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STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

NOTICE TO CONTRACTORS

AND

SPECIAL PROVISIONS

FOR CONSTRUCTION ON STATE HIGHWAY IN

SOLANO AND CONTRA COSTA COUNTIES IN BENICIA AND MARTINEZ ON ROUTE 680 FROM MOCOCO OVERHEAD TO BAYSHORE ROAD AND ON ROUTE 780 FROM ROUTE 680 TO EAST FIFTH STREET

DISTRICT 04, ROUTES 680,780

For Use in Connection with Standard Specifications Dated JULY 1999, Standard Plans Dated JULY 1999, and Labor Surcharge and Equipment Rental Rates.

CONTRACT NO. 04-006064

04-CC,Sol-680,780-39.4/41.0(680),L0.0/R1.3(680),1.1/2.3(780)

Federal Aid Project

***ACIM-680-1(054)56N**

Bids Open: October 30, 2001

Dated: August 27, 2001

DRB/QCQA
OSD

****

IMPORTANT SPECIAL NOTICES

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The bidder's attention is directed to Section 5 of these Special Provisions regarding possible establishment of a Dispute Review Board (DRB) for the project.

The specifications for this project include Quality Control / Quality Assurance provisions for the contract item "Asphalt Concrete" in the Special Provisions. Asphalt concrete shall conform to the provisions in Section 11-1, "Quality Control / Quality Assurance," and the section entitled "Asphalt Concrete" in Section 10-1, "General," of the Special Provisions. Section 39, "Asphalt Concrete," of the Standard Specifications shall not apply to Type A and Type B asphalt concrete.

Attention is directed to "Miscellaneous Metal," in Section 8-1, "Miscellaneous," of these Special Provisions for new requirements for miscellaneous metal.

The bidder's attention is directed to Section 5, containing specifications for "Disputes Review Board," of the Special Provisions, regarding establishing a Disputes Review Board (DRB) for the project.

The Special Provisions for Federal-aid projects (with and without DBE goals) have been revised to incorporate changes made by new regulations governing the DBE Program (49 CFR Part 26).

Sections 2 and 5 incorporate the changes. Bidders should read these sections to become familiar with them. Attention is directed to the following significant changes:

Section 2, "Disadvantaged Business Enterprise (DBE)" revises the counting of participation by DBE primes, and the counting of trucking performed by DBE firms. The section also revises the information that must be submitted to the Department in order to receive credit for trucking.

Section 2, "Submission of DBE Information" revises the information required to be submitted to the Department to receive credit toward the DBE goal. It also revises the criteria to demonstrate good faith efforts.

Section 5, "Subcontractor and DBE Records" revises the information required to be reported at the end of the project, and information related to trucking that must be submitted throughout the project.

Section 5, "DBE Certification Status" adds new reporting requirements related to DBE certification.

Section 5, "Subcontracting" describes the efforts that must be made in the event a DBE subcontractor is terminated or fails to complete its work for any reason.

Section 5, "Prompt Progress Payment to Subcontractors" requires prompt payment to all subcontractors.

Section 5, "Prompt Payment of Withheld Funds to Subcontractors" requires the prompt payment of retention to all subcontractors.

Payment Bonds

Attention is directed to Section 5 of the Special Provisions, regarding contract bonds. The payment bond shall be in a sum not less than one hundred percent of the total amount payable by the terms of the contract.

Attention is directed to Section 11-2, "Portland Cement Concrete," of these Special Provisions which contains Section 90, "Portland Cement Concrete," of the Standard Specifications.

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STANDARD PLANS LIST

The Standard Plan sheets applicable to this contract include, but are not limited to those indicated below. The Revised Standard Plans (RSP) and New Standard Plans (NSP) which apply to this contract are included as individual sheets of the project plans.

A10A	Abbreviations
A10B	Symbols
A20A	Pavement Markers and Traffic Lines, Typical Details
A20B	Pavement Markers and Traffic Lines, Typical Details
A20C	Pavement Markers and Traffic Lines, Typical Details
A20D	Pavement Markers and Traffic Lines, Typical Details
A24A	Pavement Markings - Arrows
A62A	Excavation and Backfill - Miscellaneous Details
A62B	Limits of Payment for Excavation and Backfill - Bridge Surcharge and Wall
A62C	Limits of Payment for Excavation and Backfill - Bridge
A62D	Excavation and Backfill - Concrete Pipe Culverts
RSP A62DA	Excavation and Backfill - Concrete Pipe Culverts
A62F	Excavation and Backfill - Metal and Plastic Culverts
A73B	Markers
RSP A73C	Delineators, Channelizers and Barricades
A76A	Concrete Barrier Type 60
A76B	Concrete Barrier Type 60
A76C	Concrete Barrier Type 60E
A77A	Metal Beam Guard Railing – Typical Wood Post With Wood Block
A77AA	Metal Beam Guard Railing – Typical Steel Post With Wood Block
A77B	Metal Beam Guard Railing - Standard Hardware
A77C	Metal Beam Guard Railing – Wood Post and Wood Block Details
A77D	Metal Beam Guard Railing – Typical Layouts
A77E	Metal Beam Guard Railing – Typical Layouts
A77F	Metal Beam Guard Railing – Typical Embankment Widening for End Treatments
A77FA	Metal Beam Guard Railing – Typical Line Post Installation
RSP A77G	Metal Beam Guard Railing – End Treatment, Terminal Anchor Assembly (Type SFT)
A77H	Metal Beam Guard Railing - Anchor Cable and Anchor Plate Details
A77I	Metal Beam Guard Railing – End Treatment, Terminal Anchor Assembly (Type CA)
A77J	Metal Beam Guard Railing Connections to Bridge Railings, Retaining Walls and Abutments

RSP A77L	Metal Beam Guard Railing and Single Faced Barrier Railing Terminal System - End Treatments
A78A	Thrie Beam Barrier – Typical Wood Post With Wood Block
A78C	Thrie Beam Barrier – Posts, Blocks and Standard Hardware Details
A78D	Thrie Beam Barrier - Miscellaneous Details
A78EA	Double Thrie Beam Barrier - End Treatment
A78I	A81A
A85	Chain Link Fence
A87	Curbs, Dikes and Driveways
D73	Drainage Inlets
D74B	Drainage Inlets
D74C	Drainage Inlet Details
D75A	Pipe Inlets
D75C	Pipe Inlets
D77A	Grate Details
D77B	Bicycle Proof Grate Details
D78	Gutter Depressions
D79	Precast Reinforced Concrete Pipe - Direct Design Method
D87A	Corrugated Metal Pipe Downdrain Details
D88	Construction Loads On Culverts
RSP D89	Pipe Headwalls
D93B	Drainage Inlet Riser Connections
D94A	Metal and Plastic Flared End Sections
D94B	Concrete Flared End Sections
D97B	Corrugated Metal Pipe Coupling Details No. 2 - Hat Band Coupler and Flange Details
D97E	Corrugated Metal Pipe Coupling Details No. 5 - Standard Joint
D97H	Reinforced Concrete Pipe or Non-Reinforced Concrete Pipe - Standard and Positive Joints
D98A	Slotted Corrugated Steel Pipe Drain Details
D98B	Slotted Corrugated Steel Pipe Drain Details
D99A	Structural Section Drainage System Details
D99B	Edge Drain Outlet and Vent Details
D99C	Edge Drain Cleanout and Vent Details
D102	Underdrains
T1A	Temporary Crash Cushion, Sand Filled (Unidirectional)
T1B	Temporary Crash Cushion, Sand Filled (Bidirectional)
RSP T2	Temporary Crash Cushion, Sand Filled (Shoulder Installations)
T3	Temporary Railing (Type K)
T7	Construction Project Funding Identification Signs
T10	Traffic Control System for Lane Closure On Freeways and Expressways
T10A	Traffic Control System for Lane and Complete Closures On Freeways and Expressways
T13	Traffic Control System for Lane Closure On Two Lane Conventional Highways
T15	Traffic Control System for Moving Lane Closure On Multilane Highways
T16	Traffic Control System for Moving Lane Closure On Multilane Highways
B0-1	Bridge Details
RSP B0-3	Bridge Details
B0-5	Bridge Details
B0-13	Bridge Details
B2-5	Pile Details-Class 400 and Class 625
RSP B3-1	Retaining Wall Type 1 - H=1200 Through 9100 mm
RSP B3-8	Retaining Wall Details No. 1
B3-9	Retaining Wall Details No. 2
B6-21	Joint Seals (Maximum Movement Rating = 50 mm)
B7-1	Box Girder Details
B7-6	Deck Drains - Types D-1 and D-2
B7-10	Utility Opening - Box Girder
B8-5	Cast-in-Place Prestressed Girder Details

B11-7	Chain Link Railing
B11-47	Cable Railing
RSP B11-53	Concrete Barrier Type 25
B14-3	Communication and Sprinkler Control Conduits (Conduit Less Than size 103)
B14-5	Water Supply Line (Details) (Pipe Sizes Less Than NPS 4)
RS1	Roadside Signs, Typical Installation Details No. 1
RS2	Roadside Signs - Wood Post, Typical Installation Details No. 2
RS4	Roadside Signs, Typical Installation Details No. 4
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RSP S2	Overhead Signs - Truss, Single Post Type - Post Types II Thru VII
RSP S3	Overhead Signs - Truss, Two Post Type - Post Types I-S Thru VII-S
S4	Overhead Signs - Truss, Single Post Type - Structural Frame Members
RSP S5	Overhead Signs - Truss Two Post Type - Structural Frame Members
RSP S6	Overhead Signs - Truss, Structural Frame Details
RSP S7	Overhead Signs -Truss, Frame Juncture Details
S8B	Overhead Signs - Removable Sign Panel Frames - Overhead Formed Panel Mounting Details
S9	Overhead Signs - Walkway Details No. 1
S10	Overhead Signs - Walkway Details No. 2
RSP S11	Overhead Signs - Walkway Safety Railing Details
RSP S13	Overhead Signs - Truss, Pile Foundation
ES-1A	Signal, Lighting and Electrical Systems - Symbols and Abbreviations
ES-1B	Signal, Lighting and Electrical Systems - Symbols and Abbreviations
ES-2A	Signal, Lighting and Electrical Systems - Service Equipment
ES-2C	Signal, Lighting and Electrical Systems - Service Equipment Notes, Type III Series
ES-2D	Signal, Lighting and Electrical Systems - Service Equipment and Typical Wiring Diagram Type III-A Series
ES-3C	Signal, Lighting and Electrical Systems - Controller Cabinet Details
RSP ES-6A	Lighting Standards - Types 15, 21 and 22
RSP ES-6B	Lighting Standards - Types 15 AND 21, Barrier Rail Mounted Details
ES-6E	Lighting Standards - Types 30 and 31
RSP ES-6F	Lighting Standards - Type 30 and 31 Base Plate Details
ES-7M	Signal and Lighting Standards - Details No. 1
ES-7N	Signal and Lighting Standards - Details No. 2
ES-8	Signal, Lighting and Electrical Systems - Pull Box Details
ES-9A	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9B	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9C	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9D	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9E	Signal, Lighting and Electrical Systems - Electrical Details, Structure Installations
ES-9F	Signal, Lighting and Electrical Systems - Flush Soffit Luminaire Modification Details, Structure Installations
ES-10	Signal, Lighting and Electrical Systems - Isolux Diagrams
ES-11	Signal, Lighting and Electrical Systems - Foundation Installations
ES-13A	Signal, Lighting and Electrical Systems - Splicing Details
ES-13B	Signal, Lighting and Electrical Systems - Wiring Details and Fuse Ratings
ES-14A	Signal, Lighting and Electrical Systems - Extinguishable Message Sign, 250 mm Letters
ES-15A	Sign Illumination - Mercury Vapor Sign Illumination Equipment
ES-15C	Sign Illumination - Sign Illumination Equipment
ES-15D	Sign Illumination - Sign Illumination Control
ES-16A	Closed Circuit Television Pole Details

Federal Project with DBE Goals (12-01-99)

DEPARTMENT OF TRANSPORTATION

NOTICE TO CONTRACTORS

CONTRACT NO. 04-006064

04-CC,Sol-680,780-39.4/41.0(680),L0.0/R1.3(680),1.1/2.3(780)

Sealed proposals for the work shown on the plans entitled:

STATE OF CALIFORNIA; DEPARTMENT OF TRANSPORTATION; PROJECT PLANS FOR CONSTRUCTION ON STATE HIGHWAY IN SOLANO AND CONTRA COSTA COUNTIES IN BENICIA AND MARTINEZ ON ROUTE 680 FROM MOCOCO OVERHEAD TO BAYSHORE ROAD AND ON ROUTE 780 FROM ROUTE 680 TO EAST FIFTH STREET

will be received at the Department of Transportation, 1120 N Street, Room 0200, MS #26, Sacramento, CA 95814, until 2 o'clock p.m. on October 30, 2001, at which time they will be publicly opened and read in Room 0100 at the same address.

Proposal forms for this work are included in a separate book entitled:

STATE OF CALIFORNIA; DEPARTMENT OF TRANSPORTATION; PROPOSAL AND CONTRACT FOR CONSTRUCTION ON STATE HIGHWAY IN SOLANO AND CONTRA COSTA COUNTIES IN BENICIA AND MARTINEZ ON ROUTE 680 FROM MOCOCO OVERHEAD TO BAYSHORE ROAD AND ON ROUTE 780 FROM ROUTE 680 TO EAST FIFTH STREET

General work description: Reconstruct interchange and electrical facilities.

This project has a goal of 20 percent disadvantaged business enterprise (DBE) participation.

No prebid meeting is scheduled for this project.

THIS PROJECT IS SUBJECT TO THE "BUY AMERICA" PROVISIONS OF THE SURFACE TRANSPORTATION ASSISTANCE ACT OF 1982 AS AMENDED BY THE INTERMODAL SURFACE TRANSPORTATION EFFICIENCY ACT OF 1991.

Bids are required for the entire work described herein.

At the time this contract is awarded, the Contractor shall possess either a Class A license or a combination of Class C licenses which constitutes a majority of the work.

This contract is subject to state contract nondiscrimination and compliance requirements pursuant to Government Code, Section 12990.

Project plans, special provisions, and proposal forms for bidding this project can only be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, MS #26, Transportation Building, 1120 N Street, Sacramento, California 95814, FAX No. (916) 654-7028, Telephone No. (916) 654-4490. Use FAX orders to expedite orders for project plans, special provisions and proposal forms. FAX orders must include credit card charge number, card expiration date and authorizing signature. Project plans, special provisions, and proposal forms may be seen at the above Department of Transportation office and at the offices of the District Directors of Transportation at Irvine, Oakland, and the district in which the work is situated. Standard Specifications and Standard Plans are available through the State of California, Department of Transportation, Publications Unit, 1900 Royal Oaks Drive, Sacramento, CA 95815, Telephone No. (916) 445-3520.

Cross sections for this project are available at the office of the District Director of Transportation of the district in which the work is situated in paper or electronic copy format.

The successful bidder shall furnish a payment bond and a performance bond.

The Department of Transportation hereby notifies all bidders that it will affirmatively insure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full opportunity to submit bids in response to this invitation.

The U.S. Department of Transportation (DOT) provides a toll-free "hotline" service to report bid rigging activities. Bid rigging activities can be reported Mondays through Fridays, between 8:00 a.m. and 5:00 p.m., eastern time, Telephone No. 1-800-424-9071. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report these activities. The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county, or counties, in which the work is to be done have been determined by the Director of the California Department of Industrial Relations. These wages are set forth in the General Prevailing Wage Rates for this project, available at the Labor Compliance Office at the offices of the District Director of Transportation for the district in which the work is situated, and available from the California Department of Industrial Relations' Internet Web Site at: http://www.dir.ca.gov. The Federal minimum wage rates for this project as predetermined by the United States Secretary of Labor are set forth in the books issued for bidding purposes entitled "Proposal and Contract," and in copies of this book that may be examined at the offices described above where project plans, special provisions, and proposal forms may be seen. Addenda to modify the Federal minimum wage rates, if necessary, will be issued to holders of "Proposal and Contract" books. Future effective general prevailing wage rates which have been predetermined and are on file with the California Department of Industrial Relations are referenced but not printed in the general prevailing wage rates.

Attention is directed to the Federal minimum wage rate requirements in the books entitled "Proposal and Contract." If there is a difference between the minimum wage rates predetermined by the Secretary of Labor and 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 shall pay not less than the higher wage rate. The Department will 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 shall pay not less than the Federal minimum wage rate which most closely approximates the duties of the employees in question.

