lamp installation. Spring must not be a part of current carrying circuit. Lampholder must match lamp requirements and must not increase cathode filament circuit resistance by more than 0.10 Ω.

Lamp must comply with ANSI C 78.

Wiring connections in fixture must be terminated on molded, phenolic, barrier-type, terminal blocks rated at 15 A, 1,000 V(ac), and must have integral-type white waterproof-marking strips. Current carrying parts of terminal blocks must be insulated from fixture with integral plugs or strips to provide protection from line-to-ground flashover voltage. If you choose to use sectionalized terminal blocks, each section must include an integral barrier on each side and be capable of rigid mounting and alignment. Terminal screws must be No. 10, minimum.

Fuses must be Type 3AG, miniature, slow-blowing type with appropriate current and voltage ratings.

Fuseholder must be a panel-mounting type with threaded or bayonet-type knob that grips the fuse tightly for extraction. Use a separate fuse for each ballast.

Screened weep holes must be constructed at strategic locations in members subject to moisture collection.

Fasteners, screws, and hardware must be passive stainless steel, Type 302 or 304, or aluminum Type 6060-T6.

Top of fixture housing must have 2 free-swinging mounting brackets. Each bracket must be adjustable vertically for leveling the sign to either a straight or curved mast arm. Bracket assembly must allow fixture to swing perpendicular to the sign panel.

Hinge pins for the free-swinging brackets must have a minimum diameter of 1/4 inch.

Message, as shown on the plans, must be displayed on both sign panels.

If not shown on the plans, the message and the size of symbols or arrows will be given by the Engineer at your request. Letters must be 8-inch upper case and 6-inch lower case, Series E.

Fixture conductors must be UL- or NRTL-listed AWM stranded copper wire with 28 mils, minimum, thermoplastic insulation, rated at 1,000 V(ac) and rated for use at 90 °C. Conductors must be No. 16 minimum and must match color coding of ballast leads.

Conductors within the fixture must be secured with easily removable spring cross straps, not clamped, in the chassis or fixture. Straps must be installed 12 inches apart or less.

Stranded copper conductors connected to screw-type terminals must terminate in approved crimp-type ring connectors.

Splices are not allowed within fixture.

Submit shop drawings showing the message for each sign, including size of letters, symbols or arrows, as shown on the plans. If requested, you must supply, without cost to the State, sufficient samples of materials to be used in the manufacturing of the sign or a complete sign assembly, to allow adequate testing and evaluation of compliance to specified requirements.

86-6.08 PHOTOELECTRIC CONTROLS

Photoelectric controls must be capable of directly switching multiple lighting systems.

86-6.08A Types

Photoelectric control type must comply with the following:

Photoelectric Control Types

Type I	Includes a remote photoelectric unit and a test switch housed in an enclosure.
Type II	Includes a remote photoelectric unit, a separate contactor located in a service equipment enclosure, and a test switch located in service equipment enclosure.
Type III	Includes a remote photoelectric unit, a separate contactor, and a test switch housed in an enclosure.
Type IV	Includes a photoelectric unit that plugs into an EEI-NEMA twist-lock receptacle integral with the luminaire.
Type V	Includes a photoelectric unit, contactor, and test switch located in service equipment enclosure.

A switch to allow manual operation of lighting circuit must be included for each Type I, Type II, Type III, and Type V photoelectric control. Switches must be single-hole mounting toggle type, single-pole, single-throw, rated at 12 A with a voltage rating that matches the circuit. Switches must have an indicating nameplate reading "Auto-

Test" and be connected in parallel with the load contacts of the photoelectric unit. Test switches must not have an "OFF" position.

Photoelectric unit for Types I, II, and III photoelectric controls, must be pole-top mounted.

86-6.08B Equipment Details

86-6.08B(1) Photoelectric Unit

Photoelectric unit must:

1. Have an output in response to changing light levels. Response level must remain stable throughout life of control unit.
2. Have a "turn-on" between 1 and 5 footcandles, and a "turn-off" between 1.5 and 5 times "turn-on." Measurements must be made by procedures in EEI-NEMA standards for physical and electrical interchangeability of light-sensitive control devices used in the control of roadway lighting.
3. Have a EEI-NEMA type receptacle. Mounting brackets must be used where pole-top mounting is not possible. Photoelectric controls must be installed at locations show on the plans and oriented.
4. Be screened to prevent artificial light from causing cycling.
5. Have a supply voltage rating of 60 Hz, 105-130 V(ac), 210-240 V(ac), or 105-240 V(ac), as specified.
6. Have a load rating of 800 W minimum, incandescent, high intensity discharge, or fluorescent.
7. Operate at a temperature range of -20 °C to 55 °C.
8. Have a power consumption less than 10 W.
9. Be housed in a weatherproof enclosure.
10. Have a base with a 3-prong, EEI-NEMA standard, twist-lock plug mounting.
11. Have a "fail-on" feature.

Unit components must not require periodic replacement.

Photoelectric controls, except Type IV and Type V, must include a 4-inch minimum inside diameter, pole-top mounting adaptor containing a terminal block, and cable supports or clamps to support pole wires.

For switching 480 V(ac), 60 Hz circuits, a 100 VA, minimum, 480/120 V(ac) transformer must be installed in the contactor enclosure to allow 120 V(ac) for the photoelectric control unit. If more than 1 photoelectric unit is to be installed at a location, a single transformer with a volt-ampere rating capable of handling the total controlled load, may be used.

86-6.08B(2) Contactor

Contactor must:

1. Have contacts rated to switch the specified lighting load
2. Be normally open
3. Be the mechanical armature type with contacts of fine silver, silver alloy, or superior alternative material

86-6.08B(3) Enclosure

Enclosure for Type I and Type III photoelectric controls must be NEMA 3R. Enclosure must be supplied with a factory-applied rust-resistant prime coat and finish coat. Two applications of paint to match the color of the standard must be applied as specified in Section 86-2.16, "Painting." Enclosure may be hot-dip galvanized instead of painting. A minimum of 2-1/2 inches must be provided between contactor terminals and end of enclosure for wiring connections. Enclosure must be mounted on the same standard as the photoelectric unit at a height of about 6 feet above finished grade.

86-6.08B(4) Terminal Blocks

Terminal blocks must be rated at 25 A, 600 V(ac), molded from phenolic or nylon material, and of the barrier type with plated-brass screw terminals and integral-type marking strips.

86-6.09 TRANSFORMERS

Multiple-to-multiple transformers must be single-phase dry type designed for operation on a 60 Hz supply.

86-6.09A Electrical Requirements

Transformers must have a decal showing a connection diagram. Diagram must show either color-coding or wire-tagging with primary (H1, H2) or secondary (X1, X2) markers, and the primary and secondary voltage and volt-ampere rating. Transformers must comply with the following:

Transformer Electrical Requirements	
Transformer Characteristic	Multiple-to-Multiple Unit
Rating	120/480 V(ac), 240/480 V(ac), or 480/120 V(ac)
Efficiency	Exceed 95 percent
Secondary Voltage Regulation and Tolerance	±3 percent from half load to full load

Secondary 480 V(ac) windings must be center-tapped.

86-6.09B Physical Requirements

External leads for multiple-to-multiple secondary connections must be Type USE, No. 10, rated 600 V(ac).

Transformer leads must extend a minimum of 12 inches from the case.

Transformer insulation must be NEMA 185 C or better.

Multiple-to-multiple transformers must withstand the application of 2,200 V(ac) from core to coils and from coil to coil for a 1-minute period.

The above tests must be made immediately after operation of transformer at full load for 24 hours.

Non-submersible transformers must include metal half-shell coil protection, have moisture resistant synthetic varnish impregnated windings, and be suitable for outdoor operation in a raintight enclosure.

Each transformer to be installed in a pull box must be the submersible type and include a handle and a hanger.

86-6.09C Submersible Type Transformers

Submersible type transformers must be securely encased in a rugged corrosion resistant, watertight case and must withstand a 5-day test submerged in 2 feet of salt water, 2 percent salt by weight, with 12-hour on and off periods. The operating periods must be at full load.

Leads of submersible transformers must be brought out through one or more sealed hubs and secured to withstand a 100 pound static pull without loosening or leaking.

86-6.10 (BLANK)

86-6.11 FALSEWORK LIGHTING

86-6.11A General

Falsework lighting must include lighting to illuminate the pavement, portals, and pedestrian walkways at or under openings in the falsework required for traffic.

Lighting for pedestrian walkway illumination must be installed at all pedestrian openings through or under falsework.

Before starting falsework opening construction, you must submit a plan of proposed lighting installations for review and obtain approval. Approval will be made as specified in Section 5-1.02, "Plans and Working Drawings."

You must design falsework lighting so that required maintenance can be performed with a minimum of inconvenience to public traffic. Closing of traffic lanes for routine maintenance will not be permitted on roadways with posted speed limits greater than 25 mph.

Pavement under falsework with portals less than 150 feet apart and falsework portals must be illuminated only during the hours of darkness as defined in Division 1, Section 280, of the California Vehicle Code. Photoelectric switches must be used to control falsework lighting systems. Pavement under falsework with portals 150 feet or more apart and all pedestrian openings through falsework must be illuminated 24 hours per day.

Lighting fixtures must be aimed to avoid glare to oncoming motorists.

Type NMC cable with No. 12 minimum conductors, with ground wire, must be used. Fasten cable to supporting structure at sufficient intervals to adequately support cable and within 12 inches from every box or fitting. Conductors within 8 feet of ground must be enclosed in a 1/2 inch or larger metal conduit.

Each illumination system must be on a minimum of 1 separate branch circuit at each bridge location. Each branch circuit must be fused, not to exceed 20 A.

For falsework lighting, you must arrange with the serving utility to complete service connections. You must pay for energy, line extension, service, and service hookup costs.

At completion of project or when ordered by the Engineer, falsework lighting equipment will become your property and you must remove it from the job site.

You may propose a lighting plan that fulfills light intensity requirements to the systems specified herein. You must supply sufficient data to allow evaluation of alternative methods.

86-6.11B Pavement Illumination

Illumination of pavement at vehicular openings through falsework must comply with the following:

1. Fixture must include R/FL commercial type floodlamp holder with protective covers.
2. Fixture must be fully adjustable with brackets and locking screws, and allow mounting directly to a standard metal junction box.
3. Lamp must be medium-base 120 V(ac), 120 W, minimum, PAR-38 quartz-halogen floodlamp.
4. A continuous row of fixture types required must be installed at locations and spacing specified. Fixtures must be installed beneath falsework structure, with the end fixtures not further than 10 feet inside portal faces. Fixtures must be installed and energized immediately after the members supporting them have been erected.
5. Fixtures along the sides of the opening must be placed not more than 4 feet behind or 2 feet in front of the roadway face of the temporary railing. Mounting heights of fixtures must be between 12 and 16 feet above the roadway surface and must present an unobstructed light pattern on the pavement.

86-6.11C Portal Illumination

Illumination of falsework portals must comply with the following:

1. On each side of each entrance portal, plywood sheet clearance guides, 4 feet wide by 8 feet high, must be fastened vertically, facing traffic, with the bottom of the panel 3 feet to 4 feet above the roadway. The center of the panel must be located approximately 3 feet horizontally behind the roadway face of the railing. Panels must be freshly painted for each installation with not less than 2 applications of flat white paint. Paint testing will not be required.
2. If ordered by the Engineer, in order to improve the general appearance of the painted surfaces, you must repaint designated areas and that painting will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."
3. Falsework portals must be illuminated on the side facing traffic with 150 W, minimum, PAR reflector floodlamps mounted on the structure directly over each vertical support adjacent to the traveled way, as needed to uniformly illuminate the exterior falsework beam, the clearance guides, and the overhead clearance sign. Each lamp must be supported approximately 16 feet above the pavement and approximately 6 feet in front of the portal face.
4. Portal lighting and clearance guides must be installed on the day that vertical members are erected.

86-6.11D Pedestrian Walkway Illumination

Illumination of pedestrian openings through or under falsework must comply with the following:

1. Fixtures must be flush-mounted in the overhead protection shield and equipped with a damage-resistant clear polycarbonate diffuser lens. Lamps must be standard incandescent 100 W, 120 V(ac).
2. Fixtures must be centered over the passageway at intervals of not more than 15 feet with the end fixtures not more than 7 feet inside the end of the pedestrian openings.
3. Pedestrian passageway light systems must be installed immediately after the overhead protection shield is erected.