DEPARTMENT OF TRANSPORTATION

Deputy Director Transportation Engineering

Dated August 27, 2001

RRG

COPY OF ENGINEER'S ESTIMATE

(NOT TO BE USED FOR BIDDING PURPOSES)

04-006064

Item	Item Code	Item	Unit of Measure	Estimated Quantity
1	022168	ELECTRONIC MOBILE DAILY DIARY COMPUTER SYSTEM DATA DELIVERY	LS	LUMP SUM
2	070018	TIME RELATED OVERHEAD	WDAY	880
3	070010	PROGRESS SCHEDULE (CRITICAL PATH)	LS	LUMP SUM
4	071322	TEMPORARY FENCE (TYPE CL-1.8)	M	380
5	022169	6.10 M TEMPORARY CHAIN LINK GATE	EA	1
6	022170	NON-STORM WATER DISCHARGE	LS	LUMP SUM
7	074019	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	LUMP SUM
8	074020	WATER POLLUTION CONTROL	LS	LUMP SUM
9	022171	TEMPORARY COVER	M2	6000
10	022172	TEMPORARY DRAINAGE INLET PROTECTION	EA	17
11	022173	TEMPORARY FENCE (TYPE ESA)	M	300
12	022174	TEMPORARY CONCRETE WASHOUT FACILITY	EA	14
13	022175	TEMPORARY ENTRANCE/EXIT	EA	15
14	074023	TEMPORARY EROSION CONTROL	M2	50 000
15	074029	TEMPORARY SILT FENCE	M	3000
16 (S)	120090	CONSTRUCTION AREA SIGNS	LS	LUMP SUM
17 (S)	120100	TRAFFIC CONTROL SYSTEM	LS	LUMP SUM
18	120159	TEMPORARY TRAFFIC STRIPE (PAINT)	M	38 600
19	120166	CHANNELIZER (SURFACE MOUNTED) (LEFT IN PLACE)	EA	32
20	120300	TEMPORARY PAVEMENT MARKER	EA	2110

Item	Item Code	Item	Unit of Measure	Estimated Quantity
21 (S)	128650	PORTABLE CHANGEABLE MESSAGE SIGN	EA	12
22	129000	TEMPORARY RAILING (TYPE K)	M	11 400
23	129100	TEMPORARY CRASH CUSHION MODULE	EA	340
24	150206	ABANDON CULVERT	M	220
25	022176	ABANDON CORRUGATED STEEL PIPE	EA	1
26	150221	ABANDON INLET	EA	5
27	022177	ABANDON WATER PIPELINE	EA	4
28	150241	ABANDON SEWER	EA	1
29	150305	OBLITERATE SURFACING	M2	7210
30	150608	REMOVE CHAIN LINK FENCE	M	2130
31	150662	REMOVE METAL BEAM GUARD RAILING	M	1210
32	150711	REMOVE PAINTED TRAFFIC STRIPE	M	12 500
33	022178	REMOVE YELLOW PAINTED TRAFFIC STRIPE	M	7770
34	150714	REMOVE THERMOPLASTIC TRAFFIC STRIPE	M	10 700
35	022179	REMOVE YELLOW THERMOPLASTIC TRAFFIC STRIPE	M	5420
36	150722	REMOVE PAVEMENT MARKER	EA	3380
37	150744	REMOVE ROADSIDE SIGN (WOOD POST)	EA	28
38	150747	REMOVE ROADSIDE SIGN (STRAP AND SADDLE BRACKET METHOD)	EA	2
39	150760	REMOVE SIGN STRUCTURE	EA	5
40	150769	REMOVE ASPHALT CONCRETE	M3	530

Item	Item Code	Item	Unit of Measure	Estimated Quantity
41	150801	REMOVE OVERSIDE DRAIN	M	140
42	150805	REMOVE CULVERT	M	160
43	022180	REMOVE PIPE (HORIZONTAL DRAIN)	M	830
44	022181	CLEAN 700 MM DRAINAGE FACILITY	EA	1
45	022182	CLEAN 450 MM DRAINAGE FACILITY	EA	1
46	022183	STORM DRAIN VIDEO SURVEY	EA	2
47	150820	REMOVE INLET	EA	11
48	150821	REMOVE HEADWALL	EA	3
49	150824	REMOVE SEWER MANHOLE	EA	1
50	150828	REMOVE JUNCTION BOX	EA	1
51	022184	REMOVE CONCRETE BOX	EA	1
52 (S)	152351	RELOCATE HYDRANT	EA	1
53 (S)	152410	RELOCATE WATER METER	EA	1
54 (S)	022185	PLANE ASPHALT CONCRETE PAVEMENT (84 MM MAX)	M2	97
55 (S)	022186	PLANE ASPHALT CONCRETE PAVEMENT (99 MM MAX)	M2	310
56 (S)	022187	PLANE ASPHALT CONCRETE PAVEMENT (25 MM MAX)	M2	650
57	153210	REMOVE CONCRETE	M3	180
58	153221	REMOVE CONCRETE BARRIER	M	1090
59	155003	CAP INLET	EA	7
60	155006	CAP RISER	EA	1

Item	Item Code	Item	Unit of Measure	Estimated Quantity
61	156590	REMOVE CRASH CUSHION (SAND FILLED)	EA	1
62	157561	BRIDGE REMOVAL (PORTION), LOCATION A	LS	LUMP SUM
63	157562	BRIDGE REMOVAL (PORTION), LOCATION B	LS	LUMP SUM
64	158100	SALVAGE CRASH CUSHION	EA	1
65	160101	CLEARING AND GRUBBING	LS	LUMP SUM
66	190101	ROADWAY EXCAVATION	M3	227 000
67 (F)	192003	STRUCTURE EXCAVATION (BRIDGE)	M3	3735
68 (F)	048683	STRUCTURE EXCAVATION (TYPE D-LDR)	M3	845
69 (F)	048684	STRUCTURE EXCAVATION (TYPE D) (HAZARDOUS)	M3	780
70 (F)	192020	STRUCTURE EXCAVATION (TYPE D)	M3	1480
71 (F)	192037	STRUCTURE EXCAVATION (RETAINING WALL)	M3	7165
72 (F)	193003	STRUCTURE BACKFILL (BRIDGE)	M3	2855
73 (F)	193013	STRUCTURE BACKFILL (RETAINING WALL)	M3	5095
74 (F)	193031	PERVIOUS BACKFILL MATERIAL (RETAINING WALL)	M3	325
75	193114	SAND BACKFILL	M3	51
76	194001	DITCH EXCAVATION	M3	170
77 (F)	197021	EARTH RETAINING STRUCTURE, LOCATION A	M2	600
78 (F)	197022	EARTH RETAINING STRUCTURE, LOCATION B	M2	310
79	022188	GEOSYNTHETIC REINFORCED EMBANKMENT	M2	230
80	022189	IMPORTED BORROW (GEOSYNTHETIC REINFORCED EMBANKMENT)	M3	750

Item	Item Code	Item	Unit of Measure	Estimated Quantity
81	203001	EROSION CONTROL (BLANKET)	M2	2990
82	022190	EROSION CONTROL (NETTING)	M2	5690
83	203003	STRAW (EROSION CONTROL)	TONN	48
84	203014	FIBER (EROSION CONTROL)	KG	7530
85	203021	FIBER ROLLS	M	14 000
86	022191	COLUMN DRAIN PROTECTION	EA	14
87	203024	COMPOST (EROSION CONTROL)	KG	22 900
88	203026	MOVE IN OR MOVE OUT (EROSION CONTROL)	EA	7
89	022192	MOVE IN/OUT (TEMPORARY EROSION CONTROL)	EA	5
90	022193	PURE LIVE SEED (TYPE 1) (EROSION CONTROL)	KG	710
91	022194	PURE LIVE SEED (TYPE 2) (EROSION CONTROL)	KG	17
92	203056	COMMERCIAL FERTILIZER (EROSION CONTROL)	KG	2460
93	203061	STABILIZING EMULSION (EROSION CONTROL)	KG	1680
94	250401	CLASS 4 AGGREGATE SUBBASE	M3	12 600
95	260210	AGGREGATE BASE (APPROACH SLAB)	M3	19
96	260301	CLASS 3 AGGREGATE BASE	M3	10 400
97	290211	ASPHALT TREATED PERMEABLE BASE	M3	2830
98	390155	ASPHALT CONCRETE (TYPE A)	TONN	37 000
99	394002	PLACE ASPHALT CONCRETE (MISCELLANEOUS AREA)	M2	2220
100	394040	PLACE ASPHALT CONCRETE DIKE (TYPE A)	M	3000

Item	Item Code	Item	Unit of Measure	Estimated Quantity
101	394044	PLACE ASPHALT CONCRETE DIKE (TYPE C)	M	870
102	394048	PLACE ASPHALT CONCRETE DIKE (TYPE E)	M	125
103	394049	PLACE ASPHALT CONCRETE DIKE (TYPE F)	M	1290
104	395001	LIQUID ASPHALT, SC-70 (PRIME COAT)	TONN	60
105	397001	ASPHALTIC EMULSION (PAINT BINDER)	TONN	3.4
106	490511	FURNISH STEEL PILING (HP 250 X 85)	M	455
107 (S)	490512	DRIVE STEEL PILE (HP 250 X 85)	EA	50
108 (S-F)	048685	INSTALL SEISMIC MONITORING CASING	M	45
109 (S)	490657	600 MM CAST-IN-DRILLED-HOLE CONCRETE PILING	M	1476
110	048686	600 MM CAST-IN-DRILLED-HOLE CONCRETE (ROCK SOCKET) PILING	M	365
111 (S)	490661	1.2 M CAST-IN-DRILLED-HOLE CONCRETE PILING	M	20
112 (S)	048687	1.5 M CAST-IN-DRILLED-HOLE CONCRETE (ROCK SOCKET) PILING	M	618
113 (S)	048688	1.83 M CAST-IN-DRILLED-HOLE CONCRETE PILING	M	980
114 (S)	048689	2.4 M CAST-IN-DRILLED-HOLE CONCRETE (ROCK SOCKET) PILING	M	37
115	048690	3.05 M CAST-IN-DRILLED-HOLE CONCRETE PILING	M	55
116 (S)	048691	3.05 M CAST-IN-DRILLED-HOLE CONCRETE (ROCK SOCKET) PILING	M	24
117	490674	4.0 M CAST-IN-DRILLED-HOLE CONCRETE PILING	M	25
118 (S)	048692	3.66 M CAST-IN-DRILLED-HOLE CONCRETE PILING	M	15
119 (S)	048693	3.35 M CAST-IN-DRILLED HOLE CONCRETE (ROCK SOCKET) PILING	M	11
120 (S)	048694	4.0 M CAST-IN-DRILLED-HOLE CONCRETE (ROCK SOCKET) PILING	M	135

Item	Item Code	Item	Unit of Measure	Estimated Quantity
121	048695	2.5 M CAST-IN-DRILLED-HOLE CONCRETE (ROCK SOCKET) PILING	M	75
122 (S)	048696	1.83 M PERMANENT CASING	M	986
123 (S)	048697	3.05 M PERMANENT CASING	M	65
124 (S)	048698	3.66 M PERMANENT CASING	M	15
125 (S)	500010	PRESTRESSING	LS	LUMP SUM
126 (F)	510051	STRUCTURAL CONCRETE, BRIDGE FOOTING	M3	2363
127 (F)	510053	STRUCTURAL CONCRETE, BRIDGE	M3	13 445
128 (F)	510060	STRUCTURAL CONCRETE, RETAINING WALL	M3	1576
129 (F)	510086	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	M3	326
130	510087	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE R)	M3	69
131	510135	CLASS 2 CONCRETE (HEADWALL)	M3	9
132 (F)	510502	MINOR CONCRETE (MINOR STRUCTURE)	M3	275
133	510522	MINOR CONCRETE (PIPE COVER)	M3	5
134	510526	MINOR CONCRETE (BACKFILL)	M3	19
135 (F)	048699	SAND LIGHTWEIGHT CONCRETE	M3	8400
136 (F)	511055	CONCRETE SURFACE TEXTURE	M2	1251
137	511106	DRILL AND BOND DOWEL	M	51
138 (S)	512231	FURNISH PRECAST PRESTRESSED CONCRETE GIRDER (15 M - 20 M)	EA	8
139 (S)	512500	ERECT PRECAST PRESTRESSED CONCRETE GIRDER	EA	8
140 (S)	518050	PTFE BEARING	EA	10

Item	Item Code	Item	Unit of Measure	Estimated Quantity
141	519010	NEOPRENE STRIP	M2	53
142 (S)	519121	JOINT SEAL (TYPE B - MR 30 MM)	M	42
143 (S)	519123	JOINT SEAL (TYPE B - MR 50 MM)	M	37
144 (S)	519129	JOINT SEAL ASSEMBLY (MR 101 MM - 160 MM)	M	33
145	519130	JOINT SEAL ASSEMBLY (MR 161 MM - 240 MM)	M	11
146 (S)	519131	JOINT SEAL ASSEMBLY (MR 241 MM - 320 MM)	M	48
147 (S)	048700	JOINT SEAL ASSEMBLY (MR 800 MM)	M	31
148 (S)	048701	JOINT SEAL ASSEMBLY (MR 980 MM)	M	18
149 (S-F)	520102	BAR REINFORCING STEEL (BRIDGE)	KG	5 446 700
150 (F)	520103	BAR REINFORCING STEEL (RETAINING WALL)	KG	238 890
151 (S-F)	048702	WELDED HEADED BAR REINFORCING	EA	41 778
152 (S)	022195	BAR REINFORCING STEEL (HEAD WALL)	KG	181
153 (F)	540101	ASPHALT MEMBRANE WATERPROOFING	M2	49
154	560218	FURNISH SIGN STRUCTURE (TRUSS)	KG	45 046
155 (S)	560219	INSTALL SIGN STRUCTURE (TRUSS)	KG	45 046
156	561008	760 MM CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION)	M	45
157	561009	920 MM CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION)	M	17
158	562004	METAL (RAIL MOUNTED SIGN)	KG	350
159	566011	ROADSIDE SIGN - ONE POST	EA	7
160	566012	ROADSIDE SIGN - TWO POST	EA	7

Item	Item Code	Item	Unit of Measure	Estimated Quantity
161	568016	INSTALL SIGN PANEL ON EXISTING FRAME	M2	16
162	575005	TIMBER RETAINING WALL	EA	1
163	620910	450 MM ALTERNATIVE PIPE CULVERT (TYPE A)	M	1810
164	620911	450 MM ALTERNATIVE PIPE CULVERT (TYPE B)	M	350
165	620914	600 MM ALTERNATIVE PIPE CULVERT (TYPE A)	M	360
166	620915	600 MM ALTERNATIVE PIPE CULVERT (TYPE B)	M	30
167	620919	750 MM ALTERNATIVE PIPE CULVERT	M	10
168	620924	900 MM ALTERNATIVE PIPE CULVERT	M	14
169	620933	1200 MM ALTERNATIVE PIPE CULVERT	M	50
170	022196	600 MM PLASTIC PIPE INSERT	M	55
171	650077	750 MM REINFORCED CONCRETE PIPE	M	3
172	655255	JACKED 450 MM REINFORCED CONCRETE PIPE (CLASS II)	M	34
173	655256	JACKED 600 MM REINFORCED CONCRETE PIPE (CLASS II)	M	45
174 (S)	048703	ISOLATION CASING	M	43
175	048704	STEEL ISOLATION CASING	KG	53 000
176	664040	1050 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	62
177	664061	1950 MM CORRUGATED STEEL PIPE (3.51 MM THICK)	M	17
178	664084	300 MM BITUMINOUS COATED CORRUGATED STEEL PIPE (1.63 MM THICK)	M	81
179	664089	450 MM BITUMINOUS COATED CORRUGATED STEEL PIPE (1.63 MM THICK)	M	214
180	664095	600 MM BITUMINOUS COATED CORRUGATED STEEL PIPE (1.63 MM THICK)	M	80

Item	Item Code	Item	Unit of Measure	Estimated Quantity
181	664105	750 MM BITUMINOUS COATED CORRUGATED STEEL PIPE (2.77 MM THICK)	M	50
182	665732	450 MM SLOTTED CORRUGATED STEEL PIPE (1.63 MM THICK)	M	152
183	022197	150 MM PLASTIC PIPE (HORIZONTAL DRAIN COLLECTOR SYSTEM)	M	460
184	681134	80 MM PLASTIC PIPE (EDGE DRAIN)	M	2840
185	681137	80 MM PLASTIC PIPE (EDGE DRAIN OUTLET)	M	400
186	681501	FURNISH AND INSTALL DRAIN PIPE (HORIZONTAL DRAIN)	M	1410
187	681502	DRILL HOLE (HORIZONTAL DRAIN)	M	1410
188	682008	PERMEABLE MATERIAL (BLANKET)	M3	4970
189	685067	200 MM ALTERNATIVE PIPE UNDERDRAIN	M	2460
190	692383	300 MM ANCHOR ASSEMBLY	EA	3
191	692385	450 MM ANCHOR ASSEMBLY	EA	9
192	692386	600 MM ANCHOR ASSEMBLY	EA	3
193	700858	900 MM BITUMINOUS COATED CORRUGATED STEEL PIPE INLET (2.77 MM THICK)	M	8
194	022198	300 MM WELDED STEEL PIPE RISER (2.77 MM THICK)	M	9
195	703592	750 MM WELDED STEEL PIPE (4.78 MM THICK)	M	.8
196	705336	450 MM ALTERNATIVE FLARED END SECTION	EA	1
197 (S)	022199	600 MM MUELLER BUTTERFLY VALVE	EA	2
198 (S)	022200	300 MM MUELLER GATE VALVE	EA	2
199 (S)	022201	200 MM MUELLER GATE VALVE	EA	4
200 (S)	022202	150 MM MUELLER GATE VALVE	EA	2

Item	Item Code	Item	Unit of Measure	Estimated Quantity
201 (S)	022203	AIR RELEASE VALVE	EA	1
202 (S)	022204	BLOW-OFF ASSEMBLY	EA	1
203 (S)	022205	150 MM DUCTILE IRON WATER PIPE	M	10
204 (S)	022206	200 MM DUCTILE IRON WATER PIPE	M	350
205	022207	200 MM DUCTILE IRON SEWER PIPE	M	38
206 (S)	022208	300 MM DUCTILE IRON WATER PIPE	M	16
207 (S)	022209	600 MM DUCTILE IRON WATER PIPE	M	120
208 (S)	719190	SEWER MANHOLE FRAME AND COVER	EA	1
209 (S)	719200	SEWER MANHOLE	EA	1
210	721008	ROCK SLOPE PROTECTION (LIGHT, METHOD B)	M3	180
211	721009	ROCK SLOPE PROTECTION (FACING, METHOD B)	M3	13
212	721011	ROCK SLOPE PROTECTION (BACKING NO. 2, METHOD B)	M3	170
213	721024	ROCK SLOPE PROTECTION (1/4T, METHOD B)	M3	400
214	721420	CONCRETE (DITCH LINING)	M3	59
215	729010	ROCK SLOPE PROTECTION FABRIC	M2	950
216	731502	MINOR CONCRETE (MISCELLANEOUS CONSTRUCTION)	M3	38
217 (S)	750001	MISCELLANEOUS IRON AND STEEL	KG	21 300
218 (S-F)	750496	MISCELLANEOUS METAL (RESTRAINER - PIPE TYPE)	KG	10 000
219 (S-F)	750499	MISCELLANEOUS METAL (RESTRAINER - ROD TYPE)	KG	15 600
220 (S-F)	750501	MISCELLANEOUS METAL (BRIDGE)	KG	38 250

Item	Item Code	Item	Unit of Measure	Estimated Quantity
221 (S)	750505	BRIDGE DECK DRAINAGE SYSTEM	KG	34 100
222 (S)	800382	CHAIN LINK FENCE (TYPE CL-0.9, VINYL-CLAD)	M	74
223 (S)	800391	CHAIN LINK FENCE (TYPE CL-1.8)	M	1980
224	802595	3.0 M CHAIN LINK GATE (TYPE CL-1.8)	EA	1
225	820107	DELINEATOR (CLASS 1)	EA	14
226	820118	GUARD RAILING DELINEATOR	EA	37
227	022210	CONCRETE BARRIER MARKER	EA	62
228 (S)	832003	METAL BEAM GUARD RAILING (WOOD POST)	M	1730
229 (S-F)	833020	CHAIN LINK RAILING	M	404
230	833080	CONCRETE BARRIER (TYPE K)	M	1670
231 (F)	833125	CONCRETE BARRIER (TYPE 25)	M	2438
232 (F)	833128	CONCRETE BARRIER (TYPE 25 MODIFIED)	M	1414
233 (S)	839311	DOUBLE THRIE BEAM BARRIER (WOOD POST)	M	310
234 (S-F)	839521	CABLE RAILING	M	29
235 (S)	839565	TERMINAL SYSTEM (TYPE SRT)	EA	9
236 (S)	839568	TERMINAL ANCHOR ASSEMBLY (TYPE SFT)	EA	6
237 (S)	839569	TERMINAL ANCHOR ASSEMBLY (TYPE CA)	EA	3
238 (S)	839570	RETURN SECTION	EA	3
239 (S)	839591	CRASH CUSHION, SAND FILLED	EA	7
240	839701	CONCRETE BARRIER (TYPE 60)	M	140

Item	Item Code	Item	Unit of Measure	Estimated Quantity
241	839703	CONCRETE BARRIER (TYPE 60C)	M	320
242	839704	CONCRETE BARRIER (TYPE 60D)	M	300
243 (F)	048705	CONCRETE BARRIER (TYPE 60D MODIFIED)	M	67
244	839705	CONCRETE BARRIER (TYPE 60E)	M	20
245 (S)	840515	THERMOPLASTIC PAVEMENT MARKING	M2	24
246 (S)	840561	100 MM THERMOPLASTIC TRAFFIC STRIPE	M	17 400
247 (S)	840563	200 MM THERMOPLASTIC TRAFFIC STRIPE	M	1600
248 (S)	840564	200 MM THERMOPLASTIC TRAFFIC STRIPE (BROKEN 3.66 M - 0.92 M)	M	1260
249 (S)	840571	100 MM THERMOPLASTIC TRAFFIC STRIPE (BROKEN 5.18 M - 2.14 M)	M	290
250 (S)	850101	PAVEMENT MARKER (NON-REFLECTIVE)	EA	1940
251 (S)	850111	PAVEMENT MARKER (RETROREFLECTIVE)	EA	1970
252 (S)	860460	LIGHTING AND SIGN ILLUMINATION	LS	LUMP SUM
253 (S)	022211	TRAFFIC OPERATIONS SYSTEM	LS	LUMP SUM
254 (S)	022212	CALL BOX SYSTEM	LS	LUMP SUM
255 (S)	022213	TRAFFIC OPERATIONS SYSTEM HUB	LS	LUMP SUM
256 (S)	022214	INTERCONNECTION BETWEEN PIER 3 AND NEW TOLL PLAZA	LS	LUMP SUM
257 (S-F)	860792	COMMUNICATION CONDUIT (BRIDGE)	M	730
258 (S)	022215	PROGRAMMABLE LOGIC CONTROL CABINET	EA	4
259 (S)	022216	VIDEO TRANSMITTER DUPLEX DATA	EA	3
260 (S)	022217	FIBER OPTIC DATA MODEM	EA	5

Item	Item Code	Item	Unit of Measure	Estimated Quantity
261 (S)	022218	MICROWAVE VEHICLE DETECTION SYSTEM, WIRELESS	EA	2
262 (S)	022219	MICROWAVE VEHICLE DETECTION SYSTEM, HARD-WIRED	EA	6
263 (S)	022220	FIBER OPTIC CABLE TERMINATION	EA	6
264 (S)	022221	CAMERA UNIT	EA	3
265 (S)	022222	PAN AND TILT UNIT	EA	3
266 (S)	022223	CAMERA CONTROL UNIT	EA	3
267 (S)	022224	SERVICE BOX	EA	6
268 (S)	022225	ELECTRICAL FACILITIES (GIRDER CONDUIT LAYOUT-780, BENT 18 THRU 22)	LS	LUMP SUM
269 (S)	022226	ELECTRICAL FACILITIES (GIRDER CONDUIT LAYOUT-780, BENT 18 THRU 19)	LS	LUMP SUM
270 (S)	022227	ELECTRICAL FACILITIES (GIRDER CONDUIT LAYOUT-780, BENT 20 THRU 23)	LS	LUMP SUM
271 (S)	022228	ELECTRICAL FACILITIES (CONDUCTOR LAYOUT ABUTMENT 1 THRU PIER 5)	LS	LUMP SUM
272 (S)	022229	ELECTRICAL FACILITIES (CONDUCTOR LAYOUT PIER 5 THRU PIER 8)	LS	LUMP SUM
273 (S)	022230	ELECTRICAL FACILITIES (CONDUCTOR LAYOUT-680, PIER 8 THRU PIER 12)	LS	LUMP SUM
274 (S)	022231	ELECTRICAL FACILITIES (CONDUCTOR LAYOUT-680, PIER 12 THRU PIER 17)	LS	LUMP SUM
275 (S)	022232	ELECTRICAL FACILITIES (CONDUCTOR LAYOUT-680, PIER 17 THRU PIER 23)	LS	LUMP SUM
276 (S)	022233	ELECTRICAL FACILITIES (CONDUCTOR LAYOUT-780, PIER 17 THRU PIER 22)	LS	LUMP SUM
277 (S)	022234	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 1 AND 2)	LS	LUMP SUM
278 (S)	022235	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 3 AND 4)	LS	LUMP SUM
279 (S)	022236	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 4 AND 5)	LS	LUMP SUM
280 (S)	022237	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 5 AND 6)	LS	LUMP SUM

Item	Item Code	Item	Unit of Measure	Estimated Quantity
281 (S)	022238	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 6)	LS	LUMP SUM
282 (S)	022239	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 6 AND 7)	LS	LUMP SUM
283 (S)	022240	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 7 AND 8)	LS	LUMP SUM
284 (S)	022241	ELECTRICAL FACILITIES (GIRDER LIGHTING	LS	LUMP SUM
285 (S)	022242	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 9 AND 10)	LS	LUMP SUM
286 (S)	022243	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 10 AND 11)	LS	LUMP SUM
287 (S)	022244	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 11 AND 12)	LS	LUMP SUM
288 (S)	022245	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 12 AND 13)	LS	LUMP SUM
289 (S)	022246	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 13 AND 14)	LS	LUMP SUM
290 (S)	022247	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 14 AND 15)	LS	LUMP SUM
291 (S)	022248	ELECTRICAL FACILITIES (GIRDER LIGHTING AND RECEPTACLE LAYOUT SPAN 15, 16 AND 17)	LS	LUMP SUM
292 (S)	022249	ELECTRICAL FACILITIES (680 BENT 18), BENT LIGHTING AND RECEPTACLE LAYOUT	LS	LUMP SUM
293 (S)	022250	ELECTRICAL FACILITIES (680 BENT 19), BENT LIGHTING AND RECEPTACLE LAYOUT	LS	LUMP SUM
294 (S)	022251	ELECTRICAL FACILITIES (680 BENT 20 AND 21) BENT LIGHTING AND RECEPTACLE LAYOUT	LS	LUMP SUM
295 (S)	022252	ELECTRICAL FACILITIES (680 BENT 21 AND 22) BENT LIGHTING AND RECEPTACLE LAYOUT	LS	LUMP SUM
296 (S)	022253	ELECTRICAL FACILITIES (780 BENT 18 AND 19) BENT LIGHTING AND RECEPTACLE LAYOUT	LS	LUMP SUM
297 (S)	022254	ELECTRICAL FACILITIES (780 BENT 20 AND 21) BENT LIGHTING AND RECEPTACLE LAYOUT	LS	LUMP SUM
298 (S)	022255	PIER STAIRWAY LIGHTING (PIER 6)	LS	LUMP SUM
299 (S)	022256	PIER STAIRWAY LIGHTING (PIER 7 THRU 9)	LS	LUMP SUM
300 (S)	022257	PIER STAIRWAY LIGHTING (PIER 10 THRU 12)	LS	LUMP SUM

Item	Item Code	Item	Unit of Measure	Estimated Quantity
301 (S)	022258	PIER STAIRWAY LIGHTING (PIER 13 THRU 15)	LS	LUMP SUM
302 (S)	022259	MARINE NAVIGATIONAL AIDS SYSTEM	LS	LUMP SUM
303 (S)	022260	NORTH APPROACH SUBSTATION	LS	LUMP SUM
304 (S)	022261	CABLE TRAY LAYOUT	LS	LUMP SUM
305 (S)	022262	PIER 3 SUBSTATION	LS	LUMP SUM
306 (S)	022263	NEW TOLL PLAZA SUBSTATION	LS	LUMP SUM
307 (S)	022264	SUPERVISOR CONTROL AND DATA ACQUISITION SYSTEM	LS	LUMP SUM
308 (S)	048706	SEISMIC MONITORING ELECTRICAL SYSTEM	LS	LUMP SUM
309 (S)	994650	BUILDING WORK	LS	LUMP SUM
310	999990	MOBILIZATION	LS	LUMP SUM

STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISIONS

Annexed to Contract No. 04-006064

SECTION 1. SPECIFICATIONS AND PLANS

The work embraced herein shall conform to the provisions in the Standard Specifications dated July 1999, and the Standard Plans dated July 1999, of the Department of Transportation insofar as the same may apply, and these special provisions.

Amendments to the Standard Specifications set forth in these special provisions shall be considered as part of the Standard Specifications for the purposes set forth in Section 5-1.04, "Coordination and Interpretation of Plans, Standard Specifications and Special Provisions," of the Standard Specifications. Whenever either the term "Standard Specifications is amended" or the term "Standard Specifications are amended" is used in the special provisions, the indented text or table following the term shall be considered an amendment to the Standard Specifications. In case of conflict between such amendments and the Standard Specifications, the amendments shall take precedence over and be used in lieu of the conflicting portions.

In case of conflict between the Standard Specifications and these special provisions, the special provisions shall take precedence over and shall be used in lieu of the conflicting portions.

SECTION 2. PROPOSAL REQUIREMENTS AND CONDITIONS

2-1.01 GENERAL

The bidder's attention is directed to the provisions in Section 2, "Proposal Requirements and Conditions," of the Standard Specifications and these special provisions for the requirements and conditions which the bidder must observe in the preparation of the Proposal form and the submission of the bid.

In addition to the subcontractors required to be listed in conformance with Section 2-1.054, "Required Listing of Proposed Subcontractors," of the Standard Specifications, each proposal shall have listed therein the portion of work that will be performed by each subcontractor listed.

The Bidder's Bond form mentioned in the last paragraph in Section 2-1.07, "Proposal Guaranty," of the Standard Specifications will be found following the signature page of the Proposal.

Submit request for substitution of an "or equal" item, and the data substantiating the request to the Department of Transportation, Division Of Construction - Duty Senior, Mail Station: 3 - B, 111 Grand Avenue / P. O. Box 23660, Oakland, Ca 94623-0660, so that the request is received by the Department by close of business on the fourth day, not including Saturdays, Sundays and legal holidays, following bid opening.

In conformance with Public Contract Code Section 7106, a Noncollusion Affidavit is included in the Proposal. Signing the Proposal shall also constitute signature of the Noncollusion Affidavit.

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. Each subcontract signed by the bidder must include this assurance.

2-1.015 FEDERAL LOBBYING RESTRICTIONS

Section 1352, Title 31, United States Code prohibits Federal funds from being expended by the recipient or any lower tier subrecipient of a Federal-aid contract to pay for any person for influencing or attempting to influence a Federal agency or Congress in connection with the awarding of any Federal-aid contract, the making of any Federal grant or loan, or the entering into of any cooperative agreement.

If any funds other than Federal funds have been paid for the same purposes in connection with this Federal-aid contract, the recipient shall submit an executed certification and, if required, submit a completed disclosure form as part of the bid documents.

A certification for Federal-aid contracts regarding payment of funds to lobby Congress or a Federal agency is included in the Proposal. Standard Form - LLL, "Disclosure of Lobbying Activities," with instructions for completion of the Standard Form is also included in the Proposal. Signing the Proposal shall constitute signature of the Certification.

The above-referenced certification and disclosure of lobbying activities shall be included in each subcontract and any lower-tier contracts exceeding $100,000. All disclosure forms, but not certifications, shall be forwarded from tier to tier until received by the Engineer.

The Contractor, subcontractors and any lower-tier contractors shall file a disclosure form at the end of each calendar quarter in which there occurs any event that requires disclosure or that materially affects the accuracy of the information contained in any disclosure form previously filed by the Contractor, subcontractors and any lower-tier contractors. An event that materially affects the accuracy of the information reported includes:

A. A cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or
B. A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or,
C. A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.

2-1.02 DISADVANTAGED BUSINESS ENTERPRISE (DBE)

This project is subject to Part 26, Title 49, Code of Federal Regulations entitled "Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs." The Regulations in their entirety are incorporated herein by this reference.