86-7 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT

86-7.01 REMOVING ELECTRICAL EQUIPMENT

Existing electrical equipment, pull boxes, and conduits, to be removed and not reused or salvaged, become your property and you must dispose of it under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way." Unused underground conduit may be abandoned in place after all conductors have been removed, except that conduit terminations from conduit to be abandoned must be removed from pull boxes to remain.

SECTION 88 ENGINEERING FABRICS

(Issued 01-20-12)

Replace Section 88 with:

SECTION 88 GEOSYNTHETICS

88-1.01 GENERAL

88-1.01A Summary

Section 88 includes specifications for geosynthetics. Geosynthetics are used for:

1. Filtration
2. Drainage
3. Reinforcement
4. Water pollution control
5. Channel and shore protection
6. Pavement interlayer
7. Separation and stabilization

88-1.01B Submittals

Submit:

1. Certificate of Compliance under Section 6-1.07, "Certificates of Compliance"
2. Samples representing each lot
3. Minimum average roll values (MARV)

Label submittals with the manufacturer's name and product information.

88-1.01C Quality Control and Assurance

Treat geosynthetics to resist degradation from exposure to sunlight. Using covers, protect geosynthetics from moisture, sunlight, and shipping and storage damage.

88-1.02 FILTRATION

88-1.02A Filter Fabric

Geosynthetics used for filter fabric must be permeable and nonwoven. Filter fabric must consist of 1 of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Filter fabric must comply with:

Filter Fabric				
Property	ASTM	Specification		
		Class A	Class B	Class C
Grab breaking load, 1-inch grip, lb minimum in each direction	D 4632	157		
Apparent elongation, percent minimum in each direction	D 4632	50		
Puncture strength, lb minimum	D 6241	600		
Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr	D 4355	70		
Permittivity, sec ⁻¹ minimum	D 4491	0.5	0.2	0.1
Apparent opening size, average roll value, U.S. Standard sieve size maximum	D 4751	40	60	70

88-1.03 DRAINAGE

88-1.03A Geocomposite Wall Drain

Geocomposite wall drain must consist of a polymeric core with filter fabric integrally bonded to 1 or both sides of the core creating a stable drainage void.

Filter fabric must comply with Section 88-1.02, "Filtration."

Geocomposite wall drain must comply with:

Geocomposite Wall Drain		
Property	ASTM	Specification
Thickness with fabric, inches maximum	--	2
Transmissivity, gradient = 1.0, normal stress = 5,000 psf, gal/min/ft	D 4716	4

88-1.04 REINFORCEMENT

88-1.04A Geotechnical Subsurface Reinforcement

General

Geosynthetic used for geotechnical subsurface reinforcement must be either of the following:

1. Geotextile
2. Geogrid

Geotextile permittivity must be at least 0.05 sec⁻¹ determined under ASTM D 4491.

Geogrid must have a regular and defined open area. The open area must be from 50 to 90 percent of the total grid area.

Long Term Design Strength

Long Term Design Strength (LTDS) of geosynthetic reinforcement is the ultimate tensile strength in the primary strength direction divided by reduction factors. Calculate the LTDS from the guidelines in Geosynthetic Research Institute (GRI) Standard Practice GG4a, GRI GG4b, or GRI GT7.

The product of the appropriate reduction factors must be at least 1.30. Determine the reduction factor for creep using a 75-year design life for permanent applications and a 5-year design life for temporary applications. Determine the installation damage reduction factor based on the characteristics of the backfill materials used.

If test data is not available, use default values of reduction factors in the GRI Standard Practice to calculate LTDS.

Submit the LTDS and its supporting calculations at least 15 days before placing geosynthetic reinforcement. Do not install before the Engineer's approval. The LTDS must be signed by an engineer who is registered as a civil engineer in the State.

88-1.05 WATER POLLUTION CONTROL

Geosynthetics used for water pollution control must comply with:

		Water Pollution Control Geosynthetics						
Property	ASTM	Application						
		Silt Fence		Sediment Filter Bag		Gravel-Filled Bags	Temporary Cover	
		Woven	Non-woven	Woven	Non-woven		Woven	Non-woven
Grab breaking load, 1-inch grip, lb minimum in each direction	D 4632	120	120	200	250	205	200	200
Apparent elongation, percent minimum, in each direction	D 4632	15	50	10	50	--	15	50
Water flow rate, gallons per minute/square foot minimum and maximum average roll value	D 4491	10 - 100	100 - 150	100 - 200	75 - 200	80 - 150	4 - 10	80 - 120
Permittivity, sec ⁻¹ minimum	D 4491	0.05	1.1	1.0	1.0	0.2	0.05	1.0
Apparent opening size, inches maximum average roll value	D 4751	0.023	0.012	0.023	0.012	0.016	0.023	0.012
Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr.	D 4355	70	70	70	70	70	70	70

88-1.06 CHANNEL AND SHORE PROTECTION

88-1.06A Rock Slope Protection

Rock slope protection (RSP) fabric must be a permeable, nonwoven, needle-punched geotextile. RSP fabric consists of 1 of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Polymers must be either virgin compounds or clean reworked material. Do not subject virgin compounds to use or processing other than required for initial manufacture. Clean reworked material must be previously processed material from the processor's own production that has been reground, pelletized, or solvated. RSP fabric must not consist of more than 20 percent by weight of clean reworked material. Do not use recycled materials from either post-consumer or post-industrial sources.

Class 8 or Class 10 RSP fabric must comply with:

Rock Slope Protection Fabric

Property	ASTM	Specification	
		Class 8	Class 10
Weight, oz/yd ² minimum	D 5261	7.5	9.5
Grab breaking load, lb 1-inch grip, min. in each direction	D 4632	200	250
Apparent elongation, percent min., in each direction	D 4632	50	50
Permittivity, sec ⁻¹ , minimum	D 4491	1.0	0.70
Apparent opening size, U.S. Standard sieve size minimum and maximum	D 4751	70 - 100	70 - 100
Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr.	D4355	70	70

88-1.07 PAVEMENT INTERLAYER

88-1.07A Paving Fabric

Geosynthetics used for paving fabric must be nonwoven. Paving fabric must comply with:

Geosynthetic Paving Fabric

Property	ASTM	Specification
Mass per unit area, oz/yd ² minimum	D 5261	4.1
Grab breaking load, lb 1-inch grip, minimum, in each direction	D 4632	100
Apparent elongation, percent minimum in each direction	D 4632	50
Hydraulic bursting strength, psi minimum	D 3786	200
Melting point, °F minimum	D 276	325
Asphalt retention, gal/yd ² minimum	D 6140	0.2

88-1.07B Paving Mat

Geosynthetics used for paving mat must be a nonwoven fiberglass and polyester hybrid material. Paving mat must comply with:

Geosynthetic Paving Mat

Property	ASTM	Specification
Breaking force, lb/2 inches minimum	D 5035	45
Ultimate elongation, percent maximum	D 5035	5
Mass per unit area, oz/ sq yd minimum	D 5261	3.7
Melting point, °F minimum	D 276	400
Asphalt retention, gal/yd ² minimum	D 6140	0.10

88-1.07C Paving Grid

Geosynthetics used for paving grid must be a geopolymer material formed into a grid of integrally connected elements with openings. Paving grid must comply with:

Geosynthetic Paving Grid

Property	Test	Specification		
		Class I	Class II	Class III
Tensile strength at ultimate, lb/in ^a minimum	ASTM D 6637	560 x 1,120	560	280
Aperture size, inch minimum	Calipered	0.5	0.5	0.5
Elongation, % maximum	ASTM D 6637	12	12	12
Mass per area, oz / sqyd minimum	ASTM D 5261	16	10	5.5
Melting point, °F minimum	ASTM D 276	325	325	325

Note:

^a For Class I, machine direction x cross direction. For Class II and Class III, both directions.

88-1.07D Paving Geocomposite Grid

Paving geocomposite grid consists of paving grid specified under Section 88-1.07C, "Paving Grid," bonded or integrated with paving fabric specified under Section 88-1.07A, "Paving Fabric."

Paving geocomposite grid must have a peel strength of at least 10 pounds per foot determined under ASTM D 413.

88-1.07E Geocomposite Strip Membrane

Geocomposite strip membrane must consist of various widths of strips manufactured from asphaltic rubber and geosynthetics. Geocomposite strip membrane must comply with:

Geocomposite Strip Membrane

Property	ASTM	Specification
Strip tensile strength, lbs/inch minimum	D 882	50
Elongation at break, % minimum	D 882	50
Resistance to puncture, lbs. minimum	E 154	200
Permeance, perms maximum	E 96/E 96M	0.10
Pliability, 1/4 inch mandrel with sample conditioned at 25 °F	D 146	No cracks in fabric or bitumen
Melting point, °F	D 276	325

88-1.08 SEPARATION AND STABILIZATION

88-1.08A Subgrade Enhancement Geotextile

Subgrade enhancement geotextile must consist of either of the following:

1. Polyester
2. Polypropylene

Subgrade enhancement geotextile must comply with:

Use	Cementitious Material Content (Pounds/CY)
Concrete designated by compressive strength: Deck slabs and slab spans of bridges Roof sections of exposed top box culverts Other portions of structures	675 min., 800 max. 675 min., 800 max. 590 min., 800 max.
Concrete not designated by compressive strength: Deck slabs and slab spans of bridges Roof sections of exposed top box culverts Prestressed members Seal courses Other portions of structures	675 min. 675 min. 675 min. 675 min. 590 min.
Concrete for precast members	590 min., 925 max.

Except for minor structures, the minimum required compressive strength for concrete in structures or portions of structures shall be the strength specified, or 3600 pounds per square inch at 28 days, whichever is greater.

Except for when a modulus of rupture is specified, the minimum required compressive strength for concrete shall be the strength specified, or 2,500 pounds per square inch, whichever is greater. Concrete shall be proportioned such that the concrete will attain the minimum required compressive strength.

If the specified 28-day compressive strength is 3,600 pounds per square inch or greater, the concrete is designated by compressive strength. For concrete with a 28-day compressive strength greater than 3,600 pounds per square inch, 42 days will be allowed to obtain the specified strength.

For concrete not designated by compressive strength, the Engineer may test the concrete for compressive strength. The concrete will be accepted if the compressive strength at 28 days attains 85 percent or more of the minimum required compressive strength.

Concrete shall be proportioned to conform to the following shrinkage limitations when tested in conformance with the requirements of AASHTO Designation: T 160, modified as follows:

Condition	Maximum Shrinkage of Laboratory Cast Specimens at 28 days Drying (average of 3, %)
Paving and approach slab concrete	0.050
Bridge deck concrete	0.045

Note: Shrinkage requirement is waived for concrete that is used for precast elements.

Shrinkage tests shall be either:

- A. Performed by a laboratory accredited to perform AASHTO Designation: T 160, or
- B. Performed by a laboratory that maintains a current rating of 3 or better for the Cement and Concrete Reference Laboratory (CCRL) concrete proficiency sample program.

Laboratory cast specimens shall have a 4" x 4" cross section. Specimens shall be removed from the molds 23 ± 1 hours after mixing the concrete and placed in lime water at 73 ± 3 °F to 7 days age. A comparator reading shall be taken at 7 days age and recorded as the initial reading. Specimens then shall be stored in a humidity controlled room maintained at 73 ± 3 °F and 50 ± 4 percent relative humidity for the remainder of the test. Subsequent readings shall be taken at 7, 14, 21, and 28 days drying.

Test data verifying conformance to the shrinkage limitations shall be submitted with the mix design. Shrinkage testing data accepted by the Engineer no more than 3 years prior to the first working day of this contract will be acceptable for this entire contract, provided the data was for concrete with similar proportions and the same materials and material sources to be used on this contract. Concrete shall be considered to have similar proportions if, when compared to concrete to be used on this project, no more than 2 mix design elements are varied. Varied mix design elements shall fall within the tolerances in the following table:

Mix Design Element	Tolerance (±)
Water to cementitious material ratio	0.03
Total water content	5 %
Coarse aggregate (weight per cubic yard)	10 %
Fine aggregate (weight per cubic yard)	10 %
Supplementary cementitious material content	5 %
Admixture (as originally dosed)	25 %

Note: Admixtures must be of the same brand.