Bidders shall be fully informed respecting the requirements of the Regulations and the Department's Disadvantaged Business Enterprise (DBE) program developed pursuant to the Regulations; particular attention is directed to the following matters:

A. A DBE must be a small business concern as defined pursuant to Section 3 of U.S. Small Business Act and relevant regulations promulgated pursuant thereto.
B. A DBE may participate as a prime contractor, subcontractor, joint venture partner with a prime or subcontractor, vendor of material or supplies, or as a trucking company.
C. A DBE bidder, not bidding as a joint venture with a non-DBE, will be required to document one or a combination of the following:

    1. The bidder will meet the goal by performing work with its own forces.
    2. The bidder will meet the goal through work performed by DBE subcontractors, suppliers or trucking companies.
    3. The bidder, prior to bidding, made adequate good faith efforts to meet the goal.

D. A DBE joint venture partner must be responsible for specific contract items of work, or portions thereof. Responsibility means actually performing, managing and supervising the work with its own forces. The DBE joint venture partner must share in the capital contribution, control, management, risks and profits of the joint venture. The DBE joint venturer must submit the joint venture agreement with the proposal or the DBE Information form required in the Section entitled "Submission of DBE Information" of these special provisions.
E. A DBE must perform a commercially useful function, i.e., must be responsible for the execution of a distinct element of the work and must carry out its responsibility by actually performing, managing and supervising the work.
F. DBEs must be certified by either the California Department of Transportation, or by a participating State of California or local agency which certifies in conformance with Title 49, Code of Federal Regulations, Part 26, as of the date of bid opening. It is the Contractor's responsibility to verify that DBEs are certified. Listings of DBEs certified by the Department are available from the following sources:

    1. The Department's DBE Directory, which is published quarterly. This Directory may be obtained from the Department of Transportation, Materiel Operations Branch, Publication Distribution Unit, 1900 Royal Oaks Drive, Sacramento, California 95815, Telephone: (916) 445-3520.

2. The Department's Electronic Information Bulletin Board Service, which is accessible by modem and is updated weekly. The Bulletin Board may be accessed by first contacting the Department's Business Enterprise Program at Telephone: (916) 227-8937 and obtaining a user identification and password.
3. The Department's web site at http://www.dot.ca.gov/hq/bep/index.htm.
4. The organizations listed in the Section entitled "DBE Goal for this Project" of these special provisions.

G. Credit for materials or supplies purchased from DBEs will be as follows:

1. If the materials or supplies are obtained from a DBE manufacturer, 100 percent of the cost of the materials or supplies will count toward the DBE goal. A DBE manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the contract and of the general character described by the specifications.
2. If the materials or supplies are purchased from a DBE regular dealer, 60 percent of the cost of the materials or supplies will count toward the DBE goal. A DBE regular dealer is a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. To be a DBE regular dealer, the firm must be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question. A person may be a DBE regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business as provided in this paragraph G.2. if the person both owns and operates distribution equipment for the products. Any supplementing of regular dealers' own distribution equipment shall be by a long-term lease agreement and not on an ad hoc or contract-by-contract basis. Packagers, brokers, manufacturers' representatives, or other persons who arrange or expedite transactions are not DBE regular dealers within the meaning of this paragraph G.2.
3. Credit for materials or supplies purchased from a DBE which is neither a manufacturer nor a regular dealer will be limited to the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site, provided the fees are reasonable and not excessive as compared with fees charged for similar services.

H. Credit for DBE trucking companies will be as follows:

1. The DBE must be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there cannot be a contrived arrangement for the purpose of meeting the DBE goal.
2. The DBE must itself own and operate at least one fully licensed, insured, and operational truck used on the contract.
3. The DBE receives credit for the total value of the transportation services it provides on the contract using trucks its owns, insures, and operates using drivers it employs.
4. The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.
5. The DBE may also lease trucks from a non-DBE firm, including an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission it receives as a result of the lease arrangement. The DBE does not receive credit for the total value of the transportation services provided by the lessee, since these services are not provided by a DBE.
6. For the purposes of this paragraph H, a lease must indicate that the DBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. Leased trucks must display the name and identification number of the DBE.

I. Noncompliance by the Contractor with the requirements of the regulations constitutes a breach of this contract and may result in termination of the contract or other appropriate remedy for a breach of this contract.
J. Bidders are encouraged to use services offered by financial institutions owned and controlled by DBEs.

2-1.02A DBE GOAL FOR THIS PROJECT

The Department has established the following goal for Disadvantaged Business Enterprise (DBE) participation for this project:

Disadvantaged Business Enterprise (DBE): 20 percent

Bidders may use the services of the following firms to contact interested DBEs. These firms are available to assist DBEs in preparing bids for subcontracting or supplying materials.

The following firms may be contacted for projects in the following locations:

Districts 04, 05 (except San Luis Obispo and Santa Barbara Counties), 06 (except Kern County) and 10:	Districts 08, 11 and 12:
Triaxial Management Services, Inc. - Oakland 1545 Willow Street, 1st Floor Oakland, CA 94607 Telephone - (510) 286-1313 FAX No. - (510) 286-6792	Triaxial Management Services, Inc. - San Diego 2725 Congress Street, Suite 1-D San Diego, CA 92110 Telephone - (619) 543-5109 FAX No. - (619) 543-5108

Districts 07 and 08; in San Luis Obispo and Santa Barbara Counties in District 05; and in Kern County in District 06:	Districts 01, 02, 03 and 09:
Triaxial Management Services, Inc. - Los Angeles 2594 Industry Way, Suite 101 Lynwood, CA 90262 Telephone - (310) 537-6677 FAX No. - (310) 637-0128	Triaxial Management Services, Inc. - Sacramento 930 Alhambra Blvd., #205 Sacramento, CA 95816 Telephone - (916) 553-4172 FAX No. - (916) 553-4173

2-1.02B SUBMISSION OF DBE INFORMATION

The required DBE information shall be submitted on the "CALTRANS BIDDER - DBE INFORMATION" form included in the Proposal. If the DBE information is not submitted with the bid, the DBE Information form shall be removed from the documents prior to submitting the bid.

It is the bidder's responsibility to make enough work available to DBEs and to select those portions of the work or material needs consistent with the available DBEs to meet the goal for DBE participation or to provide information to establish that, prior to bidding, the bidder made adequate good faith efforts to do so.

If DBE information is not submitted with the bid, the apparent successful bidder (low bidder), the second low bidder and the third low bidder shall submit DBE information to the Department of Transportation, 1120 N Street, Room 0200, MS #26, Sacramento, California 95814 so the information is received by the Department no later than 4:00 p.m. on the fourth day, not including Saturdays, Sundays and legal holidays, following bid opening. DBE information sent by U.S. Postal Service certified mail with return receipt and certificate of mailing and mailed on or before the third day, not including Saturdays, Sundays and legal holidays, following bid opening will be accepted even if it is received after the fourth day following bid opening. Failure to submit the required DBE information by the time specified will be grounds for finding the bid or proposal nonresponsive. Other bidders need not submit DBE information unless requested to do so by the Department.

The bidder's DBE information shall establish that good faith efforts to meet the DBE goal have been made. To establish good faith efforts, the bidder shall demonstrate that the goal will be met or that, prior to bidding, adequate good faith efforts to meet the goal were made.

Bidders are cautioned that even though their submittal indicates they will meet the stated DBE goal, their submittal should also include their adequate good faith efforts information along with their DBE goal information to protect their eligibility for award of the contract in the event the Department, in its review, finds that the goal has not been met.

The bidder's DBE information shall include the names, addresses and phone numbers of DBE firms that will participate, with a complete description of work or supplies to be provided by each, the dollar value of each DBE transaction, and a written confirmation from the DBE that it is participating in the contract. A copy of the DBE's quote will serve as written confirmation that the DBE is participating in the contract. When 100 percent of a contract item of work is not to be performed or furnished by a DBE, a description of the exact portion of that work to be performed or furnished by that DBE shall be included in the DBE information, including the planned location of that work. The work that a DBE prime

contractor has committed to performing with its own forces as well as the work that it has committed to be performed by DBE subcontractors, suppliers and trucking companies will count toward the goal.

The information necessary to establish the bidder's adequate good faith efforts to meet the DBE goal should include:

A. The names and dates of each publication in which a request for DBE participation for this project was placed by the bidder.
B. The names and dates of written notices sent to certified DBEs soliciting bids for this project and the dates and methods used for following up initial solicitations to determine with certainty whether the DBEs were interested.
C. The items of work which the bidder made available to DBE firms, including, where appropriate, any breaking down of the contract work items (including those items normally performed by the bidder with its own forces) into economically feasible units to facilitate DBE participation. It is the bidder's responsibility to demonstrate that sufficient work to meet the DBE goal was made available to DBE firms.
D. The names, addresses and phone numbers of rejected DBE firms, the firms selected for that work, and the reasons for the bidder's choice.
E. Efforts made to assist interested DBEs in obtaining bonding, lines of credit or insurance, and any technical assistance or information related to the plans, specifications and requirements for the work which was provided to DBEs.
F. Efforts made to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services, excluding supplies and equipment the DBE subcontractor purchases or leases from the prime contractor or its affiliate.
G. The names of agencies contacted to provide assistance in contacting, recruiting and using DBE firms.
H. Any additional data to support a demonstration of good faith efforts.

2-1.03 ESCROW OF BID DOCUMENTATION

Bid documentation shall consist of all documentary and calculated information generated by the Contractor in preparation of the bid. The bid documentation shall conform to the requirements in these special provisions, and shall be submitted to the Department and held in escrow for the duration of the contract.

In the resolution of disputes involving the project, the escrowed bid documents will be the only documents accepted from the Contractor regarding preparation of the bid.

In signing the proposal, the bidder certifies that the material submitted for escrow constitutes all the documentary information used in preparation of the bid and that he has personally examined the contents of the container and that they are complete.

Nothing in the bid documentation shall be construed to change or modify the terms or conditions of the contract.

Escrowed bid documentation will not be used for pre-award evaluation of the Contractor's anticipated methods of construction, nor to assess the Contractor's qualifications for performing the work.

Bid documentation shall clearly itemize the Contractor's estimated costs of performing the work. The documentation submitted shall be complete and so detailed as to allow for an in-depth analysis of the Contractor's estimate.

The bid documentation shall include, but not be limited to: quantity takeoffs; rate schedules for the direct costs and the time- and nontime-related indirect costs for labor (by craft), plant and equipment ownership and operation, permanent and expendable materials, insurance and subcontracted work; estimated construction schedules, including sequence and duration, and development of production rates; quotations from subcontractors and suppliers; estimates of field and home office overhead; contingency and margin for each contract item of work; names of the persons responsible for preparing the bidder's estimate; and other reports, calculations, assumptions, and information used by the bidder to arrive at the estimate submitted with the proposal.

The Contractor shall also submit bid documentation for each subcontractor whose total subcontract exceeds $250,000. Subcontractor bid documentation shall be enclosed with the Contractor's submittal. The examination of subcontractors' bid documentation will be accomplished in the same manner as for the Contractor's bid documentation. If a subcontractor is replaced, bid documentation for the new subcontractor shall be submitted for review and escrow before authorization for the substitution will be granted. Upon request of a subcontractor, the bid documentation from that subcontractor shall be reviewed only by the subcontractor and the Department.

If the bidder is a joint venture, the bid documentation shall include the joint venture agreement, the joint venture estimate comparison and final reconciliation of the joint venture estimate.

Copies of the proposals submitted by the first, second and third low bidders will be provided to the respective bidders for inclusion in the bid documentation to be escrowed.

The first, second, and third apparent low bidders shall present the bid documentation for escrow at the District 04 Office, 111 Grand Avenue, Room 12-800, Oakland, CA, on the first Monday, at 1:00 pm., following the time indicated in the "Notice to Contractors" for the opening of bids.

Bid documentation shall be submitted in a sealed container, clearly marked with the bidder's name, date of submittal, project contract number and the words, "Bid Documentation for Escrow."

Failure to submit the actual and complete bid documentation as specified herein within the time specified shall be cause for rejection of the proposal.

Upon submittal, the bid documentation of the apparent low bidder will be examined and inventoried by the duly designated representatives of the Contractor and the Department to ensure that the bid documentation is authentic, legible, and in accordance with the terms of this section "Escrow of Bid Documentation." The examination will not include review of, nor will it constitute approval of, proposed construction methods, estimating assumptions or interpretation of the contract. The examination will not alter any conditions or terms of the contract. The acceptance or rejection by the Department that the submitted bid documents are in compliance with this section "Escrow of Bid Documentation" shall be completed within 48 hours of the time the bid documentation is submitted by the Contractor.

At the completion of the examination, the bid documents will be sealed and jointly deposited at an agreed commercial bank.

Bid documentation submitted by the second and third apparent low bidders will be jointly deposited at agreed commercial banks. If the apparent low bid is withdrawn or rejected, the bid documentation of the second low bidder will be examined and inventoried in the manner specified above, then sealed and deposited again in escrow. If the second low bid is withdrawn or rejected, the bid documentation of the third low bidder will be examined and inventoried in the manner specified above, then sealed and deposited again in escrow. Upon execution and final approval of the contract or rejection of all bids, the bid documentation will be returned to any remaining unsuccessful bidders.

The escrowed bid documentation may be examined by the designated representatives of both the Department and the Contractor, at any time deemed necessary by either the Department or the Contractor to assist in the negotiation of price adjustments and change orders, or to assist in the potential resolution or settlement of claims or disputes.

If requested by a Disputes Review Board, the escrowed bid documentation may be utilized to assist the Board in its recommendations.

The bid documentation submitted by the Contractor will be held in escrow until the contract has been completed, the ultimate resolution of all disputes and claims has been achieved and receipt of final payment has been accepted by the Contractor. The escrowed bid documentation will then be released from escrow to the Contractor.

The bid documentation submitted by the bidder is, and shall remain, the property of the bidder, and is subject to only joint review by the Department and the bidder. The Department stipulates and expressly acknowledges that the submitted bid documentation constitutes trade secrets and will not be deemed public records. This acknowledgment is based on the Department's express understanding that the information contained in the bid documentation is not known outside the bidder's business, is known only to a limited extent and only by a limited number of employees of the bidder, is safeguarded while in the bidder's possession, is extremely valuable to the bidder and could be extremely valuable to the bidder's competitors by virtue of it reflecting the bidder's contemplated techniques of construction. The Department acknowledges that the bid documentation includes a compilation of information used in the bidder's business, intended to give the bidder an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. The Department agrees to safeguard the bid documentation, and all information contained therein, against disclosure, including disclosure of subcontractor bid documentation to the Contractor and other subcontractors to the fullest extent permitted by law. However, in the event of arbitration or litigation, the bid documentation shall be subject to discovery, and the Department assumes no responsibility for safeguarding the bid documentation unless the Contractor has obtained an appropriate protective order issued by the arbitrator or the court.

Full compensation for preparing the bid documentation, presenting it for escrow and reviewing it for escrow and upon request of the Engineer shall be considered as included in the contract prices paid for the various items of work, and no additional compensation will be allowed therefor.

The direct cost of depositing the bid documentation in escrow at the agreed commercial bank will be paid by the State.

SECTION 3. AWARD AND EXECUTION OF CONTRACT

The bidder's attention is directed to the provisions in Section 3, "Award and Execution of Contract," of the Standard Specifications and these special provisions for the requirements and conditions concerning award and execution of contract.

The award of the contract, if it be awarded, will be to the lowest responsible bidder whose proposal complies with all the requirements prescribed and who has met the goal for DBE participation or has demonstrated, to the satisfaction of the Department, adequate good faith efforts to do so. Meeting the goal for DBE participation or demonstrating, to the satisfaction of the Department, adequate good faith efforts to do so is a condition for being eligible for award of contract.

A "Payee Data Record" form will be included in the contract documents to be executed by the successful bidder. The purpose of the form is to facilitate the collection of taxpayer identification data. The form shall be completed and returned to the Department by the successful bidder with the executed contract and contract bonds. For the purposes of the form, payee shall be deemed to mean the successful bidder. The form is not to be completed for subcontractors or suppliers. Failure to complete and return the "Payee Data Record" form to the Department as provided herein will result in the retention of 31

percent of payments due the contractor and penalties of up to $20,000. This retention of payments for failure to complete the "Payee Data Record" form is in addition to any other retention of payments due the Contractor.

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

Attention is directed to the provisions in Section 8-1.03, "Beginning of Work," in Section 8-1.06, "Time of Completion," and in Section 8-1.07, "Liquidated Damages," of the Standard Specifications and these special provisions.

The Contractor shall begin work within 15 calendar days after the contract has been approved by the Attorney General or the attorney appointed and authorized to represent the Department of Transportation.

The work shall be diligently prosecuted to completion before the expiration of **880 WORKING DAYS** beginning on the fifteenth calendar day after approval of the contract.

The Contractor shall pay to the State of California the sum of $ 11,000 per day, for each and every calendar day's delay in finishing the work in excess of the number of working days prescribed above.