Before using concrete or in advance of revising the mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design.

Compliance with cementitious material content requirements will be verified in conformance with procedures described in California Test 518 for cement content. For testing purposes, supplementary cementitious material (SCM) shall be considered to be cement. Batch proportions shall be adjusted as necessary to produce concrete having the specified cementitious material content.

If any concrete has a cementitious material, portland cement, or SCM content that is less than the minimum required, the concrete shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place and the Contractor shall pay to the State \$0.25 for each pound of cementitious material, portland cement, or SCM that is less than the minimum required. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract. The deductions will not be made unless the difference between the contents required and those actually provided exceeds the batching tolerances permitted by Section 90-5, "Proportioning." No deductions will be made based on the results of California Test 518.

The requirements of the preceding paragraph shall not apply to minor concrete.

90-2 MATERIALS

90-2.01 CEMENTITIOUS MATERIALS

Unless otherwise specified, cementitious material shall be either a combination of Type II or Type V portland cement and SCM, or a blended cement. No cementitious material shall be used in the work unless it is on the Department's Pre-Qualified Products List at the time of mix design submittal. Information regarding cementitious material qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.

Cementitious materials used in cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same sources and of the same proportions.

Cementitious materials shall be protected from moisture until used. Sacked cementitious materials shall be piled to permit access for tallying, inspecting, and identifying each shipment.

Facilities shall be provided to ensure that the various cementitious materials meeting this Section 90-2.01 are kept separate from each other and from other cementitious materials. A storage silo containing a cementitious material shall be emptied before using that silo for a different cementitious material. Blended cements with a percentage of SCM differing by more than 2 percentage points are considered different cementitious materials. Sampling cementitious materials shall be in conformance with California Test 125.

The Contractor shall furnish a Certificate of Compliance for cementitious materials in conformance with the provisions in Section 6-1.07, "Certificates of Compliance." The Certificate of Compliance shall indicate the source by name and location (including country, state, and city). If cementitious material is delivered directly to the job site, the Certificate of Compliance shall be signed by the cementitious material supplier. If the cementitious material is used in ready-mixed concrete or in precast concrete products purchased as such by the Contractor, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product. If blended cement is used, the Certificate of Compliance shall include a statement signed by the blended cement supplier that indicates the actual percentage, by weight, of SCM in the blend. Weight of SCM shall be by weighing device conforming to Section 9-1.01, "Measurement of Quantities," or as determined by chemical analysis.

90-2.01A Cement

Portland cement shall conform to the requirements in ASTM Designation: C 150 except the C₃S content of Type II cement shall not exceed 65 percent.

Blended cement shall conform to the requirements for Portland Blast-Furnace Slag Cement, Type IS (MS) or Portland-Pozzolan Cement, Type IP (MS) in AASHTO Designation: M 240, except that the maximum limits on the pozzolan content shall not apply. Blended cement shall be comprised of Type II or Type V cement and SCM produced by intergrinding portland cement clinker and granulated blast furnace slag, ground granulated blast furnace

slag (GGBFS), or pozzolan; by blending portland cement and either GGBFS or finely divided pozzolan; or by a combination of intergrinding and blending.

In addition, Type II portland cement and Type V portland cement shall conform to the following requirements:

- A. The cement shall not contain more than 0.60-percent by mass of alkalis, calculated as the percentage of Na₂O plus 0.658 times the percentage of K₂O, when determined by methods as required in AASHTO Designation: T 105; and
- B. The autoclave expansion shall not exceed 0.50-percent

Type III portland cement shall be used only as specified or with the approval of the Engineer. Type III portland cement shall conform to the additional requirements listed above for Type II portland cement. The Contractor may use Type III portland cement in the manufacturing of precast concrete.

90-2.01B Supplementary Cementitious Materials

Each supplementary cementitious material shall conform to one of the following:

- A. Fly ash conforming to the requirements in AASHTO Designation: M 295, Class F, and these specifications. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.
- B. Ultra fine fly ash (UFFA) conforming to the requirements in AASHTO Designation: M 295, Class F, and the following chemical and physical requirements:

Chemical Requirements	Percent
Sulfur Trioxide (SO ₃)	1.5 max.
Loss on ignition	1.2 max.
Available Alkalies (as Na ₂ O) equivalent	1.5 max.

Physical Requirements	Percent
Particle size distribution	
Less than 3.5 microns	50
Less than 9.0 microns	90
Strength Activity Index with portland cement	
7 days	95 (minimum % of control)
28 days	110 (minimum % of control)
Expansion at 16 days when testing job materials in conformance with ASTM C 1567*	0.10 max.

* In the test mix, Type II or Type V portland cement shall be replaced with at least 12% UFFA by weight.

- C. Raw or calcined natural pozzolans conforming to the requirements in AASHTO Designation: M 295, Class N, and the following requirements and these specifications. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.
- D. Metakaolin conforming to the requirements in AASHTO Designation: M 295, Class N, and the following chemical and physical requirements:

Chemical Requirements	Percent
Silicon Dioxide (SiO ₂) + Aluminum Oxide (Al ₂ O ₃)	92.0 min.
Calcium Oxide (CaO)	1.0 max
Sulfur Trioxide (SO ₃)	1.0 max.
Loss on ignition	1.2 max.
Available Alkalies (as Na ₂ O) equivalent	1.0 max.

Physical Requirements	Percent
Particle size distribution Less than 45 microns	95
Strength Activity Index with portland cement 7 days 28 days	100 (minimum % of control) 100 (minimum % of control)

- E. Ground Granulated Blast Furnace Slag (GGBFS) conforming to the requirements in AASHTO Designation: M 302, Grade 100 or Grade 120.
- F. Silica Fume conforming to the requirements of AASHTO Designation: M 307, with reduction in mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.

Commingling of fly ash from different sources at uncontrolled ratios is permissible only if the following criteria are satisfied:

- A. Sources of fly ash to be commingled shall each produce fly ash that conforms to the requirements in AASHTO Designation: M 295, Class F.
- B. Testing of the commingled product is the responsibility of the fly ash supplier.
- C. Each fly ash's running average of relative density shall not differ from any other by more than 0.25 at the time of commingling.
- D. Each fly ash's running average of loss on ignition shall not differ from any other by more than one percent at the time of commingling.
- E. The final product of commingled fly ash shall conform to the requirements in AASHTO Designation: M 295, Class F.

90-2.01C Required Use Of Supplementary Cementitious Materials

General

The amount of portland cement and SCM used in portland cement concrete shall conform to the minimum cementitious material content provisions in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," and these specifications.

The SCM content in portland cement concrete shall conform to one of the following:

- A. Any combination of portland cement and at least one SCM, satisfying Equations (1) and (2):

Equation (1)

$$\frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{MC} \geq X$$

Where:

- UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard.
- FA = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 10 percent, including the amount in blended cement, pounds per cubic yard.
- FB = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content greater than 10 percent and up to 15 percent, including the amount in blended cement, pounds per cubic yard.
- SL = GGBFS, including the amount in blended cement, pounds per cubic yard.
- MC = Minimum amount of cementitious material specified, pounds per cubic yard.
- X = 1.8 for innocuous aggregate, 3.0 for all other aggregate.

Equation (2)

$$MC - MSCM - PC \geq 0$$

Where:

MC = Minimum amount of cementitious material specified, pounds per cubic yard.

MSCM = The minimum sum of SCMs that satisfies Equation (1) above, pounds per cubic yard.

PC = The amount of portland cement, including the amount in blended cement, pounds per cubic yard.

- B. 15 percent of Class F fly ash with at least 48 ounces of LiNO₃ solution added per 100 pounds of portland cement. CaO content of the fly ash shall not exceed 15 percent.

Precast Concrete

The SCM content in precast portland cement concrete shall conform to one of the following:

- A. Any combination of portland cement and SCM, satisfying the following equation:

Equation (3)

$$\frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{TC} \geq X$$

Where:

UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard.

FA = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 10 percent, including the amount in blended cement, pounds per cubic yard.

FB = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content greater than 10 percent and up to 15 percent, including the amount in blended cement, pounds per cubic yard.

SL = GGBFS, including the amount in blended cement, pounds per cubic yard.

TC = Total amount of cementitious material used in the mix, pounds per cubic yard.

X = 0.0 if precast members are constructed with portland cement concrete using aggregate that is "innocuous" in conformance with the provisions in Section 90-2.02, "Aggregates."

X = 3.0 for all other aggregate.

- B. 15 percent of Class F fly ash with at least 48 ounces of LiNO₃ solution added per 100 pounds of portland cement. CaO content of the fly ash shall not exceed 15 percent.
- C. Any combination of supplementary cementitious material and portland cement may be used if the expansion of cementitious material and aggregate does not exceed 0.10 percent when tested in conformance with the requirements in ASTM C 1567. Test data shall be submitted with each mix design. Test data accepted by the Engineer no more than 3 years prior to the first working day of this contract will be acceptable for this entire contract, provided the data was for the same concrete mix and the same materials and material sources to be used on this contract.

90-2.02 AGGREGATES

To be considered innocuous, aggregate must be on the Department's approved list, "Innocuous Aggregates for use in Concrete." Information regarding aggregate qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.

Both coarse and fine aggregate must be on the approved list for the aggregate used in concrete to be considered innocuous.

Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

The Contractor shall provide safe and suitable facilities, including necessary splitting devices for obtaining samples of aggregates, in conformance with California Test 125.

Aggregates shall be of such character that it will be possible to produce workable concrete within the limits of water content provided in Section 90-6.06, "Amount of Water and Penetration."

Aggregates shall have not more than 10 percent loss when tested for soundness in conformance with the requirements in California Test 214. The soundness requirement for fine aggregate will be waived, provided that the durability index, D_f , of the fine aggregate is 60 or greater when tested for durability in conformance with California Test 229.

If the results of any one or more of the Cleanness Value, Sand Equivalent, or aggregate grading tests do not meet the requirements specified for "Operating Range" but all meet the "Contract Compliance" requirements, the placement of concrete shall be suspended at the completion of the current pour until tests or other information indicate that the next material to be used in the work will comply with the requirements specified for "Operating Range."

If the results of either or both the Cleanness Value and coarse aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete that is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State \$3.50 per cubic yard for paving concrete and \$5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

If the results of either or both the Sand Equivalent and fine aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete which is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State \$3.50 per cubic yard for paving concrete and \$5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

The 2 preceding paragraphs apply individually to the "Contract Compliance" requirements for coarse aggregate and fine aggregate. When both coarse aggregate and fine aggregate do not conform to the "Contract Compliance" requirements, both paragraphs shall apply. The payments specified in those paragraphs are in addition to any payments made in conformance with the provisions in Section 90-1.01, "Description."

No single Cleanness Value, Sand Equivalent, or aggregate grading test shall represent more than 300 cubic yards of concrete or one day's pour, whichever is smaller.

When the source of an aggregate is changed, the Contractor shall adjust the mix proportions and submit in writing to the Engineer a copy of the mix design before using the aggregates.

90-2.02A Coarse Aggregate

Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, reclaimed aggregate, crushed air-cooled iron blast furnace slag or combinations thereof. Crushed air-cooled blast furnace slag shall not be used in reinforced or prestressed concrete.

Reclaimed aggregate is aggregate that has been recovered from plastic concrete by washing away the cementitious material. Reclaimed aggregate shall conform to all aggregate requirements.

Coarse aggregate shall conform to the following quality requirements:

Tests	California Test	Requirements
Loss in Los Angeles Rattler (after 500 revolutions)	211	45% max.
Cleanness Value		
Operating Range	227	75 min.
Contract Compliance	227	71 min.

In lieu of the above Cleanness Value requirements, a Cleanness Value "Operating Range" limit of 71, minimum, and a Cleanness Value "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the coarse aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

- A. Coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested in conformance with the requirements in California Test 227; and

- B. Prequalification tests performed in conformance with the requirements in California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.02B Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand produced from larger aggregate or a combination thereof. Manufactured sand shall be well graded.

Fine aggregate shall conform to the following quality requirements:

Test	California Test	Requirements
Organic Impurities	213	Satisfactory ^a
Sand Equivalent:		
Operating Range	217	75, min.
Contract Compliance	217	71, min.

^a Fine aggregate developing a color darker than the reference standard color may be accepted if 95% relative mortar strength is achieved when tested in conformance with ASTM C87.

In lieu of the above Sand Equivalent requirements, a Sand Equivalent "Operating Range" limit of 71, minimum, and a Sand Equivalent "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the fine aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

- A. Fine aggregate sampled at the completion of processing at the aggregate production plant had a Sand Equivalent value of not less than 82 when tested by California Test 217; and
- B. Prequalification tests performed in conformance with California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.03 WATER

In conventionally reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 1,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO₄, when tested in conformance with California Test 417. In prestressed concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 650 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO₄, when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either of the following results when compared to the same test using distilled or deionized water: 1) a change in the setting time of cement of more than 25 percent when tested in conformance with the requirements in ASTM Designation: C 191 or ASTM Designation: C 266 or 2) a reduction in the compressive strength of mortar at 14 days of more than 5 percent, when tested in conformance with the requirements in ASTM Designation: C 109.

In nonreinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1,500 parts per million of sulfates as SO₄, when tested in conformance with California Test 417.

In addition to the above provisions, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of the concrete or produce etching of the surface.

Water reclaimed from mixer wash-out operations may be used in mixing concrete. The water shall not contain coloring agents or more than 300 parts per million of alkalis (Na₂O + 0.658 K₂O) as determined on the filtrate. The specific gravity of the water shall not exceed 1.03 and shall not vary more than ±0.010 during a day's operations.

90-2.04 Admixture Materials

Admixture materials shall be stored and dispensed in liquid form and conform to the following requirements:

- A. Chemical Admixtures—ASTM Designation: C 494.
- B. Air-entraining Admixtures—ASTM Designation: C 260.
- C. Lithium Nitrate shall be in an aqueous solution conforming to the following:

1. Lithium Nitrate (LiNO₃) must be 30 percent +/- 0.5 percent by weight
2. Sulfate (SO₄) must be less than 1000 ppm
3. Chloride (Cl) must be less than 1000 ppm
4. Alkalis (Na₂O + 0.658 K₂O) must be less than 1000 ppm

90-3 AGGREGATE GRADINGS

90-3.01 GENERAL

Before beginning concrete work, the Contractor shall submit in writing to the Engineer the gradation of the primary aggregate nominal sizes that the Contractor proposes to furnish. If a primary coarse aggregate or the fine aggregate is separated into 2 or more sizes, the proposed gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically to indicate one proposed gradation. The proposed gradation shall meet the grading requirements shown in the table in this section, and shall show the percentage passing each of the sieve sizes used in determining the end result.

The Engineer may waive, in writing, the gradation requirements in this Section 90-3.01 and in Sections 90-3.02, "Coarse Aggregate Grading," 90-3.03, "Fine Aggregate Grading," and 90-3.04, "Combined Aggregate Gradings," if, in the Engineer's opinion, furnishing the gradation is not necessary for the type or amount of concrete work to be constructed.

Gradations proposed by the Contractor shall be within the following percentage passing limits:

Primary Aggregate Nominal Size	Sieve Size	Limits of Proposed Gradation
1-1/2" x 3/4"	1"	19 - 41
1" x No. 4	3/4"	52 - 85
1" x No. 4	3/8"	15 - 38
1/2" x No. 4	3/8"	40 - 78
3/8" x No. 8	3/8"	50 - 85
Fine Aggregate	No. 16	55 - 75
Fine Aggregate	No. 30	34 - 46
Fine Aggregate	No. 50	16 - 29

Should the Contractor change the source of supply, the Contractor shall submit in writing to the Engineer the new gradations before their intended use.

90-3.02 COARSE AGGREGATE GRADING

The grading requirements for coarse aggregates are shown in the following table for each size of coarse aggregate:

Sieve Sizes	Percentage Passing Primary Aggregate Nominal Sizes							
	1-1/2" x 3/4"		1" x No. 4		1/2" x No. 4		3/8" x No. 8	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance
2"	100	100	—	—	—	—	—	—
1-1/2"	88 - 100	85 - 100	100	100	—	—	—	—
1"	X ±18	X ±25	88 - 100	86 - 100	—	—	—	—
3/4"	0 - 17	0 - 20	X ±15	X ±22	100	100	—	—
1/2"	—	—	—	—	82 - 100	80 - 100	100	100
3/8"	0 - 7	0 - 9	X ±15	X ±22	X ±15	X ±22	X ±15	X ±20
No. 4	—	—	0 - 16	0 - 18	0 - 15	0 - 18	0 - 25	0 - 28
No. 8	—	—	0 - 6	0 - 7	0 - 6	0 - 7	0 - 6	0 - 7

In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

Coarse aggregate for the 1-1/2 inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," shall be furnished in 2 or more primary aggregate nominal sizes. Each primary aggregate nominal size may be separated into 2 sizes and stored separately, provided that the combined material conforms to the grading requirements for that particular primary aggregate nominal size.

When the one inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," is to be used, the coarse aggregate may be separated into 2 sizes and stored separately, provided that the combined material shall conform to the grading requirements for the 1" x No. 4 primary aggregate nominal size.

90-3.03 FINE AGGREGATE GRADING

Fine aggregate shall be graded within the following limits:

Sieve Sizes	Percentage Passing	
	Operating Range	Contract Compliance
3/8"	100	100
No. 4	95 - 100	93 - 100
No. 8	65 - 95	61 - 99
No. 16	X ±10	X ±13
No. 30	X ±9	X ±12
No. 50	X ±6	X ±9
No. 100	2 - 12	1 - 15
No. 200	0 - 8	0 - 10

In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

In addition to the above required grading analysis, the distribution of the fine aggregate sizes shall be such that the difference between the total percentage passing the No. 16 sieve and the total percentage passing the No. 30 sieve shall be between 10 and 40, and the difference between the percentage passing the No. 30 and No. 50 sieves shall be between 10 and 40.

Fine aggregate may be separated into 2 or more sizes and stored separately, provided that the combined material conforms to the grading requirements specified in this Section 90-3.03.

90-3.04 COMBINED AGGREGATE GRADINGS

Combined aggregate grading limits shall be used only for the design of concrete mixes. Concrete mixes shall be designed so that aggregates are combined in proportions that shall produce a mixture within the grading limits for combined aggregates as specified herein.

The combined aggregate grading, except when otherwise specified in these specifications or the special provisions, shall be either the 1-1/2 inch, maximum grading, or the 1 inch, maximum grading, at the option of the Contractor.

Grading Limits of Combined Aggregates

Sieve Sizes	Percentage Passing			
	1-1/2" Max.	1" Max.	1/2" Max.	3/8" Max.
2"	100	—	—	—
1-1/2"	90 - 100	100	—	—
1"	50 - 86	90 - 100	—	—
3/4"	45 - 75	55 - 100	100	—
1/2"	—	—	90 - 100	100
3/8"	38 - 55	45 - 75	55 - 86	50 - 100
No. 4	30 - 45	35 - 60	45 - 63	45 - 63
No. 8	23 - 38	27 - 45	35 - 49	35 - 49
No. 16	17 - 33	20 - 35	25 - 37	25 - 37
No. 30	10 - 22	12 - 25	15 - 25	15 - 25
No. 50	4 - 10	5 - 15	5 - 15	5 - 15
No. 100	1 - 6	1 - 8	1 - 8	1 - 8
No. 200	0 - 3	0 - 4	0 - 4	0 - 4

Changes from one grading to another shall not be made during the progress of the work unless permitted by the Engineer.

90-4 ADMIXTURES

90-4.01 GENERAL

Admixtures used in portland cement concrete shall conform to and be used in conformance with the provisions in this Section 90-4 and the special provisions. Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option as provided herein.

Chemical admixtures and air-entraining admixtures containing chlorides as Cl in excess of one percent by weight of admixture, as determined by California Test 415, shall not be used.

Admixtures shall be uniform in properties throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.

If more than one admixture is used, the admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.

Chemical admixtures shall be used in conformance with the manufacturer's written recommendations. The manufacturer's written recommendations shall include a statement that the admixtures are compatible with the types and amounts of SCMs used.

90-4.02 MATERIALS

Admixture materials shall conform to the provisions in Section 90-2.04, "Admixture Materials."

90-4.03 ADMIXTURE APPROVAL

No admixture brand shall be used in the work unless it is on the Department's current list of approved brands for the type of admixture involved. Information regarding admixture qualification and placement on the Department's list can be obtained at the Transportation Laboratory.

If the Contractor proposes to use an admixture of a brand and type on the current list of approved admixture brands, the Contractor shall furnish a Certificate of Compliance from the manufacturer, as provided in Section 6-1.07, "Certificates of Compliance," certifying that the admixture furnished is the same as that previously approved. If a previously approved admixture is not accompanied by a Certificate of Compliance, the admixture shall not be used in the work until the Engineer has had sufficient time to make the appropriate tests and has approved the admixture for use. The Engineer may take samples for testing at any time, whether or not the admixture has been accompanied by a Certificate of Compliance.

90-4.04 REQUIRED USE OF CHEMICAL ADMIXTURES

If the use of a chemical admixture is specified, the admixture shall be used at the dosage specified, except that if no dosage is specified, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

90-4.05 OPTIONAL USE OF CHEMICAL ADMIXTURES

The Contractor may use Type A or F, water-reducing; Type B, retarding; or Type D or G, water-reducing and retarding admixtures as described in ASTM Designation: C 494 to conserve cementitious material or to facilitate any concrete construction application subject to the following conditions:

- A. If a water-reducing admixture or a water-reducing and retarding admixture is used, the cementitious material content specified or ordered may be reduced by a maximum of 5 percent by weight, except that the resultant cementitious material content shall be not less than 505 pounds per cubic yard; and
- B. When a reduction in cementitious material content is made, the dosage of admixture used shall be no less than the dosage used in determining approval of the admixture.

The Contractor may use Type S admixtures conforming to the requirements in ASTM Designation: C 494.

Unless otherwise specified, a Type C accelerating chemical admixture conforming to the requirements in ASTM Designation: C 494, may be used in portland cement concrete. Inclusion in the mix design submitted for approval will not be required provided that the admixture is added to counteract changing conditions that contribute to delayed setting of the portland cement concrete, and the use or change in dosage of the admixture is approved in writing by the Engineer.

90-4.06 REQUIRED USE OF AIR-ENTRAINING ADMIXTURES

When air-entrainment is specified or ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce a concrete having the specified air content as determined by California Test 504.

90-4.07 OPTIONAL USE OF AIR-ENTRAINING ADMIXTURES

When air-entrainment has not been specified or ordered by the Engineer, the Contractor will be permitted to use an air-entraining admixture to facilitate the use of any construction procedure or equipment provided that the average air content, as determined by California Test 504, of 3 successive tests does not exceed 4 percent, and no single test value exceeds 5.5 percent. If the Contractor elects to use an air-entraining admixture in concrete for pavement, the Contractor shall so indicate at the time the Contractor designates the source of aggregate.

90-4.08 BLANK

90-4.09 BLANK

90-4.10 PROPORTIONING AND DISPENSING LIQUID ADMIXTURES

Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers for liquid admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within ± 5 percent of the prescribed quantity for each batch. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each measuring unit shall be clearly marked for the type and quantity of admixture.

Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn slowly by the Engineer.

If more than one liquid admixture is used in the concrete mix, each liquid admixture shall have a separate measuring unit and shall be dispensed by injecting equipment located in such a manner that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other. When air-entraining admixtures are used in conjunction with other liquid admixtures, the air-entraining admixture shall be the first to be incorporated into the mix, unless it is demonstrated that a different sequence improves performance.

When automatic proportioning devices are used, dispensers for liquid admixtures shall operate automatically with the batching control equipment. The dispensers shall be equipped with an automatic warning system in good operating condition that will provide a visible or audible signal at the point at which proportioning operations are controlled when the quantity of admixture measured for each batch of concrete varies from the preselected dosage by more than 5 percent, or when the entire contents of the measuring unit are not emptied from the dispenser into each batch of concrete.