SECTION 5. GENERAL

SECTION 5-1. MISCELLANEOUS

5-1.01 PLANS AND WORKING DRAWINGS

When the specifications require working drawings to be submitted to the Engineer, the drawings shall be submitted to: Office of Resident Engineer, 757 Arnold Drive, Suite 200, Martinez, CA 9553-6526.

5-1.011 EXAMINATION OF PLANS, SPECIFICATIONS, CONTRACT, AND SITE OF WORK

The second paragraph of Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications is amended to read:

- Where the Department has made investigations of site conditions, including subsurface conditions in areas where work is to be performed under the contract, or in other areas, some of which may constitute possible local material sources, bidders or Contractors may, upon written request, inspect the records of the Department as to those investigations subject to and upon the conditions hereinafter set forth.

Attention is directed to "Differing Site Conditions" of these special provisions regarding physical conditions at the site which may differ from those indicated in "Materials Information," log of test borings or other geotechnical information obtained by the Department's investigation of site conditions.

5-1.012 DIFFERING SITE CONDITIONS

Attention is directed to Section 5-1.116, "Differing Site Conditions," of the Standard Specifications.

During the progress of the work, if subsurface or latent conditions are encountered at the site differing materially from those indicated in the "Materials Information," log of test borings, other geotechnical data obtained by the Department's investigation of subsurface conditions, or an examination of the conditions above ground at the site, the party discovering those conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

The Contractor will be allowed 15 days from the notification of the Engineer's determination of whether or not an adjustment of the contract is warranted, in which to file a notice of potential claim in conformance with the provisions of Section 9-1.04, "Notice of Potential Claim," of the Standard Specifications and as specified herein; otherwise the decision of the Engineer shall be deemed to have been accepted by the Contractor as correct. The notice of potential claim shall set forth in what respects the Contractor's position differs from the Engineer's determination and provide any additional information obtained by the Contractor, including but not limited to additional geotechnical data. The notice of potential claim shall be accompanied by the Contractor's certification that the following were made in preparation of the bid: a review of the contract, a review of the "Materials Information," a review of the log of test borings and other records of geotechnical data to the extent they were made available to bidders prior to the opening of bids, and an examination of the conditions above ground at the site. Supplementary information, obtained by the Contractor subsequent to the filing of the notice of potential claim, shall be submitted to the Engineer in an expeditious manner.

5-1.015 LABORATORY

When a reference is made in the specifications to the "Laboratory," the reference shall mean the Division of Materials Engineering and Testing Services and the Division of Structural Foundations of the Department of Transportation, or established laboratories of the various Districts of the Department, or other laboratories authorized by the Department to test materials and work involved in the contract. When a reference is made in the specifications to the "Transportation

Laboratory," the reference shall mean the Division of Materials Engineering and Testing Services and the Division of Structural Foundations, located at 5900 Folsom Boulevard, Sacramento, CA 95819, Telephone (916) 227-7000.

5-1.017 CONTRACT BONDS

Attention is directed to Section 3-1.02, "Contract Bonds," of the Standard Specifications and these special provisions.

The payment bond shall be in a sum not less than one hundred percent of the total amount payable by the terms of the contract.

5-1.018 EXCAVATION SAFETY PLANS

Section 5-1.02A, "Trench Excavation Safety Plans," of the Standard Specifications is amended to read:

5-1.02A Excavation Safety Plans

- The Construction Safety Orders of the Division of Occupational Safety and Health shall apply to all excavations. For all excavations 1.5 m or more in depth, the Contractor shall submit to the Engineer a detailed plan showing the design and details of the protective systems to be provided for worker protection from the hazard of caving ground during excavation. The detailed plan shall include any tabulated data and any design calculations used in the preparation of the plan. Excavation shall not begin until the detailed plan has been reviewed and approved by the Engineer.
- Detailed plans of protective systems for which the Construction Safety Orders require design by a registered professional engineer shall be prepared and signed by an engineer who is registered as a Civil Engineer in the State of California, and shall include the soil classification, soil properties, soil design calculations that demonstrate adequate stability of the protective system, and any other design calculations used in the preparation of the plan.
- No plan shall allow the use of a protective system less effective than that required by the Construction Safety Orders.
- If the detailed plan includes designs of protective systems developed only from the allowable configurations and slopes, or Appendices, contained in the Construction Safety Orders, the plan shall be submitted at least 5 days before the Contractor intends to begin excavation. If the detailed plan includes designs of protective systems developed from tabulated data, or designs for which design by a registered professional engineer is required, the plan shall be submitted at least 3 weeks before the Contractor intends to begin excavation.
- Attention is directed to Section 7-1.01E, "Trench Safety."

The third paragraph of Section 19-1.02, "Preservation of Property," of the Standard Specifications is amended to read:

- In addition to the provisions in Sections 5-1.02, "Plans and Working Drawings," and 5-1.02A, "Excavation Safety Plans," detailed plans of the protective systems for excavations on or affecting railroad property will be reviewed for adequacy of protection provided for railroad facilities, property, and traffic. These plans shall be submitted at least 9 weeks before the Contractor intends to begin excavation requiring the protective systems. Approval by the Engineer of the detailed plans for the protective systems will be contingent upon the plans being satisfactory to the railroad company involved.

5-1.019 COST REDUCTION INCENTIVE

Attention is directed to Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications.

Prior to preparing a cost reduction proposal, the Contractor shall request a meeting with the Engineer to discuss the proposal in concept and to determine the merit of the cost reduction proposal. Items of discussion will also include permit issues, impact on other projects, impact on the project schedule, peer reviews, and review times required by the Department and other agencies.

5-1.02 LABOR NONDISCRIMINATION

Attention is directed to the following Notice that is required by Chapter 5 of Division 4 of Title 2, California Code of Regulations.

NOTICE OF REQUIREMENT FOR NONDISCRIMINATION PROGRAM

(GOV. CODE, SECTION 12990)

Your attention is called to the "Nondiscrimination Clause", set forth in Section 7-1.01A(4), "Labor Nondiscrimination," of the Standard Specifications, which is applicable to all nonexempt State contracts and subcontracts, and to the "Standard

California Nondiscrimination Construction Contract Specifications" set forth therein. The specifications are applicable to all nonexempt State construction contracts and subcontracts of $5000 or more.

5-1.03 INTEREST ON PAYMENTS

Interest shall be payable on progress payments, payments after acceptance, final payments, extra work payments, and claim payments as follows:

A. Unpaid progress payments, payment after acceptance, and final payments shall begin to accrue interest 30 days after the Engineer prepares the payment estimate.
B. Unpaid extra work bills shall begin to accrue interest 30 days after preparation of the first pay estimate following receipt of a properly submitted and undisputed extra work bill. To be properly submitted, the bill must be submitted within 7 days of the performance of the extra work and in conformance with the provisions in Section 9-1.03C, "Records," and Section 9-1.06, "Partial Payments," of the Standard Specifications. An undisputed extra work bill not submitted within 7 days of performance of the extra work will begin to accrue interest 30 days after the preparation of the second pay estimate following submittal of the bill.
C. The rate of interest payable for unpaid progress payments, payments after acceptance, final payments, and extra work payments shall be 10 percent per annum.
D. The rate of interest payable on a claim, protest or dispute ultimately allowed under this contract shall be 6 percent per annum. Interest shall begin to accrue 61 days after the Contractor submits to the Engineer information in sufficient detail to enable the Engineer to ascertain the basis and amount of said claim, protest or dispute.

The rate of interest payable on any award in arbitration shall be 6 percent per annum if allowed under the provisions of Civil Code Section 3289.

5-1.031 FINAL PAYMENT AND CLAIMS

Attention is directed to Section 9-1.07B, "Final Payment and Claims," of the Standard Specifications.

If the Contractor files a timely written statement of claims in response to the proposed final estimate, the District that administers the contract will submit a claim position letter to the Contractor by hand delivery or deposit in the U.S. mail within 135 days of acceptance of the contract. The claim position letter will delineate the District's position on the Contractor's claims. If the Contractor disagrees with the claim position letter, the Contractor shall submit a written notification of its disagreement to be received by the District not later than 15 days after the Contractor's receipt of the claim position letter. The written notification of disagreement shall set forth the basis for the Contractor's disagreement and be submitted to the office designated in the claim position letter. The Contractor's failure to provide a timely, written notification of disagreement shall constitute the Contractor's acceptance and agreement with the determinations provided in the claim position letter and with final payment pursuant to the claim position letter.

If the Contractor files a timely notification of disagreement with the District claim position letter, the board of review designated by the District Director to review claims that remain in dispute will meet with the Contractor within 45 days after receipt by the District of the notification of disagreement. Attendance by the Contractor at the board of review meeting shall be mandatory.

If the District fails to submit a claim position letter to the Contractor within 135 days after the acceptance of the contract and the Contractor has claims that remain in dispute, the Contractor may request a meeting with the board of review designated by the District Director to review claims that remain in dispute. The Contractor's request for a meeting shall identify the claims that remain in dispute. If the Contractor files a request for a meeting, the board of review will meet with the Contractor within 45 days after the District receives the request for the meeting. Attendance by the Contractor at the District Director's board of review meeting shall be mandatory.

Failure of the Contractor to file a timely written statement of claims in response to the proposed final estimate, or to file a timely notification of disagreement with the District claim position letter, or to attend the District Director's board of review meeting shall constitute a failure to pursue diligently and exhaust the administrative procedures in the contract and shall be a bar to arbitration in conformance with the requirements in Section 10240.2 of the California Public Contract Code.

5-1.04 PUBLIC SAFETY

The Contractor shall provide for the safety of traffic and the public in conformance with the provisions in Section 7-1.09, "Public Safety," of the Standard Specifications and these special provisions.

The Contractor shall install temporary railing (Type K) between a lane open to public traffic and an excavation, obstacle or storage area when the following conditions exist:

A. Excavations**.—**The near edge of the excavation is 3.6 m or less from the edge of the lane, except:

1. Excavations covered with sheet steel or concrete covers of adequate thickness to prevent accidental entry by traffic or the public.
2. Excavations less than 0.3-m deep.
3. Trenches less than 0.3-m wide for irrigation pipe or electrical conduit, or excavations less than 0.3-m in diameter.
4. Excavations parallel to the lane for the purpose of pavement widening or reconstruction.
5. Excavations in side slopes, where the slope is steeper than 1:4 (vertical:horizontal).
6. Excavations protected by existing barrier or railing.

B. Temporarily Unprotected Permanent Obstacles**.—**The work includes the installation of a fixed obstacle together with a protective system, such as a sign structure together with protective railing, and the Contractor elects to install the obstacle prior to installing the protective system; or the Contractor, for the Contractor's convenience and with permission of the Engineer, removes a portion of an existing protective railing at an obstacle and does not replace such railing complete in place during the same day.

C. Storage Areas.—Material or equipment is stored within 3.6 m of the lane and the storage is not otherwise prohibited by the provisions of the Standard Specifications and these special provisions.

The approach end of temporary railing (Type K), installed in conformance with the provisions in this section "Public Safety" and in Section 7-1.09, "Public Safety," of the Standard Specifications, shall be offset a minimum of 4.6 m from the edge of the traffic lane open to public traffic. The temporary railing shall be installed on a skew toward the edge of the traffic lane of not more than 0.3-m transversely to 3 m longitudinally with respect to the edge of the traffic lane. If the 4.6-m minimum offset cannot be achieved, the temporary railing shall 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 shall be installed at the approach end of the temporary railing.

Temporary railing (Type K) shall conform to the provisions in Section 12-3.08, "Temporary Railing (Type K)," of the Standard Specifications. Temporary railing (Type K), conforming to the details shown on 1999 Standard Plan T3, may be used. Temporary railing (Type K) fabricated prior to January 1, 1993, and conforming to 1988 Standard Plan B11-30 may be used, provided the fabrication date is printed on the required Certificate of Compliance.

Temporary crash cushion modules shall conform to the provisions in "Temporary Crash Cushion Module" of these special provisions.

Except for installing, maintaining and removing traffic control devices, whenever work is performed or equipment is operated in the following work areas, the Contractor shall close the adjacent traffic lane unless otherwise provided in the Standard Specifications and these special provisions:

Approach Speed of Public Traffic (Posted Limit) (Kilometers Per Hour)	Work Areas
Over 72 (45 Miles Per Hour)	Within 1.8 m of a traffic lane but not on a traffic lane
56 to 72 (35 to 45 Miles Per Hour)	Within 0.9-m of a traffic lane but not on a traffic lane

The lane closure provisions of this section shall not apply if the work area is protected by permanent or temporary railing or barrier.

When traffic cones or delineators are used to delineate a temporary edge of a traffic lane, the line of cones or delineators shall be considered to be the edge of the traffic lane, however, the Contractor shall not reduce the width of an existing lane to less than 3 m without written approval from the Engineer.

When work is not in progress on a trench or other excavation that required closure of an adjacent lane, the traffic cones or portable delineators used for the lane closure shall be placed off of and adjacent to the edge of the traveled way. The spacing of the cones or delineators shall be not more than the spacing used for the lane closure.

Suspended loads or equipment shall not be moved nor positioned over public traffic or pedestrians.

Full compensation for conforming to the provisions in this section "Public Safety," including furnishing and installing temporary railing (Type K) and temporary crash cushion modules, 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.

5-1.05 SURFACE MINING AND RECLAMATION ACT

Attention is directed to the Surface Mining and Reclamation Act of 1975, commencing in Public Resources Code, Mining and Geology, Section 2710, which establishes regulations pertinent to surface mining operations, and to California Public Contract Code Section 10295.5.

Material from mining operations furnished for this project shall only come from permitted sites in compliance with California Public Contract Code Section 10295.5.

The requirements of this section shall apply to materials furnished for the project, except for acquisition of materials in conformance with the provisions in Section 4-1.05, "Use of Materials Found on the Work," of the Standard Specifications.

5-1.06 REMOVAL OF ASBESTOS AND HAZARDOUS SUBSTANCES

When the presence of asbestos or hazardous substances are not shown on the plans or indicated in the specifications and the Contractor encounters materials which the Contractor reasonably believes to be asbestos or a hazardous substance as defined in Section 25914.1 of the Health and Safety Code, and the asbestos or hazardous substance has not been rendered harmless, the Contractor may continue work in unaffected areas reasonably believed to be safe. The Contractor shall immediately cease work in the affected area and report the condition to the Engineer in writing.

In conformance with Section 25914.1 of the Health and Safety Code, removal of asbestos or hazardous substances including exploratory work to identify and determine the extent of the asbestos or hazardous substance will be performed by separate contract.

If delay of work in the area delays the current controlling operation, the delay will be considered a right of way delay and the Contractor will be compensated for the delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

5-1.07 YEAR 2000 COMPLIANCE

This contract is subject to Year 2000 Compliance for automated devices in the State of California.

Year 2000 compliance for automated devices in the State of California is achieved when embedded functions have or create no logical or mathematical inconsistencies when dealing with dates prior to and beyond 1999. The year 2000 is recognized and processed as a leap year. The product shall operate accurately in the manner in which the product was intended for date operation without requiring manual intervention.

The Contractor shall provide the Engineer a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for all automated devices furnished for the project.

5-1.075 BUY AMERICA REQUIREMENTS

Attention is directed to the "Buy America" requirements of the Surface Transportation Assistance Act of 1982 (Section 165) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) Sections 1041(a) and 1048(a), and the regulations adopted pursuant thereto. In conformance with the law and regulations, all manufacturing processes for steel and iron materials furnished for incorporation into the work on this project shall occur in the United States; with the exception that pig iron and processed, pelletized and reduced iron ore manufactured outside of the United States may be used in the domestic manufacturing process for such steel and iron materials. The application of coatings, such as epoxy coating, galvanizing, painting, and other coatings that protect or enhance the value of steel or iron materials shall be considered a manufacturing process subject to the "Buy America" requirements.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for steel and iron materials. The certificates, in addition to certifying that the materials comply with the specifications, shall specifically certify that all manufacturing processes for the materials occurred in the United States, except for the above exceptions.

The requirements imposed by the law and regulations do not prevent a minimal use of foreign steel and iron materials if the total combined cost of the materials used does not exceed one-tenth of one percent (0.1 percent) of the total contract cost or $2500, whichever is greater. The Contractor shall furnish the Engineer acceptable documentation of the quantity and value of the foreign steel and iron prior to incorporating the materials into the work.

5-1.08 SUBCONTRACTOR AND DBE RECORDS

The Contractor shall maintain records showing the name and business address of each first-tier subcontractor. The records shall also show the name and business address of every DBE subcontractor, DBE vendor of materials and DBE trucking company, regardless of tier. The records shall show the date of payment and the total dollar figure paid to all of these firms. DBE prime contractors shall also show the date of work performed by their own forces along with the corresponding dollar value of the work.