Unless liquid admixtures are added to premeasured water for the batch, their discharge into the batch shall be arranged to flow into the stream of water so that the admixtures are well dispersed throughout the batch, except that air-entraining admixtures may be dispensed directly into moist sand in the batching bins provided that adequate control of the air content of the concrete can be maintained.

Liquid admixtures requiring dosages greater than one-half gallon per cubic yard shall be considered to be water when determining the total amount of free water as specified in Section 90-6.06, "Amount of Water and Penetration."

90-4.11 BLANK

90-5 PROPORTIONING

90-5.01 STORAGE OF AGGREGATES

Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size shall be avoided and the various sizes shall not become intermixed before proportioning.

Aggregates shall be stored or stockpiled and handled in a manner that prevent contamination by foreign materials. In addition, storage of aggregates at batching or mixing facilities that are erected subsequent to the award of the contract and that furnish concrete to the project shall conform to the following:

- A. Intermingling of the different sizes of aggregates shall be positively prevented. The Contractor shall take the necessary measures to prevent intermingling. The preventive measures may include, but are not necessarily limited to, physical separation of stockpiles or construction of bulkheads of adequate length and height; and
- B. Contamination of aggregates by contact with the ground shall be positively prevented. The Contractor shall take the necessary measures to prevent contamination. The preventive measures shall include, but are

not necessarily limited to, placing aggregates on wooden platforms or on hardened surfaces consisting of portland cement concrete, asphalt concrete, or cement treated material.

In placing aggregates in storage or in moving the aggregates from storage to the weigh hopper of the batching plant, any method that may cause segregation, degradation, or the combining of materials of different gradings that will result in any size of aggregate at the weigh hopper failing to meet the grading requirements, shall be discontinued. Any method of handling aggregates that results in excessive breakage of particles shall be discontinued. The use of suitable devices to reduce impact of falling aggregates may be required by the Engineer.

90-5.02 PROPORTIONING DEVICES

Weighing, measuring, or metering devices used for proportioning materials shall conform to the requirements in Section 9-1.01, "Measurement of Quantities," and this Section 90-5.02. In addition, automatic weighing systems shall comply with the requirements for automatic proportioning devices in Section 90-5.03A, "Automatic Proportioning." Automatic devices shall be automatic to the extent that the only manual operation required for proportioning the aggregates, cement, and SCM for one batch of concrete is a single operation of a switch or starter.

For concrete pavement, aggregate and bulk cementitious material must be proportioned by weight by means of automatic proportioning devices.

Proportioning devices shall be tested as frequently as the Engineer may deem necessary to ensure their accuracy.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the plant is in operation, the weight of each batch of material shall not vary from the weight designated by the Engineer by more than the tolerances specified herein.

Equipment for cumulative weighing of aggregate shall have a zero tolerance of ± 0.5 percent of the designated total batch weight of the aggregate. For systems with individual weigh hoppers for the various sizes of aggregate, the zero tolerance shall be ± 0.5 percent of the individual batch weight designated for each size of aggregate. Equipment for cumulative weighing of cement and SCM shall have a zero tolerance of ± 0.5 percent of the designated total batch weight of the cement and SCM. Equipment for weighing cement or SCM separately shall have a zero tolerance of ± 0.5 percent of their designated individual batch weights. Equipment for measuring water shall have a zero tolerance of ± 0.5 percent of its designated weight or volume.

The weight indicated for any batch of material shall not vary from the preselected scale setting by more than the following:

- A. Aggregate weighed cumulatively shall be within 1.0 percent of the designated total batch weight of the aggregate. Aggregates weighed individually shall be within 1.5 percent of their respective designated batch weights; and
- B. Cement shall be 99 to 102 percent of its designated batch weight. When weighed individually, SCM shall be 99 to 102 percent of its designated batch weight. When SCM and cement are permitted to be weighed cumulatively, cement shall be weighed first to 99 to 102 percent of its designated batch weight, and the total for cement and SCM shall be 99 to 102 percent of the sum of their designated batch weights. When a blended cement is used, the percentages of cement and SCM used for calculating batch weights shall be based on the percentage of SCM indicated in the Certificate of Compliance from the blended cement supplier; and
- C. Water shall be within 1.5 percent of its designated weight or volume.

Each scale graduation shall be approximately 0.001 of the total capacity of the scale. The capacity of scales for weighing cement, SCM, or cement plus SCM and aggregates shall not exceed that of commercially available scales having single graduations indicating a weight not exceeding the maximum permissible weight variation above, except that no scale shall be required having a capacity of less than 1,000 pounds, with one pound graduations.

90-5.03 PROPORTIONING

Proportioning shall consist of dividing the aggregates into the specified sizes, each stored in a separate bin, and combining them with cementitious material and water as provided in these specifications. Aggregates shall be proportioned by weight.

At the time of batching, aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing. In no event shall the free moisture content of the fine aggregate at the time of batching exceed 8 percent of its saturated, surface-dry weight.

Should separate supplies of aggregate material of the same size group, but of different moisture content or specific gravity or surface characteristics affecting workability, be available at the proportioning plant, withdrawals shall be made from one supply exclusively and the materials therein completely exhausted before starting upon another.

Bulk Type IP (MS) or Type IS (MS) cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer.

Bulk cement and SCM may be weighed in separate, individual weigh hoppers or may be weighed in the same weigh hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer. If the cement and SCM are weighed cumulatively, the cement shall be weighed first.

If cement and SCM are weighed in separate weigh hoppers, the weigh systems for the proportioning of the aggregate, the cement, and the SCM shall be individual and distinct from all other weigh systems. Each weigh system shall be equipped with a hopper, a lever system, and an indicator to constitute an individual and independent material-weighing device. The cement and the SCM shall be discharged into the mixer simultaneously with the aggregate.

The scales and weigh hoppers for bulk weighing cement, SCM, or cement plus SCM shall be separate and distinct from the aggregate weighing equipment.

For batches of one cubic yard or more, the batching equipment shall conform to one of the following combinations:

- A. Separate boxes and separate scale and indicator for weighing each size of aggregate.
- B. Single box and scale indicator for all aggregates.
- C. Single box or separate boxes and automatic weighing mechanism for all aggregates.

In order to check the accuracy of batch weights, the gross weight and tare weight of batch trucks, truck mixers, truck agitators, and non-agitating hauling equipment shall be determined when ordered by the Engineer. The equipment shall be weighed on scales designated by the Engineer.

90-5.03A Automatic Proportioning

Automatic proportioning devices shall be authorized by the Department.

For concrete pavement, the Contractor shall install and maintain in operating condition an electronically actuated moisture meter that will indicate, on a readily visible scale, changes in the moisture content of the fine aggregate as it is batched within a sensitivity of 0.5 percent by weight of the fine aggregate.

The batching of cement, SCM, or cement plus SCM and aggregate shall be interlocked so that a new batch cannot be started until all weigh hoppers are empty, the proportioning devices are within zero tolerance, and the discharge gates are closed. The interlock shall permit no part of the batch to be discharged until all aggregate hoppers and the cement and SCM hoppers or the cement plus SCM hopper are charged with weights that are within the tolerances specified in Section 90-5.02, "Proportioning Devices."

If interlocks are required for cement and SCM charging mechanisms and cement and SCM are weighed cumulatively, their charging mechanisms shall be interlocked to prevent the introduction of SCM until the weight of cement in the cement weigh hopper is within the tolerances specified in Section 90-5.02, "Proportioning Devices."

If concrete is completely mixed in stationary mixers, the SCMs shall be weighed in a separate weigh hopper and the SCM and cement shall be introduced simultaneously into the mixer proportionately with the aggregate. If the Contractor provides certification that the stationary mixer is capable of mixing the cement, SCM, aggregates, and water uniformly before discharge, weighing the SCM cumulatively with the cement is permitted. Certification shall contain the following:

- A. Test results for 2 compressive strength test cylinders of concrete taken within the first one-third and 2 compressive strength test cylinders of concrete taken within the last one-third of the concrete discharged from a single batch from the stationary mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength";
- B. Calculations demonstrating that the difference in the averages of 2 compressive strengths taken in the first one-third is no greater than 7.5 percent different than the averages of 2 compressive strengths taken in the last one-third of the concrete discharged from a single batch from the stationary mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength;" and
- C. The mixer rotation speed and time of mixing before discharge that are required to produce a mix that meets the requirements above.

The discharge gate on the cement and SCM hoppers or the cement plus SCM hopper shall be designed to permit regulating the flow of cement, SCM, or cement plus SCM into the aggregate as directed by the Engineer.

If separate weigh boxes are used for each size of aggregate, the discharge gates shall permit regulating the flow of each size of aggregate as directed by the Engineer.

Material discharged from the several bins shall be controlled by gates or by mechanical conveyors. The means of withdrawal from the several bins, and of discharge from the weigh box, shall be interlocked so that not more than one bin can discharge at a time, and so that the weigh box cannot be tripped until the required quantity from each of the several bins has been deposited therein. Should a separate weigh box be used for each size of aggregate, all may be operated and discharged simultaneously.

If the discharge from the several bins is controlled by gates, each gate shall be actuated automatically so that the required weight is discharged into the weigh box, after which the gate shall automatically close and lock.

The automatic weighing system shall be designed so that all proportions required may be set on the weighing controller at the same time.

90-6 MIXING AND TRANSPORTING

90-6.01 GENERAL

Concrete shall be mixed in mechanically operated mixers, except that when permitted by the Engineer, batches not exceeding 1/3 cubic yard may be mixed by hand methods in conformance with the provisions in Section 90-6.05, "Hand-Mixing."

Equipment having components made of aluminum or magnesium alloys that would have contact with plastic concrete during mixing, transporting, or pumping of portland cement concrete shall not be used.

Concrete shall be homogeneous and thoroughly mixed, and there shall be no lumps or evidence of undispersed cementitious material.

Uniformity of concrete mixtures will be determined by differences in penetration as determined by California Test 533, or slump as determined by ASTM Designation: C 143, and by variations in the proportion of coarse aggregate as determined by California Test 529.

When the mix design specifies a penetration value, the difference in penetration, determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed 1/2 inch. When the mix design specifies a slump value, the difference in slump, determined by comparing slump tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed the values given in the table below. Variation in the proportion of coarse aggregate will be determined by comparing the results of tests of 2 samples of mixed concrete from the same batch or truck mixer load and the difference between the 2 results shall not exceed 170 pounds per cubic yard of concrete.

Average Slump	Maximum Permissible Difference
Less than 4"	1"
4" to 6"	1-1/2"
Greater than 6" to 9"	2"

The Contractor shall furnish samples of the freshly mixed concrete and provide satisfactory facilities for obtaining the samples.

90-6.02 MACHINE MIXING

Concrete mixers may be of the revolving drum or the revolving blade type, and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. Mixers and agitators that have an accumulation of hard concrete or mortar shall not be used.

The temperature of mixed concrete, immediately before placing, shall be not less than 50 °F or more than 90 °F. Aggregates and water shall be heated or cooled as necessary to produce concrete within these temperature limits. Neither aggregates nor mixing water shall be heated to exceed 150 °F. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.

The batch shall be so charged into the mixer that some water will enter in advance of cementitious materials and aggregates. All water shall be in the drum by the end of the first one-fourth of the specified mixing time. When concrete is delivered in a truck mixer, a portion of the mixing water may be withheld and, if allowed by the Engineer, may be added at the point of delivery as specified under Section 90-6.03, "Transporting Mixed Concrete."

Cementitious materials shall be batched and charged into the mixer by means that will not result either in loss of cementitious materials due to the effect of wind, in accumulation of cementitious materials on surfaces of conveyors or hoppers, or in other conditions that reduce or vary the required quantity of cementitious material in the concrete mixture.

Stationary mixers shall be operated with an automatic timing device. The timing device and discharge mechanism shall be interlocked so that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.

The total elapsed time between the intermingling of damp aggregates and all cementitious materials and the start of mixing shall not exceed 30 minutes.

The size of batch shall not exceed the manufacturer's guaranteed capacity.

When producing concrete for pavement or base, suitable batch counters shall be installed and maintained in good operating condition at job site batching plants and stationary mixers. The batch counters shall indicate the exact number of batches proportioned and mixed.

Concrete shall be mixed and delivered to the job site by means of one of the following combinations of operations:

- A. Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in nonagitating hauling equipment (central-mixed concrete).
- B. Mixed partially in a stationary mixer, and the mixing completed in a truck mixer (shrink-mixed concrete).
- C. Mixed completely in a truck mixer (transit-mixed concrete).

Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified.

When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed will be allowed for partial mixing in a central plant.

90-6.03 TRANSPORTING MIXED CONCRETE

Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place, and provided the mixed concrete after hauling to the delivery point conforms to the provisions in Section 90-6.01, "General."

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity and shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

Bodies of nonagitating hauling equipment shall be constructed so that leakage of the concrete mix, or any part thereof, will not occur at any time.

Concrete hauled in open-top vehicles shall be protected during hauling against rain or against exposure to the sun for more than 20 minutes when the ambient temperature exceeds 75 °F.

No water in excess of that in the approved mix design shall be incorporated into the concrete. If approved by the Engineer, water withheld during batching may be added to the concrete at the delivery point in one operation before the discharge of more than 1/4 cubic yard. Equipment for supplying the water shall conform to Section 90-6.06, "Amount of Water and Penetration." When water is added at the point of delivery, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharged is commenced.

The rate of discharge of mixed concrete from a truck mixer or agitator shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

If a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1.5 hours or before 250 revolutions of the drum or blades, whichever occurs first, after the introduction of the cementitious materials to the aggregates. Under conditions contributing to quick stiffening of the concrete, or if the temperature of the concrete is 85 °F or above, the time allowed may be less than 1.5 hours. If an admixture is used to retard the set time, the temperature of the concrete shall not exceed 85 °F, the time limit shall be 2 hours, and the revolution limitation shall be 300.

If nonagitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cementitious materials to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 °F or above, the time between the introduction of cementitious materials to the aggregates and discharge shall not exceed 45 minutes.

Each load of concrete delivered at the job site shall be accompanied by a weighmaster certificate showing the mix identification number, nonrepeating load number, date and time at which the materials were batched, the total amount of water added to the load, and for transit-mixed concrete, the reading of the revolution counter at the time

the truck mixer is charged with cement. This weighmaster certificate shall also show the actual scale weights (pounds) for the ingredients batched. Theoretical or target batch weights shall not be used as a substitute for actual scale weights.

Weighmaster certificates shall be provided in printed form, or if approved by the Engineer, the data may be submitted in electronic media. Electronic media shall be presented in a tab-delimited format on a CD or DVD. Captured data, for the ingredients represented by each batch shall be "line feed, carriage return" (LFCR) and "one line, separate record" with allowances for sufficient fields to satisfy the amount of data required by these specifications.

The Contractor may furnish a weighmaster certificate accompanied by a separate certificate that lists the actual batch weights or measurements for a load of concrete provided that both certificates are imprinted with the same nonrepeating load number that is unique to the contract and delivered to the jobsite with the load.

Weighmaster certificates furnished by the Contractor shall conform to the provisions in Section 9-1.01, "Measurement of Quantities."

90-6.04 TIME OR AMOUNT OF MIXING

Mixing of concrete in stationary mixers shall continue for the required mixing time after all ingredients, except water and admixture, if added with the water, are in the mixing compartment of the mixer before any part of the batch is released. Transfer time in multiple drum mixers shall not be counted as part of the required mixing time.

The required mixing time, in stationary mixers, of concrete used for concrete structures, except minor structures, shall be not less than 90 seconds or more than 5 minutes, except that when directed by the Engineer in writing, the requirements of the following paragraph shall apply.

The required mixing time in stationary mixers, except as provided in the preceding paragraph, shall be not less than 50 seconds or more than 5 minutes.

The minimum required revolutions at the mixing speed for transit-mixed concrete shall not be less than that recommended by the mixer manufacturer, but in no case shall the number of revolutions be less than that required to consistently produce concrete conforming to the provisions for uniformity in Section 90-6.01, "General."

When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

90-6.05 HAND-MIXING

Hand-mixed concrete shall be made in batches of not more than 1/3 cubic yard and shall be mixed on a watertight, level platform. The proper amount of coarse aggregate shall be measured in measuring boxes and spread on the platform and the fine aggregate shall be spread on this layer, the 2 layers being not more than one foot in total depth. On this mixture shall be spread the dry cementitious materials and the whole mass turned no fewer than 2 times dry; then sufficient clean water shall be added, evenly distributed, and the whole mass again turned no fewer than 3 times, not including placing in the carriers or forms.

90-6.06 AMOUNT OF WATER AND PENETRATION

The amount of water used in concrete mixes shall be regulated so that the penetration of the concrete as determined by California Test 533 or the slump of the concrete as determined by ASTM Designation: C 143 is within the nominal values shown in the following table. When the penetration or slump of the concrete is found to exceed the nominal values listed, the mixture of subsequent batches shall be adjusted to reduce the penetration or slump to a value within the nominal range shown. Batches of concrete with a penetration or slump exceeding the maximum values listed shall not be used in the work. If Type F or Type G chemical admixtures are added to the mix, the penetration requirements shall not apply and the slump shall not exceed 9 inches after the chemical admixtures are added.

Type of Work	Nominal		Maximum	
	Penetration (inches)	Slump (inches)	Penetration (inches)	Slump (inches)
Concrete Pavement	0 - 1	—	1-1/2	—
Non-reinforced concrete facilities	0 - 1-1/2	—	2	—
Reinforced concrete structures				
Sections over 12 inches thick	0 - 1-1/2	—	2-1/2	—
Sections 12 inches thick or less	0 - 2	—	3	—
Concrete placed under water	—	6 - 8	—	9
Cast-in-place concrete piles	2-1/2 - 3-1/2	5 - 7	4	8

The amount of free water used in concrete shall not exceed 310 pounds per cubic yard, plus 20 pounds for each required 100 pounds of cementitious material in excess of 550 pounds per cubic yard.

The term free water is defined as the total water in the mixture minus the water absorbed by the aggregates in reaching a saturated surface-dry condition.

If there are adverse or difficult conditions that affect the placing of concrete, the above specified penetration and free water content limitations may be exceeded providing the Contractor is granted permission by the Engineer in writing to increase the cementitious material content per cubic yard of concrete. The increase in water and cementitious material shall be at a ratio not to exceed 30 pounds of water per added 100 pounds of cementitious material per cubic yard. Full compensation for additional cementitious material and water added under these conditions shall be considered as included in the contract price paid for the concrete work involved and no additional compensation will be allowed therefor.

The equipment for supplying water to the mixer shall be constructed and arranged so that the amount of water added can be measured accurately. Any method of discharging water into the mixer for a batch shall be accurate within 1.5 percent of the quantity of water required to be added to the mix for any position of the mixer. Tanks used to measure water shall be designed so that water cannot enter while water is being discharged into the mixer and discharge into the mixer shall be made rapidly in one operation without dribbling. All equipment shall be arranged so as to permit checking the amount of water delivered by discharging into measured containers.

90-7 CURING CONCRETE

90-7.01 METHODS OF CURING

Newly placed concrete shall be cured by the methods specified in this Section 90-7.01 and the special provisions.

90-7.01A Water Method

The concrete shall be kept continuously wet by the application of water for a minimum curing period of 7 days after the concrete has been placed.

Cotton mats, rugs, carpets, or earth or sand blankets may be used as a curing medium to retain the moisture during the curing period.

If a curing medium consisting of cotton mats, rugs, carpets, polyethylene sheeting, polyethylene sheeting on burlap, or earth or sand blankets is to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing media.

At the option of the Contractor, a curing medium consisting of white opaque polyethylene sheeting extruded onto burlap may be used to cure concrete structures. The polyethylene sheeting shall have a minimum thickness of 4-mil, and shall be extruded onto 10-ounce burlap.

At the option of the Contractor, a curing medium consisting of polyethylene sheeting may be used to cure concrete columns. The polyethylene sheeting shall have a minimum thickness of 10-mil achieved in a single layer of material.

If the Contractor chooses to use polyethylene sheeting or polyethylene sheeting on burlap as a curing medium, these media and any joints therein shall be secured as necessary to provide moisture retention and shall be within 3 inches of the concrete at all points along the surface being cured. When these media are used, the temperature of the concrete shall be monitored during curing. If the temperature of the concrete cannot be maintained below 140° F, use of these curing media shall be disallowed.

When concrete bridge decks and flat slabs are to be cured without the use of a curing medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified above, until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

90-7.01B Curing Compound Method

Surfaces of the concrete that are exposed to the air shall be sprayed uniformly with a curing compound.

Curing compounds to be used shall be as follows:

1. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B, except the resin type shall be poly-alpha-methylstyrene.

2. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B.
3. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class A.
4. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class B.
5. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class A.
6. Nonpigmented curing compound with fugitive dye conforming to the requirements in ASTM Designation: C 309, Type 1-D, Class A.

The infrared scan for the dried vehicle from curing compound (1) shall match the infrared scan on file at the Transportation Laboratory.

The loss of water for each type of curing compound, when tested in conformance with the requirements in California Test 534, shall not be more than 0.28 pounds per square yard in 24 hours.

The curing compound to be used will be specified elsewhere in these specifications or in the special provisions.

If the use of curing compound is required or permitted elsewhere in these specifications or in the special provisions and no specific kind is specified, any of the curing compounds listed above may be used.

Curing compound shall be applied at a nominal rate of one gallon per 150 square feet, unless otherwise specified.

At any point, the application rate shall be within ± 50 square feet per gallon of the nominal rate specified, and the average application rate shall be within ± 25 square feet per gallon of the nominal rate specified when tested in conformance with the requirements in California Test 535. Runs, sags, thin areas, skips, or holidays in the applied curing compound shall be evidence that the application is not satisfactory.

Curing compounds shall be applied using power operated spray equipment. The power operated spraying equipment shall be equipped with an operational pressure gage and a means of controlling the pressure. Hand spraying of small and irregular areas that are not reasonably accessible to mechanical spraying equipment, in the opinion of the Engineer, may be permitted.

The curing compound shall be applied to the concrete following the surface finishing operation, immediately before the moisture sheen disappears from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any drying or cracking of the surface, application of water with an atomizing nozzle as specified in Section 90-7.01A, "Water Method," shall be started immediately and shall be continued until application of the compound is resumed or started; however, the compound shall not be applied over any resulting freestanding water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures and 72 hours in the case of pavement, the damaged portion shall be repaired immediately with additional compound.

At the time of use, compounds containing pigments shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. A paddle shall be used to loosen all settled pigment from the bottom of the container, and a power driven agitator shall be used to disperse the pigment uniformly throughout the vehicle.

Agitation shall not introduce air or other foreign substance into the curing compound.

The manufacturer shall include in the curing compound the necessary additives for control of sagging, pigment settling, leveling, de-emulsification, or other requisite qualities of a satisfactory working material. Pigmented curing compounds shall be manufactured so that the pigment does not settle badly, does not cake or thicken in the container, and does not become granular or curdled. Settlement of pigment shall be a thoroughly wetted, soft, mushy mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sideways manual motion of the paddle across the bottom of the container, to form a smooth uniform product of the proper consistency.

Curing compounds shall remain sprayable at temperatures above 40 °F and shall not be diluted or altered after manufacture.

The curing compound shall be packaged in clean 274-gallon totes, 55-gallon barrels or 5-gallon pails shall be supplied from a suitable storage tank located at the jobsite. The containers shall comply with "Title 49, Code of Federal Regulations, Hazardous Materials Regulations." The 274-gallon totes and the 55-gallon barrels shall have removable lids and airtight fasteners. The 5-gallon pails shall be round and have standard full open head and bail. Lids with bungholes will not be permitted. Settling or separation of solids in containers, except tanks, must be completely redispersed with low speed mixing prior to use, in conformance with these specifications and the manufacturer's recommendations. Mixing shall be accomplished either manually by use of a paddle or by use of a mixing blade driven by a drill motor, at low speed. Mixing blades shall be the type used for mixing paint. On-site storage tanks shall be kept clean and free of contaminants. Each tank shall have a permanent system designed to completely redisperse settled material without introducing air or other foreign substances.