Upon completion of the contract, a summary of these records shall be prepared on Form CEM-2402 (F) and certified correct by the Contractor or the Contractor's authorized representative, and shall be furnished to the Engineer. The form shall be furnished to the Engineer within 90 days from the date of contract acceptance. $10,000 will be withheld from payment until the Form CEM-2402 (F) is submitted. The amount will be returned to the Contractor when a satisfactory Form CEM-2402 (F) is submitted.

Prior to the fifteenth of each month, the Contractor shall submit documentation to the Engineer showing the amount paid to DBE trucking companies listed in the Contractor's DBE information. This monthly documentation shall indicate the portion of the revenue paid to DBE trucking companies which is claimed toward DBE participation. The Contractor shall also obtain and submit documentation to the Engineer showing the amount paid by DBE trucking companies to all firms, including owner-operators, for the leasing of trucks. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission it receives as a result of the lease arrangement. The records must confirm that the amount of credit claimed toward DBE participation conforms with Section 2-1.02, "Disadvantaged Business Enterprise," of these special provisions.

The Contractor shall also obtain and submit documentation to the Engineer showing the truck number, owner's name, California Highway Patrol CA number, and if applicable, the DBE certification number of the owner of the truck for all trucks used during that month for which DBE participation will be claimed. This documentation shall be submitted on Form CEM-2404 (F).

5-1.083 DBE CERTIFICATION STATUS

If a DBE subcontractor is decertified during the life of the project, the decertified subcontractor shall notify the Contractor in writing with the date of decertification. If a subcontractor becomes a certified DBE during the life of the project, the subcontractor shall notify the Contractor in writing with the date of certification. The Contractor shall furnish the written documentation to the Engineer.

Upon completion of the contract, Form CEM-2403 (F) indicating the DBE's existing certification status shall be signed and certified correct by the Contractor. The certified form shall be furnished to the Engineer within 90 days from the date of contract acceptance.

5-1.086 PERFORMANCE OF DBE SUBCONTRACTORS AND SUPPLIERS

The DBEs listed by the Contractor in response to the provisions in Section 2-1.02B, "Submission of DBE Information," and Section 3, "Award and Execution of Contract," of these special provisions, which are determined by the Department to be certified DBEs, shall perform the work and supply the materials for which they are listed, unless the Contractor has received prior written authorization to perform the work with other forces or to obtain the materials from other sources.

Authorization to use other forces or sources of materials may be requested for the following reasons:

A. The listed DBE, after having had a reasonable opportunity to do so, fails or refuses to execute a written contract, when such written contract, based upon the general terms, conditions, plans and specifications for the project, or on the terms of such subcontractor's or supplier's written bid, is presented by the Contractor.
B. The listed DBE becomes bankrupt or insolvent.
C. The listed DBE fails or refuses to perform the subcontract or furnish the listed materials.
D. The Contractor stipulated that a bond was a condition of executing a subcontract and the listed DBE subcontractor fails or refuses to meet the bond requirements of the Contractor.
E. The work performed by the listed subcontractor is substantially unsatisfactory and is not in substantial conformance with the plans and specifications, or the subcontractor is substantially delaying or disrupting the progress of the work.
F. It would be in the best interest of the State.

The Contractor shall not be entitled to any payment for such work or material unless it is performed or supplied by the listed DBE or by other forces (including those of the Contractor) pursuant to prior written authorization of the Engineer.

5-1.09 SUBCONTRACTING

Attention is directed to the provisions in Section 8-1.01, "Subcontracting," of the Standard Specifications, and Section 2, "Proposal Requirements and Conditions," and Section 3, "Award and Execution of Contract," of these special provisions.

Pursuant to the provisions of Section 1777.1 of the Labor Code, the Labor Commissioner publishes and distributes a list of contractors ineligible to perform work as a subcontractor on a public works project. This list of debarred contractors is available from the Department of Industrial Relations web site at:

http://www.dir.ca.gov/DLSE/Debar.html.

The provisions in the third paragraph of Section 8-1.01, "Subcontracting," of the Standard Specifications, that the Contractor shall perform with the Contractor's own organization contract work amounting to not less than 50 percent of the original contract price, is not changed by the Federal Aid requirement specified under "Required Contract Provisions Federal-Aid Construction Contracts" in Section 14 of these special provisions that the Contractor perform not less than 30 percent of the original contract work with the Contractor's own organization.

Each subcontract and any lower tier subcontract that may in turn be made shall include the "Required Contract Provisions Federal-Aid Construction Contracts" in Section 14 of these special provisions. This requirement shall be enforced as follows:

A. Noncompliance shall be corrected. Payment for subcontracted work involved will be withheld from progress payments due, or to become due, until correction is made. Failure to comply may result in termination of the contract.

In conformance with the Federal DBE regulations Sections 26.53(f)(1) and 26.53(f)(2) Part 26, Title 49 CFR:

A. The Contractor shall not terminate for convenience a DBE subcontractor listed in response to Section 2-1.02B, "Submission of DBE Information," and then perform that work with its own forces, or those of an affiliate without the written consent of the Department, and
B. If a DBE subcontractor is terminated or fails to complete its work for any reason, the Contractor will be required to make good faith efforts to substitute another DBE subcontractor for the original DBE subcontractor, to the extent needed to meet the contract goal.

The requirement in Section 2-1.02, "Disadvantaged Business Enterprise (DBE)," of these special provisions that DBEs must be certified on the date bids are opened does not apply to DBE substitutions after award of the contract.

5-1.10 PROMPT PROGRESS PAYMENT TO SUBCONTRACTORS

Attention is directed to the provisions in Sections 10262 and 10262.5 of the Public Contract Code and Section 7108.5 of the Business and Professions Code concerning prompt payment to subcontractors.

5-1.102 PROMPT PAYMENT OF WITHHELD FUNDS TO SUBCONTRACTORS

The Contractor shall return all moneys withheld in retention from the subcontractor within 30 days after receiving payment for work satisfactorily completed, even if the other contract work is not completed and has not been accepted in conformance with Section 7-1.17, "Acceptance of Contract," of the Standard Specifications. This requirement shall not be construed to limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or noncompliance by a subcontractor.

5-1.11 PARTNERING

The State will promote the formation of a "Partnering" relationship with the Contractor in order to effectively complete the contract to the benefit of both parties. The purpose of this relationship will be to maintain cooperative communication and mutually resolve conflicts at the lowest possible management level.

A one-day “Training in Partnering Concepts” forum will be conducted regardless of whether the Contractor requests the formation of a “Partnering” relationship. The forum will be conducted locally for the Contractor and the Engineer’s project representatives. The Contractor shall be represented by a minimum of two representatives, one being the Contractor’s authorized representative pursuant to Section 5-1.06, “Superintendence,” of the Standard Specifications. If, upon the Contractor’s request, “Partnering” is approved by the Engineer, “Training in Partnering Concepts” shall be conducted prior to the “Partnering” workshop. Scheduling of “Training in Partnering Concepts,” selection of the Engineer’s representatives to participate in “Training of Partnering Concepts,” and selection of the partnering concepts trainer and site shall be as determined by the Engineer.

The Contractor may request the formation of a "Partnering" relationship by submitting a request in writing to the Engineer after approval of the contract. If the Contractor's request for "Partnering" is approved by the Engineer, scheduling of a "Partnering" workshop, selecting the "Partnering" facilitator and workshop site, and other administrative details shall be as agreed to by both parties.

The costs involved in providing a trainer and site for the "Training in Partnering Concepts" forum will be borne by the State. The Contractor shall pay all compensation for the wages and expenses of the facilitator and of the expenses for obtaining the workshop site. The State will reimburse the Contractor for these costs as extra work in conformance with the provisions in Section 4-1.03D of the Standard Specifications. Full compensation for the wages and expenses of the

Contractor's representatives, including travel costs, shall be considered as included in the contract prices paid for the various items of work and no additional compensation will be allowed therefor.

The costs involved in providing a “Partnering” facilitator and a workshop site will be borne equally by the State and the Contractor. The Contractor shall pay all compensation for the wages and expenses of the facilitator and of the expenses for obtaining the workshop site. The State's share of such costs will be reimbursed to the Contractor in a change order written by the Engineer.

Markups will not be added to the costs of “Training in Partnering Concepts” or the costs of providing a “Partnering” facilitator and workshop site. All other costs associated with the "Partnering" relationship will be borne separately by the party incurring the costs.

The establishment of a "Partnering" relationship will not change or modify the terms and conditions of the contract and will not relieve either party of the legal requirements of the contract.

5–1.114 VALUE ANALYSIS

The Contractor may submit to the Engineer, in writing, a request for a "Value Analysis" workshop. The purpose for having a workshop is to identify value enhancing opportunities and to consider modifications to the plans and specifications that will reduce either the total cost, time of construction or traffic congestion, without impairing, in any manner, the essential functions or characteristics of the project including, but not limited to, service life, economy of operation, ease of maintenance, benefits to the travelling public, desired appearance, or design and safety standards.

To maximize the potential benefits of a workshop, the request should be submitted to the Engineer early in the project after approval of the contract. If the Contractor's request for a "Value Analysis" workshop is approved by the Engineer, scheduling of a workshop, selecting the facilitator and workshop site, and other administrative details shall be determined cooperatively by the Contractor and the Engineer.

The workshop shall be conducted in conformance with the methodology described in the Department's "Value Analysis Team Guide" available at the Department's web site at:

http://www.dot.ca.gov/hq/oppd/value/

The facilitator shall be a Certified Value Specialist (CVS) as recognized by the Society of American Value Engineers (SAVE) International, which may be contacted as follows:

SAVE International, 60 Revere Drive, Northbrook, IL 60062
Telephone 1-847-480-1730, FAX 1-847-480-9282

The Contractor may submit recommendations resulting from a "Value Analysis" workshop for approval by the Engineer as cost reduction incentive proposals in conformance with the provisions in Section 5-1.14, "Cost Reduction Incentive," of the Standard Specifications.

The costs involved in providing the "Value Analysis" facilitator and workshop site will be borne equally by the State and the Contractor. The division of cost will be made by determining the cost in providing the "Value Analysis" facilitator and workshop site in conformance with the provisions in Section 9-1.03B, "Work Performed by Special Forces or Other Special Services," of the Standard Specifications, and paying to the Contractor one-half of that cost, except no markups will be allowed.

All other costs associated with the "Value Analysis" workshop will be borne separately by the party incurring the costs, such as wages and travel expenses, and no additional compensation will be allowed therefor.

5–1.12 DISPUTE REVIEW BOARD

To assist in the resolution of disputes or potential claims arising out of the work of this project, a Dispute Review Board, hereinafter referred to as the "DRB," shall be established by the Engineer and Contractor cooperatively upon approval of the contract. The DRB is intended to assist the contract administrative claims resolution process as specified in the provisions in Section 9-1.04, "Notice of Potential Claim," and Section 9-1.07B, "Final Payment and Claims," of the Standard Specifications. The DRB shall not serve as a substitute for provisions in the specifications in regard to filing potential claims. The requirements and procedures established in this special provision shall be considered as an essential prerequisite to filing a claim, for arbitration or for litigation prior or subsequent to project completion.

The DRB shall be utilized when dispute or potential claim resolution at the project level is unsuccessful. The DRB shall function until the day of acceptance of the contract, at which time the work of the DRB will cease except for completion of unfinished dispute hearings and reports. After acceptance of the contract, disputes or potential claims that the Contractor wants to pursue that have not been settled, shall be stated or restated, by the Contractor, in response to the Proposed Final Estimate within the time limits provided in Section 9-1.07B, "Final Payment and Claims," of the Standard Specifications. The State will review those claims in conformance with the provisions in Section 9-1.07B of the Standard Specifications.

Following the completion of the State's administrative claims procedure, the Contractor may resort to arbitration in conformance with the provisions in Section 9-1.10, "Arbitration," of the Standard Specifications.

Disputes, as used in this section, shall include differences of opinion, properly noticed as provided hereinafter, between the State and Contractor on matters related to the work and other subjects considered by the State or Contractor, or by both, to be of concern to the DRB on this project, except matters relating to Contractor, subcontractor or supplier claims not actionable against the State as specified in these special provisions. Whenever the term "dispute" or "disputes" is used herein, it shall be deemed to include potential claims as well as disputes.

The DRB shall serve as an advisory body to assist in the resolution of disputes between the State and the Contractor, hereinafter referred to as the "parties." The DRB shall consider disputes referred to it, and furnish written reports containing findings and recommendations pertaining to those disputes, to the parties to aid in resolution of the differences between them. DRB findings and recommendations are not binding on the parties.

The DRB shall consist of one member selected by the State, one member selected by the Contractor, and a third member selected by the first 2 members and approved by both the State and the Contractor. The third member shall act as DRB Chairperson.

The first 2 DRB members shall select a third DRB member subject to mutual approval of the parties or may mutually concur on a list of potentially acceptable third DRB members and submit the list to the parties for final selection and approval of the third member. The goal in selection of the third member is to complement the professional experience of the first 2 members and to provide leadership for the DRB's activities.

No DRB member shall have prior direct involvement in this contract. No member shall have a financial interest in this contract or the parties thereto, within a period of 6 months prior to award of this contract or during the contract, except as follows:

A. Compensation for services on this DRB.
B. Ownership interest in a party or parties, documented by the prospective DRB member, that has been reviewed and determined in writing by the State to be sufficiently insignificant to render the prospective member acceptable to the State.
C. Service as a member of other Dispute Review Boards on other contracts.
D. Retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.
E. The above provisions apply to parties having a financial interest in this contract, including but not limited to contractors, subcontractors, suppliers, consultants, and legal and business services.

DRB members shall be especially knowledgeable in the type of construction and contract documents potentially anticipated by the contract. The members shall discharge their responsibilities impartially and as an independent body considering the facts and circumstances related to the matters under consideration, applicable laws and regulations, and the pertinent provisions of the contract.

The State and the Contractor shall select their respective DRB members, in conformance with the terms and conditions of the Dispute Review Board Agreement and these special provisions, within 45 days of the approval of the contract. Each party shall provide written notification to the other of the name of their selected DRB member along with the prospective member's written disclosure statement.

Before their appointments are final, the first 2 prospective DRB members shall submit complete disclosure statements to both the State and the Contractor. The statement shall include a resume of the prospective member's experience, together with a declaration describing past, present, and anticipated or planned future relationships, including indirect relationships through the prospective member's primary or full-time employer, to this project and with the parties involved in this construction contract, including, but not limited to, relevant subcontractors or suppliers to the parties, the parties' principals or the parties' counsel. The DRB members shall also include a full disclosure of close professional or personal relationships with all key members of the parties to the contract. Either the Contractor or the State may object to the others nominee and that person will not be selected for the DRB. No reason need be given for the first objection. Objections to subsequent nominees must be based on a specific breech or violation of nominee responsibilities under this specification. A different person shall then be nominated within 14 Days. The third DRB member shall supply a full disclosure statement to the first 2 DRB members and to the parties prior to appointment. Either party may reject any of the 3 prospective DRB members who fail to fully comply with all required employment and financial disclosure conditions of DRB membership as described in the Dispute Review Board Agreement and herein. A copy of the Dispute Review Board Agreement is included in this special provision.

The first duty of the State and Contractor selected members of the DRB is to select and recommend prospective third member(s) to the parties for final selection and approval. The first 2 DRB members shall proceed with the selection of the third DRB member immediately upon receiving written notification from the State of their selection, and shall provide their recommendation simultaneously to the parties within 14 days of the notification.

An impasse shall be considered to have been reached if the parties are unable to approve a third member within 14 days of receipt of the recommendation of the first 2 DRB members, or if the first 2 members are unable to agree upon a recommendation within the 14 day time limit allowed in the preceding paragraph. In the event of an impasse in selection of the third DRB member, the State and the Contractor shall each propose 3 candidates for the third position. The parties shall select the candidates proposed under this paragraph from the current list of arbitrators certified by the Public Works Contract Arbitration Committee created by Article 7.2 (commencing with Section 10245) of the State Contract Act. The first 2 DRB members shall then select one of the 6 proposed candidates in a blind draw.

The Contractor, the State, and the 3 members of the DRB shall complete and adhere to the Dispute Review Board Agreement in administration of this DRB within 14 days of the parties' concurrence in the selection of the third member. The State authorizes the Engineer to execute and administer the terms of the Agreement. The person(s) designated by the Contractor as authorized to execute Contract Change Orders shall be authorized to execute and administer the terms of this agreement, or to delegate the authority in writing. The operation of the DRB shall be in conformance with the terms of the Dispute Review Board Agreement.

The State and the Contractor shall bear the costs and expenses of the DRB equally. Each DRB board member shall be compensated at an agreed rate of $1,000 per day if time spent per meeting, including on-site time plus one hour of travel time, is greater than 4 hours. Each DRB board member shall be compensated at an agreed rate of $600 per day if time spent per meeting, including on-site time plus one hour of travel time, is less than or equal to 4 hours. The agreed rates 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 State and Contractor. Time away from the project, that has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of $100 per hour. The agreed amount of $100 per hour shall include all incidentals including expenses for telephone, fax, and computer services. Members serving on more than one DRB, regardless of the number of meetings per day, shall not be paid more than the all inclusive rate per day or rate per hour for an individual project. The State will provide, at no cost to the Contractor, administrative services such as conference facilities and secretarial services to the DRB. These special provisions and the Dispute Review Board Agreement state provisions for compensation and expenses of the DRB. DRB members shall be compensated at the same daily and hourly rate. 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 State will reimburse the Contractor for its 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 State's share of DRB expenses.

Service of a DRB member may be terminated at any time with not less than 14 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 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 14 days. Changes in either of the DRB members chosen by the two parties will not require re-selection of the third member, unless both parties agree to such re-selection in writing. The Dispute Review Board Agreement shall be amended to reflect the change of a DRB member.

The following procedure shall be used for dispute resolution:

A. If the Contractor objects to any decision, act or order of the Engineer, the Contractor shall give written notice of potential claim in conformance with the provisions in Section 9-1.04, "Notice of Potential Claim," of the Standard Specifications, including provision of applicable cost documentation; or file written protests or notices pursuant to Section 4-1.03A, "Procedure and Protest," Section 8-1.06, "Time of Completion," Section 8-1.07, "Liquidated Damages," or Section 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications.
B. The Engineer will respond, in writing, to the Contractor's written protest or notice within 14 days of receipt of the written protest or notice.
C. Within 14 days after receipt of the Engineer's written response, the Contractor shall, if the Contractor still objects, file a written reply with the Engineer, stating clearly and in detail the basis of the objection.
D. Following the Contractor's objection to the Engineer's decision, the Contractor shall refer the dispute to the DRB if the Contractor wishes to further pursue the objection to the Engineer's decision. The Contractor shall make the referral in writing to the DRB, simultaneously copied to the State, within 21 days after receipt of the written reply from the Engineer. 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.

E. The Contractor, by failing to submit the written notice of referral of the matter to the DRB, within 21 days after receipt of the State's written reply, waives future claims on the matter in contention.

F. The Contractor and the State 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 14 days prior to the date the DRB is scheduled to convene the hearing for the dispute. Either party shall produce such additional evidence as the DRB may deem necessary to reach an understanding and 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 will not consider evidence not furnished in conformance with the terms specified herein.

G. The DRB shall furnish a report, containing findings and recommendations as described in the Dispute Review Board Agreement, in writing to both the State and the Contractor. The DRB shall complete its reports, including minority opinion, if any, and submit them to the parties within 30 days of the DRB hearing, except that time extensions may be granted at the request of the DRB with the written concurrence of both parties. The report shall include the facts and circumstances related to the matters under consideration, applicable laws and regulations, the pertinent provisions of the Contract and the actual costs and time incurred as shown on the Contractor's cost accounting records.

H. Within 30 days after receiving the DRB's report, both the State and the Contractor 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 presented in the report by either party, shall conclusively indicate that the party(s) failing to respond accepts the DRB recommendation. Immediately after responses have been received by both parties, the DRB will 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 will 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.

I. The DRB's recommendations, stated in the DRB's reports, are not binding on either party. Either party may seek a reconsideration of a recommendation of the DRB. The DRB shall only grant a 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.

J. If the State and the Contractor are able to resolve their dispute with the aid of the DRB's report, the State and Contractor shall promptly accept and implement the recommendations of the DRB.

K. The State or the Contractor shall not call members who served on the DRB for this contract as witnesses in arbitration proceedings which may arise from this contract, and all documents created by the DRB shall be inadmissible as evidence in subsequent arbitration proceedings, except the DRB's final written reports on each issue brought before it.

L. The State and Contractor 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.

M. The 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 report.

DISPUTES INVOLVING SUBCONTRACTOR CLAIMS

For purposes of this section, a "subcontractor claim" shall include any claim by a subcontractor (including also any pass through claims by a lower tier subcontractor or supplier) against the Contractor that is actionable by the Contractor against the Department which arises from the work, services, or materials provided or to be provided in connection with the contract. If the Contractor determines to pursue a dispute against the Department that includes a subcontractor claim, the dispute shall be processed and resolved in conformance with these special provisions and in conformance with the following:

A. The Contractor shall identify clearly in submissions pursuant to this section, that portion of the dispute that involves a subcontractor claim or claims.

B. The Contractor shall include, as part of its submission pursuant to Step 4 above, a certification (False Claims Act Certification) by the subcontractor's or supplier's officer, partner, or authorized representative with authority to bind the subcontractor and with direct knowledge of the facts underlying the subcontractor claim. The Contractor shall submit a certification that the subcontractor claim is acknowledged and forwarded by the Contractor. The form for these certifications are available from the Engineer.

C. At any DRB meeting on a dispute that includes one or more subcontractor claims, the Contractor shall require that each subcontractor that is involved in the dispute have present an authorized representative with actual knowledge of the facts underlying the subcontractor claim to assist in presenting the subcontractor claim and to answer questions raised by the DRB members or the Department's representatives.

D. Failure by the Contractor to declare a subcontractor claim on behalf of its subcontractor (including lower tier subcontractors' and suppliers' pass through claims) at the time of submission of the Contractor's claims, as provided hereunder, shall constitute a release of the Department by the Contractor on account of such subcontractor claim.

E. The Contractor shall include in all subcontracts under this contract that subcontractors and suppliers of any tier (a) agree to submit subcontractor claims to the Contractor in a proper form and in sufficient time to allow processing by the Contractor in conformance with the Dispute Review Board resolution specifications; (b) agree to be bound by the terms of the Dispute Review Board provisions to the extent applicable to subcontractor claims; (c) agree that, to the extent a subcontractor claim is involved, completion of all steps required under these Dispute Review Board special provisions shall be a condition precedent to pursuit by the subcontractor of other remedies permitted by law, including without limitation of a lawsuit against the Contractor; and (d) agree that the existence of a dispute resolution process for disputes involving subcontractor claims shall not be deemed to create any claim, right, or cause of action by any subcontractor or supplier against the Department.

Notwithstanding the foregoing, this Dispute Review Board special provision shall not apply to, and the DRB shall not have the authority to consider, subcontractor claims between the subcontractor(s) or supplier(s) and the Contractor that is not actionable by the Contractor against the Department.

A copy of the "Dispute Review Board Agreement" to be executed by the Contractor, State and the 3 DRB members after approval of the contract follows:

Form 6202 Rev (01-05-98)

DISPUTE REVIEW BOARD AGREEMENT

_____
(Contract Identification)

Contract No. _____

THIS DISPUTE REVIEW 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 Review Board, hereinafter called the "DRB" consisting of the following members:

_____ ,
(Contractor Appointee)

_____ ,
(State Appointee)

and _____
(Third Person)

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 special provisions 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;

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 resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRB. The intent of the DRB is to fairly and impartially consider disputes placed before it and provide written recommendations for resolution of these disputes to both parties. The members of this DRB shall perform the services necessary to participate in the DRB's actions as designated in Section II, Scope of Work.

SECTION II SCOPE OF WORK

The scope of work of the DRB includes, but is not limited to, the following:

A. OBJECTIVE

The principal objective of the DRB is to assist in the timely resolution of disputes between the parties arising from performance of this contract. It is not intended for either party to default on their normal responsibility to amicably and fairly settle their differences by indiscriminately assigning them to the DRB. It is intended that the mere existence of the DRB will encourage the parties to resolve disputes without resorting to this review procedure. But when a dispute which is serious enough to warrant the DRB's review does develop, the process for prompt and efficient action will be in place.

B. PROCEDURES

The DRB shall render written reports on disputes between the parties arising from the construction contract. Prior to consideration of a dispute, the DRB shall establish rules and regulations 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. DRB recommendations, resulting from its consideration of a dispute, shall be furnished in writing to both parties. The recommendations shall be based on the pertinent contract provisions, and the facts and circumstances involved in the dispute. The recommendations shall find one responsible party in a dispute; shared or "jury" determinations shall not be rendered.

The DRB shall refrain from officially giving advice or consulting services to anyone involved in the contract. The individual members shall act in a completely independent manner and while serving as members of the DRB shall have no consulting business connections with either party or its principals or attorneys or other affiliates (subcontractors, suppliers, etc.) who have a beneficial interest in the contract.

During scheduled meetings of the DRB as well as during dispute hearings, 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, except as directed by the DRB Chairperson. Such discussions or meetings shall be disclosed to both parties. Other 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.

C. CONSTRUCTION SITE VISITS, PROGRESS MEETINGS AND FIELD INSPECTIONS

The 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 6 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. 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 CONTRACTOR's representative of potential problems and a description of proposed solutions.
5. An outline by the STATE's representative of the status of the work as the STATE views it.

6. A brief description by the CONTRACTOR's or STATE's representative of potential claims or disputes which 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 disputes and claims.

The STATE's representative will prepare minutes of all regular meetings and circulate them for revision and approval by all concerned.
The field inspection shall cover all active segments of the work, the DRB being accompanied by both parties' representatives. The field inspection may be waived upon mutual agreement of the parties.

D. DRB CONSIDERATION AND HANDLING OF DISPUTES

Upon receipt by the DRB of a written referral of a dispute, the DRB shall convene to review and consider the dispute. The DRB shall determine the time and location of DRB hearings, with due consideration for the needs and preferences of the parties while recognizing the paramount importance of speedy resolution of issues. If the matter is not urgent, it may be scheduled for the time of the next scheduled DRB visit to the project. For an urgent matter, and upon the request of either party, the DRB shall meet at its earliest convenience.

Normally, hearings shall be conducted at or near the project site. However, any location which would be more convenient and still provide required facilities and access to necessary documentation shall be satisfactory.

Both parties shall be given the opportunity to present their evidence at these hearings. It is expressly understood that the DRB members are to act impartially and independently in the consideration of the contract provisions, and the facts and conditions surrounding any dispute presented by either party, and that the recommendations concerning any such dispute are advisory and nonbinding on the parties.

The DRB may request that written documentation and arguments from both parties be sent to each DRB member, through the DRB Chairperson, for review before the hearing begins. A party furnishing written documentation to the DRB shall furnish copies of such information to the other party at the same time that such information is supplied to the DRB.

DRB hearings shall be informal. There shall be no testimony under oath or cross-examination. 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 acceptance standards established by the DRB. These standards need not comply with prescribed legal laws of evidence.

The third DRB member shall act as Chairperson for dispute hearings and all other DRB activities. The parties shall have a representative at all hearings. Failure to attend a duly noticed meeting by either of the parties shall be conclusively considered by the DRB as indication that the non-attending party considers written submittals 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 until all aspects of the dispute are thoroughly covered. DRB members may ask questions, seek clarification, or request further data from either of the parties. The DRB may request from either party documents or information that would assist the DRB in making its findings and recommendations including, but not limited to, documents used by the CONTRACTOR in preparing the bid for the project. A refusal by a party to provide information requested by the DRB may be considered by the DRB as an indication that the requested material would tend to disprove that party's position. Claims shall not necessarily be computed by merely subtracting bid price from the total cost of the affected work. However, if claims are based on the "total cost method," then, to be considered by the DRB, they shall be supported by evidence furnished by the CONTRACTOR that (1) the nature of the dispute(s) makes it impossible or impracticable to determine costs with a reasonable degree of accuracy, (2) the CONTRACTOR's bid estimate was realistic, (3) the CONTRACTOR's actual costs were reasonable, and (4) the CONTRACTOR was not responsible for the added expenses. As to claims based on the CONTRACTOR's field or home office accounting records, those claims shall be supported by an audit report of an independent Certified Public Accountant unless the contract includes special provisions that provide for an alternative method to calculate unabsorbed home office overhead. Any of those claims shall also be subject to audit by the DRB with the concurrence of the parties. In large or complex cases, additional hearings may be necessary in order to consider all the evidence presented by both parties. All involved parties shall maintain the confidentiality of all documents and information, as provided in this AGREEMENT.

During dispute hearings, no DRB member shall express an opinion concerning the merit of any facet of the case. DRB deliberations shall be conducted in private, with interim individual views kept strictly confidential.

After hearings are concluded, the DRB shall meet in private and reach a conclusion supported by 2 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's findings and recommendations, along with discussion of reasons therefor, shall then be submitted as a written report to both parties. Recommendations shall be based on the pertinent contract provisions, applicable laws and regulations, and facts and circumstances related to the dispute. The report shall be thorough in discussing the facts considered, the contract language, law or regulation viewed by the DRB as pertinent to the issues, and the DRB's interpretation and

philosophy in arriving at its conclusions and recommendations. The DRB's report shall stand on its own, without attachments or appendices. The DRB chairman shall complete and furnish a summary report to the DRB Program Manager, Construction Program, MS 44, P.O. Box 942874, Sacramento, CA 94274.

With prior written approval of both parties, the DRB 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 2 parties as specified in an approved contract change order. The CONTRACTOR will not be entitled to markups for the payments made for these services.

The DRB shall resist submittal of incremental portions of information by either party, in the interest of making a fully-informed decision and recommendation.

The DRB shall make every effort to reach a unanimous decision. If this proves impossible, the dissenting member shall prepare a minority opinion, which shall be included in the DRB's report.

Although both parties should place weight upon the DRB's recommendations, they are not binding. Either party may appeal a recommendation to the DRB for reconsideration. However, reconsideration shall only be allowed when there is new evidence to present, and the DRB shall accept only one appeal from each party pertaining to an individual DRB recommendation. The DRB shall hear appeals in conformance with the terms described in the Section entitled "Dispute Review Board" in the special provisions.

E. DRB MEMBER REPLACEMENT

Should the need arise to appoint a replacement DRB member, the replacement DRB member shall be appointed in the same manner as the original DRB members were appointed. The selection of a replacement DRB member shall begin promptly upon notification of the necessity for a replacement and shall be completed within 14 days. This AGREEMENT will be amended to indicate change in DRB membership.

SECTION III CONTRACTOR RESPONSIBILITIES

The CONTRACTOR shall furnish to each DRB member one copy of pertinent documents which are or may become necessary for the DRB to perform their function. Pertinent documents are drawings or sketches, calculations, procedures, schedules, estimates, or other documents which are used in the performance of the work or in justifying or substantiating the CONTRACTOR's position. The CONTRACTOR shall also furnish a copy of such pertinent documents to the STATE, in conformance with the terms outlined in the special provisions.

SECTION IV STATE RESPONSIBILITIES

The STATE will furnish the following services and items:

A. CONTRACT RELATED DOCUMENTS

The STATE will furnish to each DRB member one copy of Notice to Contractors and Special Provisions, Proposal and Contract, Plans, Standard Specifications, and Standard Plans, change orders, written instructions issued by the STATE to the CONTRACTOR, or other documents pertinent to any dispute that has been referred to the DRB and necessary for the DRB to perform its function.

B. COORDINATION AND SERVICES

The STATE, through the Engineer, will, in cooperation with the CONTRACTOR, coordinate the operations of the DRB. The Engineer will arrange or provide conference facilities at or near the project site and provide secretarial and copying services to the DRB without charge to the CONTRACTOR.

SECTION V TIME FOR BEGINNING AND COMPLETION

Once established, the DRB shall be in operation until the day of acceptance of the contract. The DRB members shall not begin work under the terms of this AGREEMENT until authorized in writing by the STATE.

SECTION VI PAYMENT

A. ALL INCLUSIVE RATE PAYMENT

The STATE and the CONTRACTOR shall bear the costs and expenses of the DRB equally. Each DRB board member shall be compensated at an agreed rate of $1,000 per day if time spent per meeting, including on-site time plus one hour of travel time, is greater than 4 hours. Each DRB board member shall be compensated at an agreed rate of $600 per day if time spent per meeting, including on-site time plus one hour of travel time, is less than or equal to 4 hours. The agreed rates 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 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 parties, will be compensated at an agreed rate of $100 per hour. The agreed amount of $100 per hour shall include all incidentals including expenses for telephone, fax, and computer services. Members serving on more than one DRB, regardless of the number of meetings per day, shall not be paid more than the all inclusive rate per day or rate per hour for an individual project. The STATE will provide, at no cost to the CONTRACTOR, administrative services such as conference facilities and secretarial services to the DRB.

B. PAYMENTS

DRB members shall be compensated at the same rate. 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 STATE will reimburse the CONTRACTOR for its share of the costs of the DRB.

The 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 CONTRACTOR.