Steel containers and lids shall be lined with a coating that will prevent destructive action by the compound or chemical agents in the air space above the compound. The coating shall not come off the container or lid as skins. Containers shall be filled in a manner that will prevent skinning. Plastic containers shall not react with the compound.

Each container shall be labeled with the manufacturer's name, kind of curing compound, batch number, volume, date of manufacture, and volatile organic compound (VOC) content. The label shall also warn that the curing compound containing pigment shall be well stirred before use. Precautions concerning the handling and the application of curing compound shall be shown on the label of the curing compound containers in conformance with the Construction Safety Orders and General Industry Safety Orders of the State.

Containers of curing compound shall be labeled to indicate that the contents fully comply with the rules and regulations concerning air pollution control in the State.

When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

Curing compound will be sampled by the Engineer at the source of supply, at the job site, or at both locations.

Curing compound shall be formulated so as to maintain the specified properties for a minimum of one year. The Engineer may require additional testing before use to determine compliance with these specifications if the compound has not been used within one year or whenever the Engineer has reason to believe the compound is no longer satisfactory.

Tests will be conducted in conformance with the latest ASTM test methods and methods in use by the Transportation Laboratory.

90-7.01C Waterproof Membrane Method

The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the curing membrane, shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

Sheeting material for curing concrete shall conform to the requirements in AASHTO Designation: M 171 for white reflective materials.

The sheeting material shall be fabricated into sheets of such width as to provide a complete cover for the entire concrete surface. Joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 0.33 foot.

The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.

Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

Sections of membrane that have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

90-7.01D Forms-In-Place Method

Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 20 inches in least dimension the forms shall remain in place for a minimum period of 5 days.

Joints in the forms and the joints between the end of forms and concrete shall be kept moisture tight during the curing period. Cracks in the forms and cracks between the forms and the concrete shall be resealed by methods subject to the approval of the Engineer.

90-7.02 BLANK

90-7.03 CURING STRUCTURES

Newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, in conformance with the provisions in Section 90-7.01, "Methods of Curing."

The curing compound method using a pigmented curing compound may be used on concrete surfaces of construction joints, surfaces that are to be buried underground, and surfaces where only ordinary surface finish is to be applied and on which a uniform color is not required and that will not be visible from a public traveled way. If the Contractor elects to use the curing compound method on the bottom slab of box girder spans, the curing compound shall be curing compound (1).

The top surface of highway bridge decks shall be cured by both the curing compound method and the water method. The curing compound shall be curing compound (1).

Concrete surfaces of minor structures, as defined in Section 51-1.02, "Minor Structures," shall be cured by the water method, the forms-in-place method or the curing compound method.

When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required. Application of water for this purpose will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

90-7.04 CURING PRECAST CONCRETE MEMBERS

Precast concrete members shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing." Curing shall be provided for the minimum time specified for each method or until the concrete reaches its design strength, whichever is less. Steam curing may also be used for precast members and shall conform to the following provisions:

- A. After placement of the concrete, members shall be held for a minimum 4-hour presteaming period. If the ambient air temperature is below 50 °F, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 50 °F and 90 °F.
- B. To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered as soon as possible after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.
- C. Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner as to prevent the loss of steam and moisture.
- D. Steam at the jets shall be at low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 40 °F per hour. The curing temperature throughout the enclosure shall not exceed 150 °F and shall be maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature is representative of the average temperature of the enclosure.
- E. Temperature recording devices that will provide an accurate, continuous, permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 200 feet of continuous bed length will be required for checking temperature.
- F. Members in pretension beds shall be detensioned immediately after the termination of steam curing while the concrete and forms are still warm, or the temperature under the enclosure shall be maintained above 60 °F until the stress is transferred to the concrete.
- G. Curing of precast concrete will be considered completed after termination of the steam curing cycle.

90-7.05 CURING PRECAST PRESTRESSED CONCRETE PILES

Newly placed concrete for precast prestressed concrete piles shall be cured in conformance with the provisions in Section 90-7.04, "Curing Precast Concrete Members," except that piles in a corrosive environment shall be cured as follows:

- A. Piles shall be either steam cured or water cured. If water curing is used, the piles shall be kept continuously wet by the application of water in conformance with the provisions in Section 90-7.01A, "Water Method."
- B. If steam curing is used, the steam curing provisions in Section 90-7.04, "Curing Precast Concrete Members," shall apply except that the piles shall be kept continuously wet for their entire length for a period of not less than 3 days, including the holding and steam curing periods.

90-7.06 CURING SLOPE PROTECTION

Concrete slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

Concreted-rock slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing," with a blanket of earth kept wet for 72 hours, or by sprinkling with a fine spray of water every 2 hours during the daytime for a period of 3 days.

90-7.07 CURING MISCELLANEOUS CONCRETE WORK

Exposed surfaces of curbs shall be cured by pigmented curing compounds as specified in Section 90-7.01B, "Curing Compound Method."

Concrete sidewalks, gutter depressions, island paving, curb ramps, driveways, and other miscellaneous concrete areas shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

Shotcrete shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

Mortar and grout shall be cured by keeping the surface damp for 3 days.

After placing, the exposed surfaces of sign structure foundations, including pedestal portions, if constructed, shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

90-8 PROTECTING CONCRETE

90-8.01 GENERAL

In addition to the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials," the Contractor shall protect concrete as provided in this Section 90-8. If required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.

The Contractor shall protect concrete from damage from any cause, which shall include, but not be limited to: rain, heat, cold, wind, Contractor's actions, and actions of others.

Concrete shall not be placed on frozen or ice-coated ground or subgrade nor on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints.

Under rainy conditions, placing of concrete shall be stopped before the quantity of surface water is sufficient to damage surface mortar or cause a flow or wash of the concrete surface, unless the Contractor provides adequate protection against damage.

Concrete that has been frozen or damaged by other causes, as determined by the Engineer, shall be removed and replaced by the Contractor at the Contractor's expense.

90-8.02 PROTECTING CONCRETE STRUCTURES

Structure concrete and shotcrete used as structure concrete shall be maintained at a temperature of not less than 45 °F for 72 hours after placing and at not less than 40 °F for an additional 4 days.

90-9 COMPRESSIVE STRENGTH

90-9.01 GENERAL

Concrete compressive strength requirements consist of a minimum strength that shall be attained before various loads or stresses are applied to the concrete and, for concrete designated by compressive strength, a minimum strength at the age of 28 days or at the age otherwise allowed in Section 90-1.01, "Description." The various strengths required are specified in these specifications or the special provisions or are shown on the plans.

The compressive strength of concrete will be determined from test cylinders that have been fabricated from concrete sampled in conformance with the requirements of California Test 539. Test cylinders will be molded and initially field cured in conformance with California Test 540. Test cylinders will be cured and tested after receipt at the testing laboratory in conformance with the requirements of California Test 521. A strength test shall consist of the average strength of 2 cylinders fabricated from material taken from a single load of concrete, except that, if any cylinder should show evidence of improper sampling, molding, or testing, that cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinder.

When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, test cylinders for other than steam cured concrete will be cured in conformance with Method 1 of California Test 540. The compressive strength of concrete determined for these purposes will be evaluated on the basis of individual tests.

When concrete is designated by compressive strength rather than by cementitious material content, the concrete strength to be used as a basis for acceptance of other than steam cured concrete will be determined from cylinders cured in conformance with Method 1 of California Test 540. If the result of a single compressive strength test at the maximum age specified or allowed is below the specified strength but is 95 percent or more of the specified strength, the Contractor shall make corrective changes, subject to approval of the Engineer, in the mix proportions or in the concrete fabrication procedures, before placing additional concrete, and shall pay to the State \$10 for each in-place cubic yard of concrete represented by the deficient test. If the result of a single compressive strength test at the maximum age specified or allowed is below 95 percent of the specified strength, but is 85 percent or more of the specified strength, the Contractor shall make the corrective changes specified above, and shall pay to the State \$15 for each in-place cubic yard of concrete represented by the deficient test. In addition, such corrective changes shall be made when the compressive strength of concrete tested at 7 days indicates, in the judgment of the Engineer, that the concrete will not attain the required compressive strength at the maximum age specified or allowed. Concrete

represented by a single test that indicates a compressive strength of less than 85 percent of the specified 28-day compressive strength will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials."

If the test result indicates that the compressive strength at the maximum age specified or allowed is below the specified strength, but is 85 percent or more of the specified strength, payments to the State as required above shall be made, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength of the concrete placed in the work meets or exceeds the specified 28-day compressive strength. If the test result indicates a compressive strength at the maximum age specified or allowed below 85 percent, the concrete represented by that test will be rejected, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength of the concrete placed in the work is at least 85 percent of the specified strength. If the evidence consists of tests made on cores taken from the work, the cores shall be obtained and tested in conformance with the requirements in ASTM Designation: C 42.

No single compressive strength test shall represent more than 320 cubic yards.

If a precast concrete member is steam cured, the compressive strength of the concrete will be determined from test cylinders that have been handled and stored in conformance with Method 3 of California Test 540. The compressive strength of steam cured concrete will be evaluated on the basis of individual tests representing specific portions of production. If the concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete shall be considered to be acceptable whenever its compressive strength reaches the specified 28-day compressive strength provided that strength is reached in not more than the maximum number of days specified or allowed after the member is cast.

When concrete has a specified 28-day compressive strength greater than 3,600 pounds per square inch or when prequalification is specified, prequalification of materials, mix proportions, mixing equipment, and procedures proposed for use will be required prior to placement of the concrete. Prequalification shall be accomplished by the submission of acceptable certified test data or trial batch reports by the Contractor. Prequalification data shall be based on the use of materials, mix proportions, mixing equipment, procedures, and size of batch proposed for use in the work.

Certified test data, in order to be acceptable, shall indicate that not less than 90 percent of at least 20 consecutive tests exceed the specified strength at the maximum number of days specified or allowed, and none of those tests are less than 95 percent of specified strength. Strength tests included in the data shall be the most recent tests made on concrete of the proposed mix design and all shall have been made within one year of the proposed use of the concrete.

Trial batch test reports, in order to be acceptable, shall indicate that the average compressive strength of 5 consecutive concrete cylinders, taken from a single batch, at not more than 28 days (or the maximum age allowed) after molding shall be at least 600 pounds per square inch greater than the specified 28-day compressive strength, and no individual cylinder shall have a strength less than the specified strength at the maximum age specified or allowed. Data contained in the report shall be from trial batches that were produced within one year of the proposed use of specified strength concrete in the project. Whenever air-entrainment is required, the air content of trial batches shall be equal to or greater than the air content specified for the concrete without reduction due to tolerances.

Tests shall be performed in conformance with either the appropriate California Test methods or the comparable ASTM test methods. Equipment employed in testing shall be in good condition and shall be properly calibrated. If the tests are performed during the life of the contract, the Engineer shall be notified sufficiently in advance of performing the tests in order to witness the test procedures.

The certified test data and trial batch test reports shall include the following information:

- A. Date of mixing.
- B. Mixing equipment and procedures used.
- C. The size of batch in cubic yards and the weight, type, and source of all ingredients used.
- D. Penetration or slump (if the concrete will be placed under water or placed in cast-in-place concrete piles) of the concrete.
- E. The air content of the concrete if an air-entraining admixture is used.
- F. The age at time of testing and strength of all concrete cylinders tested.

Certified test data and trial batch test reports shall be signed by an official of the firm that performed the tests.

When approved by the Engineer, concrete from trial batches may be used in the work at locations where concrete of a lower quality is required and the concrete will be paid for as the type of concrete required at that location.

After materials, mix proportions, mixing equipment, and procedures for concrete have been prequalified for use, additional prequalification by testing of trial batches will be required prior to making changes that, in the judgment of the Engineer, could result in a strength of concrete below that specified.

The Contractor's attention is directed to the time required to test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date so that the progress of the work is not delayed.

When precast concrete members are manufactured at the plant of an established manufacturer of precast concrete members, the mix proportions of the concrete shall be determined by the Contractor, and a trial batch and prequalification of the materials, mix proportions, mixing equipment, and procedures will not be required.

90-10 MINOR CONCRETE

90-10.01 GENERAL

Concrete for minor structures, slope paving, curbs, sidewalks and other concrete work, when designated as minor concrete on the plans, in the specifications, or in the contract item, shall conform to the provisions specified herein.

The Engineer, at the Engineer's discretion, will inspect and test the facilities, materials and methods for producing the concrete to ensure that minor concrete of the quality suitable for use in the work is obtained.

Before using minor concrete or in advance of revising the mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design. When required by the following table, the Contractor shall include compressive strength test results verifying the minimum specified compressive strength:

SCM	Test Submittal Required
Fly Ash used alone	When portland cement content < 350 lbs/cy
GGBFS used alone	When portland cement content < 250 lbs/cy
Natural Pozzolan used alone	When portland cement content < 350 lbs/cy
More than 1 SCM	Always

Tests shall be performed by an ACI certified technician.

90-10.02 MATERIALS

Minor concrete shall conform to the following requirements:

90-10.02A Cementitious Material

Cementitious material shall conform to the provisions in Section 90-1.01, "Description," and 90-2, "Materials."

90-10.02B Aggregate

Aggregate shall be clean and free from deleterious coatings, clay balls, roots, and other extraneous materials.

Use of crushed concrete or reclaimed aggregate is acceptable only if the aggregate satisfies all aggregate requirements.

The Contractor shall submit to the Engineer for approval, a grading of the combined aggregate proposed for use in the minor concrete. After acceptance of the grading, aggregate furnished for minor concrete shall conform to that grading, unless a change is authorized in writing by the Engineer.

The Engineer may require the Contractor to furnish periodic test reports of the aggregate grading furnished. The maximum size of aggregate used shall be at the option of the Contractor, but in no case shall the maximum size be larger than 1-1/2-inch or smaller than 3/4 inch.

The Engineer may waive, in writing, the gradation requirements in this Section 90-10.02B, if, in the Engineer's opinion, the furnishing of the gradation is not necessary for the type or amount of concrete work to be constructed.

90-10.02C Water

Water used for washing, mixing, and curing shall be free from oil, salts, and other impurities that would discolor or etch the surface or have an adverse affect on the quality of the concrete.

90-10.02D Admixtures

The use of admixtures shall conform to the provisions in Section 90-4, "Admixtures."

90-10.03 PRODUCTION

Cementitious material, water, aggregate, and admixtures shall be stored, proportioned, mixed, transported, and discharged in conformance with recognized standards of good practice that will result in concrete that is thoroughly and uniformly mixed, that is suitable for the use intended, and that conforms to requirements specified herein. Recognized standards of good practice are outlined in various industry publications such as are issued by American Concrete Institute, AASHTO, or the Department.

The cementitious material content of minor concrete shall conform to the provisions in Section 90-1.01, "Description."

The amount of water used shall result in a consistency of concrete conforming to the provisions in Section 90-6.06, "Amount of Water and Penetration." Additional mixing water shall not be incorporated into the concrete during hauling or after arrival at the delivery point, unless allowed by the Engineer.

Discharge of ready-mixed concrete from the transporting vehicle shall be made while the concrete is still plastic and before stiffening occurs. An elapsed time of 1.5 hours (one hour in non-agitating hauling equipment), or more than 250 revolutions of the drum or blades, after the introduction of the cementitious material to the aggregates, or a temperature of concrete of more than 90 °F will be considered conditions contributing to the quick stiffening of concrete. The Contractor shall take whatever action is necessary to eliminate quick stiffening, except that the addition of water will not be permitted.

The required mixing time in stationary mixers shall be not less than 50 seconds or more than 5 minutes.

The minimum required revolutions at mixing speed for transit-mixed concrete shall be not less than that recommended by the mixer manufacturer, and shall be increased, if necessary, to produce thoroughly and uniformly mixed concrete.

When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

Each load of ready-mixed concrete shall be accompanied by a weighmaster certificate that shall be delivered to the Engineer at the discharge location of the concrete, unless otherwise directed by the Engineer. The weighmaster certificate shall be clearly marked with the date and time of day when the load left the batching plant and, if hauled in truck mixers or agitators, the time the mixing cycle started.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished to the Engineer, prior to placing minor concrete from a source not previously used on the contract, stating that minor concrete to be furnished meets contract requirements, including minimum cementitious material content specified.

90-10.04 CURING MINOR CONCRETE

Curing minor concrete shall conform to the provisions in Section 90-7, "Curing Concrete."

90-10.05 PROTECTING MINOR CONCRETE

Protecting minor concrete shall conform to the provisions in Section 90-8, "Protecting Concrete," except the concrete shall be maintained at a temperature of not less than 40 °F for 72 hours after placing.

90-10.06 MEASUREMENT AND PAYMENT

Minor concrete will be measured and paid for in conformance with the provisions specified in the various sections of these specifications covering concrete construction when minor concrete is specified in the specifications, shown on the plans, or indicated by contract item in the Engineer's Estimate.

90-11 MEASUREMENT AND PAYMENT

90-11.01 MEASUREMENT

Portland cement concrete will be measured in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.

For concrete measured at the mixer, the volume in cubic feet shall be computed as the total weight of the batch in pounds divided by the density of the concrete in pounds per cubic foot. The total weight of the batch shall be calculated as the sum of all materials, including water, entering the batch. The density of the concrete will be determined in conformance with the requirements in California Test 518.

90-11.02 PAYMENT

Portland cement concrete will be paid for in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.

Performance Graded Asphalt Binder

Property	AASHTO Test Method	Specification				
		Grade				
		PG 58-22 ^a	PG 64-10	PG 64-16	PG 64-28	PG 70-10
Original Binder						
Flash Point, Minimum °C	T 48	230	230	230	230	230
Solubility, Minimum % ^b	T 44	99	99	99	99	99
Viscosity at 135°C, ^c Maximum, Pa·s	T 316	3.0	3.0	3.0	3.0	3.0
Dynamic Shear, Test Temp. at 10 rad/s, °C Minimum G*/sin(delta), kPa Maximum G*/sin(delta), kPa	T 315	58 1.00 2.00	64 1.00 2.00	64 1.00 2.00	64 1.00 2.00	70 1.00 2.00
RTFO Test, ^e Mass Loss, Maximum, %	T 240	1.00	1.00	1.00	1.00	1.00
RTFO Test Aged Binder						
Dynamic Shear, Test Temp. at 10 rad/s, °C Minimum G*/sin(delta), kPa	T 315	58 2.20	64 2.20	64 2.20	64 2.20	70 2.20
Ductility at 25°C Minimum, cm	T 51	75	75	75	75	75
PAV ^f Aging, Temperature, °C	R 28	100	100	100	100	110
RTFO Test and PAV Aged Binder						
Dynamic Shear, Test Temp. at 10 rad/s, °C Maximum G*/sin(delta), kPa	T 315	22 ^d 5000	31 ^d 5000	28 ^d 5000	22 ^d 5000	34 ^d 5000
Creep Stiffness, Test Temperature, °C Maximum S-value, Mpa Minimum M-value	T 313	-12 300 0.300	0 300 0.300	-6 300 0.300	-18 300 0.300	0 300 0.300

Notes:

- Use as asphalt rubber base stock for high mountain and high desert area.
- The Engineer waives this specification if the supplier is a Quality Supplier as defined by the Department's "Certification Program for Suppliers of Asphalt."
- The Engineer waives this specification if the supplier certifies the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.
- Test the sample at 3°C higher if it fails at the specified test temperature. G*/sin(delta) remains 5000 kPa maximum.
- "RTFO Test" means the asphaltic residue obtained using the Rolling Thin Film Oven Test, AASHTO Test Method T 240 or ASTM Designation: D 2872. The residue from mass change determination may be used for other tests.
- "PAV" means Pressurized Aging Vessel.

Performance graded polymer modified asphalt binder (PG Polymer Modified) is:

Performance Graded Polymer Modified Asphalt Binder ^a

Property	AASHTO Test Method	Specification Grade		
		PG 58-34 PM	PG 64-28 PM	PG 76-22 PM
Original Binder				
Flash Point, Minimum °C	T 48	230	230	230
Solubility, Minimum % ^b	T 44 ^c	98.5	98.5	98.5
Viscosity at 135°C, ^d Maximum, Pa·s	T 316	3.0	3.0	3.0
Dynamic Shear, Test Temp. at 10 rad/s, °C Minimum G*/sin(delta), kPa	T 315	58 1.00	64 1.00	76 1.00
RTFO Test , Mass Loss, Maximum, %	T 240	1.00	1.00	1.00
RTFO Test Aged Binder				
Dynamic Shear, Test Temp. at 10 rad/s, °C Minimum G*/sin(delta), kPa	T 315	58 2.20	64 2.20	76 2.20
Dynamic Shear, Test Temp. at 10 rad/s, °C Maximum (delta), %	T 315	Note e 80	Note e 80	Note e 80
Elastic Recovery ^f , Test Temp., °C Minimum recovery, %	T 301	25 75	25 75	25 65
PAV ^g Aging, Temperature, °C	R 28	100	100	110
RTFO Test and PAV Aged Binder				
Dynamic Shear, Test Temp. at 10 rad/s, °C Maximum G*sin(delta), kPa	T 315	16 5000	22 5000	31 5000
Creep Stiffness, Test Temperature, °C Maximum S-value, MPa Minimum M-value	T 313	-24 300 0.300	-18 300 0.300	-12 300 0.300

Notes:

- a. Do not modify PG Polymer Modified using acid modification.
- b. The Engineer waives this specification if the supplier is a Quality Supplier as defined by the Department's "Certification Program for Suppliers of Asphalt."
- c. The Department allows ASTM D 5546 instead of AASHTO T 44
- d. The Engineer waives this specification if the supplier certifies the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.
- e. Test temperature is the temperature at which G*/sin(delta) is 2.2 kPa. A graph of log G*/sin(delta) plotted against temperature may be used to determine the test temperature when G*/sin(delta) is 2.2 kPa. A graph of (delta) versus temperature may be used to determine delta at the temperature when G*/sin(delta) is 2.2 kPa. The Engineer also accepts direct measurement of (delta) at the temperature when G*/sin(delta) is 2.2 kPa.
- f. Tests without a force ductility clamp may be performed.
- g. "PAV" means Pressurized Aging Vessel.

SAMPLING

Provide a sampling device in the asphalt feed line connecting the plant storage tanks to the asphalt weighing system or spray bar. Make the sampling device accessible between 24 and 30 inches above the platform. Provide a receptacle for flushing the sampling device.

Include with the sampling device a valve:

1. Between 1/2 and 3/4 inch in diameter

Replace the table in Section 95-2.11 with:

Characteristics of Adhesive:

Test ^a	California Test	Requirement
Brookfield Viscosity, No. 3 Spindle at 20 rpm, Poise at 77°F	434, Part 4	0.9 max.
Gel time, minutes	434, Part 1	2 to 15
Slant Shear Strength on Dry Concrete, psi, after 4 days of cure in air at 77° F ±2° F	434, Part 5 ^b	3,000 min.
Slant Shear Strength on Wet Concrete, psi, after 4 days of cure in air at 77° F ±2° F	434, Part 5 ^b	1,700 min.
Tensile Strength, psi	434, Part 7, except test after 4 days of cure at 77° F ±2° F	4,500 min.
Elongation, %	434, Part 7, except test after 4 days of cure at 77° F ±2° F	10 max.

^a The mixing ratio used will be that recommended by the manufacturer.

^b For slant shear strength on concrete, delete Sections B-1 and B-5 of California Test 434, Part 5. For dry concrete, use Step "2" below only. For wet concrete, use both Steps "1" & "2":

1. Soak blocks in water for 24 hours at 77° F ±2° F. Remove and wipe off excess water.
2. Mix epoxy as described in California Test 434, Part 1, and apply a coat approximately 0.010-inch thick to each diagonal surface. Place four 0.125-inch square pieces of shim stock 0.012-inch thick on one block to control final film thickness. Before pressing the coated surfaces together, leave the blocks so that the coated surfaces are horizontal until the epoxy reacts slightly to prevent excessive flow.