Invoices shall be accompanied by original supporting documents, which the CONTRACTOR shall include with the extra work billing when submitting for reimbursement of the STATE's share of cost from the STATE. The CONTRACTOR will be reimbursed for one-half of approved costs of the DRB. No markups will be added to the CONTRACTOR's payment.

C. INSPECTION OF COSTS RECORDS

The DRB members 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 VII ASSIGNMENT OF TASKS OF WORK

The DRB members shall not assign the work of this AGREEMENT.

SECTION VIII TERMINATION OF AGREEMENT, THE DRB, AND DRB MEMBERS

DRB members may resign from the DRB by providing not less than 14 days written notice of the resignation to the STATE and CONTRACTOR. DRB members may be terminated by their original appointing power, in conformance with the terms of the contract.

SECTION IX LEGAL RELATIONS

The parties hereto mutually understand and agree that the DRB member in the performance of duties on the DRB, 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 X 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 the DRB. 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 shall be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

SECTION XI DISPUTES

Disputes between the parties hereto, including disputes between the DRB members and either party or both 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.

SECTION XII VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION

In the event that any party, including an individual member of the DRB, 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 XIII 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.
Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

SECTION XIV CERTIFICATION OF THE CONTRACTOR, THE DRB MEMBERS, AND THE STATE

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRB MEMBER

By: _____

Title: _____

DRB MEMBER

By: _____

Title :_____

DRB MEMBER

By :_____

Title :_____

CONTRACTOR

By: _____

Title: _____

CALIFORNIA STATE DEPARTMENT
OF TRANSPORTATION

By: _____

Title: _____

5-1.13 COMPENSATION ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS

The provisions of this section shall apply only to the following contract items:

ITEM CODE	ITEM
390155	ASPHALT CONCRETE (TYPE A)
290211	ASPHALT TREATED PERMEABLE BASE

The compensation payable for asphalt concrete and asphalt treated permeable base will be increased or decreased in conformance with the provisions of this section for paving asphalt price fluctuations exceeding 5 percent (Iu/Ib is greater than 1.05 or less than 0.95) which occur during performance of the work.

The adjustment in compensation will be determined in conformance with the following formulae when the item of asphalt concrete or asphalt treated permeable base (or both) is included in a monthly estimate:

A. Total monthly adjustment = AQ
B. For an increase in paving asphalt price index exceeding 5 percent:

$$A = 0.90\ (1.1023)\ (Iu/Ib - 1.05)\ Ib$$

C. For a decrease in paving asphalt price index exceeding 5 percent:

$$A = 0.90\ (1.1023)\ (Iu/Ib - 0.95)\ Ib$$

D. Where:

A = Adjustment in dollars per tonne of paving asphalt used to produce asphalt concrete and asphalt treated permeable base rounded to the nearest $0.01.
Iu = The California Statewide Paving Asphalt Price Index which is in effect on the first business day of the month within the pay period in which the quantity subject to adjustment was included in the estimate.
Ib = The California Statewide Paving Asphalt Price Index for the month in which the bid opening for the project occurred.
Q = Quantity in tonnes of paving asphalt that was used in producing the quantity of asphalt concrete shown under "This Estimate" on the monthly estimate using the amount of asphalt determined by the Engineer plus the quantity in tonnes of paving asphalt that would have been used in producing the quantity of asphalt treated permeable base shown under "This Estimate" on the monthly estimate using the amount of asphalt specified in the specifications.

The adjustment in compensation will also be subject to the following:

A. The compensation adjustments provided herein will be shown separately on payment estimates. The Contractor shall be liable to the State for decreased compensation adjustments and the Department may deduct the amount thereof from any moneys due or that may become due the Contractor.
B. Compensation adjustments made under this section will be taken into account in making adjustments in conformance with the provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications.
C. The total price adjustment for price index increases of paving asphalt on this project shall not exceed $181,000.00.
D. In the event of an overrun of contract time, adjustment in compensation for paving asphalt included in estimates during the overrun period will be determined using the California Statewide Paving Asphalt Price Index in effect on the first business day of the month within the pay period in which the overrun began.

The California Statewide Paving Asphalt Price Index is determined each month on the first business day of the month by the Department using the median of posted prices in effect as posted by Chevron, Mobil, and Unocal for the Buena Vista, Huntington Beach, Kern River, Long Beach, Midway Sunset, and Wilmington fields.

In the event that the companies discontinue posting their prices for a field, the Department will determine an index from the remaining posted prices. The Department reserves the right to include in the index determination the posted prices of additional fields.

5-1.14 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.

5-1.15 USE OF DREDGED MATERIALS

If sand, gravel, aggregates, imported borrow or other minerals are dredged from San Francisco Bay, the Contractor shall provide documentation that a permit from the Bay Conservation and Development Commission (BCDC) has been obtained. The documentation shall include the permit number, parcel number and specific location of the source of the material. The Contractor must also include this information on the HC-30 "Notice of Materials to be Used".

5.1.16 FORCE ACCOUNT PAYMENT

The second, third and fourth paragraphs of Section 9-1.03A, "Work Performed by Contractor," of the Standard Specifications, shall not apply.

Attention is directed to "Progress Schedule (Critical Path) of these special provisions. To the total of the direct costs for work performed on a force account basis, computed as provided in Sections 9-1.03A(1), "Labor," 9-1.03A(2), "Materials," and 9-1.03A(3), "Equipment Rental," of the Standard Specifications, there will be added a markup of 28 percent to the cost of labor, 10 percent to the cost of materials, and 10 percent to the equipment rental. These markups shall be applied to all 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 pursuant to "Overhead" of these Special Provisions, shall constitute full compensation for all overhead costs for work performed on a force account basis. These overhead costs shall be deemed to include all items of expense not specifically designated as cost or equipment rental in Sections 9-1.03A(1), "Labor," 9-1.03A(2), "Materials," and 9-1.03A(3), "Equipment Rental," of the Standard Specifications. The total payment made as provided above and in the first paragraph of Section 9-1.03A, "Work Performed by Contractor," shall be deemed to be the actual cost of the work performed on a force account basis, and shall constitute full compensation therefor. Full compensation for all overhead costs for work performed on a force account basis, and for which no adjustment is made to the contract lump sum price for related overhead pursuant to "Overhead" of these Special Provisions, shall be considered as included in the markups specified above, and no additional compensation will be allowed therefor.

When extra work to be paid for on a force account basis is performed by a subcontractor, approved in accordance with the provisions in Section 8-1.01, "Subcontracting," of the Standard Specifications, an additional markup of 7 percent will be added to the total cost of that extra work including all markups specified in this section "Force Account Payment." The additional 7 percent markup shall reimburse the Contractor for additional administrative costs, and no other additional payment will be made by reason of performance of the extra work by a subcontractor.

5-1.17 PERMITS AND LICENSES

Attention is directed to Section 7-1.04, "Permits and Licenses," of the Standard Specifications and these special provisions.

The Department has obtained the following permits for this project:

A. USCG Bridge permit-New Benicia Bridge
B. BCDC permit No. 17-99 (M)
C. RWCQB File No. 2128.03
D. U.S. Army Corps of Engineer-File No. 21-392N

Copies of these permits can be obtained at the Department of Transportation, Plans and Bid Documents Section, (MS 26), 1120 N Street, Room 200, Sacramento, CA 95814, Telephone (916) 654-4490 or may be seen at the office of the Toll Bridge Program Duty Senior's Desk, 111 Grand Avenue, Oakland, California 94612-3717. Please call the Toll Bridge Program Duty Senior, Telephone No. (510) 286-5549 or e-mail at duty_senior_tollbridge_district04@dot.ca.gov., to reserve copies at least 24 hours in advance.

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

5-1.18 SUNKEN DEBRIS REMOVAL

Should the Contractor during the progress of the work, sink, lose, or throw overboard any material, plant or machinery into the waters of the Bay, he shall recover or remove such debris immediately.

The Contractor shall give immediate notice to proper authorities and shall mark the location of the fallen debris with U.S. Coast Guard-approved lighted buoys until such debris are removed. Attention is directed to Section "Relations with the U.S. Coast Guard" of these special provisions regarding specific conditions in connection with obstructions to navigation.

5-1.19 PAYMENTS

Attention is directed to Sections 9-1.06, "Partial Payments," and 9-1.07, "Payment After Acceptance," of the Standard Specifications and these special provisions.

For the purpose of making partial payments pursuant to Section 9-1.06, "Partial Payments," of the Standard Specifications, the amount set forth for the contract items of work hereinafter listed shall be deemed to be the maximum value of the contract item of work which will be recognized for progress payment purposes:

A.	Clearing and Grubbing	$135,000.00
B.	Bridge Removal (Portion), Location. A	$5000.00
C.	Bridge Removal (Portion), Location. B	$5000.00

After acceptance of the contract pursuant to the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, the amount, if any, payable for a contract item of work in excess of the maximum value for progress payment purposes hereinabove listed for the item, will be included for payment in the first estimate made after acceptance of the contract.

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. Metal Sign Structures
B. Culvert Pipe
C. Edge Drain Pipe
D. Underdrain Pipe
E. Horizontal Drain Pipe
F. Ductile Iron Pipe (Sewer & Water)
G. Rock Slope Protection Fabric
H. Miscellaneous Iron and Steel
I. Chain Link Fence
J. Metal Beam Guard Railing
K. Thrie Beam Barrier
L. Crash Cushions
M. Pavement Markers
N. Piling.
O. Prestressing ducts and anchorage devices.
P. Prestressing steel in sealed containers.
Q. Precast Prestressed members.
R. Type B Joint Seal and Joint.
S. Joint Seal Assembly.
T. PTFE Bearing.
U. Bar Reinforcing Steel.
V. Miscellaneous Metal.
W. Lighting Standards
X. Luminaires

5-1.20 SOUND CONTROL REQUIREMENTS

Sound control shall conform to the provisions in Section 7-1.01I, "Sound Control Requirements," of the Standard Specifications and these special provisions.

The noise level from all of the Contractor's operations, between the hours of 6:00 p.m. and 8:00 a.m., shall not exceed 86 dbA at a distance of 15 meters. No pile driving operation will be allowed between the hours of 6:00 p.m. and 8:00 a.m. This requirement in no way relieves the Contractor from Said responsibility for complying with local ordinances regulating noise level.

Said noise level requirement shall apply to all 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. The use of loud sound signals shall be avoided in favor of light warnings except those required by safety laws for the protection of personnel.

Full compensation for conforming to the requirements of this section 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.

5–1.21 NON-HAZARDOUS AND HAZARDOUS MATERIAL, GENERAL

Attention is directed to "Earthwork" of these special provisions regarding the removal and disposal of non-hazardous and hazardous material described in this section.

Contaminants have been discovered through testing within the project limits. Testing consisted of collecting and analyzing in situ samples from within the limits of excavation shown on the plans. A description of the sampling plan and summary tables of the test results are included in the "Materials Information." The complete report entitled "Site Investigation Report, Interstate 680/780 Interchange Improvement Project, Solano County, California," is available for inspection at the Department of Transportation, Toll Bridge Duty Senior's Desk, 111 Grand Avenue, Oakland, California, (510) 286-5549. Requests to review the reports must be made with the duty senior at least 24 hours in advance. These test results have been used for disposal characterization of material within the excavation limits and shall not be construed as identifying all locations within the project limits that contain contaminants.

Wherever the following terms are used in the contract documents, the meaning and intent shall be interpreted as provided below:

A. Land disposal restriction (LDR) material – Material that contains contaminants at concentrations equal to or greater than 10 times the Universal Treatment Standards listed in Section 66268.48 of Title 22 of the California Code of Regulations.
B. Non-RCRA (Resource Conservation and Recovery Act) hazardous material – Material that contains contaminants at concentrations equal to or greater than the threshold limit concentrations listed in Section 66261.24 of Title 22 of the California Code of Regulations, excluding Section 66261.24 (a) (1).
C. Non-hazardous material – Material that does not contain contaminants at concentrations equal to or greater than the threshold limit concentrations listed in Section 66261.24 of Title 22 of the California Code of Regulations.

Characterization and disposal of additional material resulting from excavations performed outside of the pay limits shown on the plans, specified in the Standard Specifications, or specified or directed by the Engineer, for the Contractor's convenience, shall be at the Contractor's expense. This resultant material shall be presumed to be either non-hazardous material or hazardous material if the test results for the location indicate that the material being excavated is non-hazardous material or hazardous material. Unless backfilling with the material is approved in writing by the Engineer, the Contractor shall dispose of the resultant material outside highway right of way in conformance with the provisions in "Earthwork" of these special provisions. When the material must be removed from highway right of way the Contractor shall furnish replacement material suitable for the purpose intended in conformance with the provisions in Section 19, "Earthwork," of the Standard Specifications.

APPLICABLE RULES AND REGULATIONS.–Excavation, transport and disposal of hazardous material shall be in conformance with the rules and regulations of the following agencies:

United States Department of Transportation (USDOT)
United States Environmental Protection Agency (USEPA)
California Environmental Protection Agency (CAL-EPA)
1. Department of Toxic Substance Control (DTSC)
2. Integrated Waste Management Board
3. Regional Water Quality Control Board, Region 2 (RWQCB)
4. State Air Resources Board
Bay Area Air Quality Management District (BAAQMD)
California Division of Occupational Safety and Health Administration (CAL-OSHA)

PERMITS AND LICENSES.–The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work, including registration for transporting vehicles carrying hazardous material, in conformance with the provisions in Section 7-1.04, "Permits and Licenses," of the Standard Specifications.

The Engineer will obtain the Environmental Protection Agency Generator Identification Number and Board of Equalization Identification Number and sign all manifests as the Generator.

SITE HEALTH AND SAFETY PLAN.–The Contractor shall prepare a detailed Site Health and Safety Plan for all site personnel, including State personnel, that identifies potential health and safety hazards associated with each operation and specifies work practices that will be used to protect workers from those hazards in conformance with the DTSC and CAL-OSHA regulations. At a minimum, the Site Health and Safety Plan shall identify key site safety personnel, describe risks associated with the work, describe training requirements, describe appropriate personal protective equipment, describe any

site-specific medical surveillance requirements, describe any periodic air monitoring requirements, define appropriate site work zones, and describe any decontamination requirements. The Site Health and Safety Plan shall be submitted at least 15 working days prior to beginning any excavation work for review and acceptance by the Engineer. Prior to submittal, the Contractor shall have the Site Health and Safety Plan approved by an Industrial Hygienist certified by the American Board of Industrial Hygiene. Subcontractors shall use the Site Health and Safety Plan prepared by the Contractor or prepare and submit a separate Site Health and Safety Plan in conformance with the provisions in this section.

SAFETY TRAINING.–Prior to performing any work, all personnel, including State personnel, shall complete a safety training program that communicates the potential health and safety hazards associated with work on the site and instructs the personnel in procedures for doing the work safely. The level of training provided shall be consistent with the personnel's job function and conform to CAL-OSHA regulations. The training, including subsequent training required until completion of the project, shall be provided by the Contractor. The Contractor shall provide a certification of completion of the Safety Training Program to all personnel. Personal protective equipment required by State personnel to inspect the work shall be provided by the Contractor. The number of State personnel requiring the above mentioned safety training program and personal protective equipment will be 15.

SAMPLING AND ANALYSIS.–The Contractor shall test the material to be excavated at his own expense for any additional acceptance requirements put forth by the disposal facility. Sampling and analysis shall be performed using the sampling and analysis procedure required by the disposal facility.

The Contractor may perform additional tests on the material to be excavated at his option and expense for confirmation of the classification as non-hazardous material or hazardous material. Sampling and analysis shall be based on guidelines in USEPA, SW 846, "Test Methods for Evaluating Solid Waste, Volume II: Field Manual Physical/Chemical Methods."

The Contractor shall submit, for approval by the Engineer, a Sampling and Analysis Plan that describes the scope of the investigation, along with the name, address, and certification number of the testing laboratory, 15 working days prior to beginning any sampling or analysis for additional disposal facility requirements, reclassification of material, or characterization of material outside of the excavation pay limits. The Sampling and Analysis Plan shall be prepared under the guidance of a registered professional experienced in site characterization. The Engineer will make the final decision on reclassification or characterization of material after review of the test data. Five working days shall be allowed for review of test data.

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

5-1.22 RELATIONS WITH CALIFORNIA DEPARTMENT OF FISH AND GAME

This project is located within the jurisdiction of the California Department of Fish and Game. The Department of Fish and Game has concurred with protection measures developed by the Department of Transportation. The Contractor shall be fully informed of the requirements associated with all rules regulations, and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's operations accordingly.

Copies of the agreement may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916)654-4490, and are available for inspection at the office of the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, e-mail address duty_senior_tollbridge_district04@dot.ca.gov., telephone number (510) 286-5549.

Attention is directed to Section "Environmental Work Restrictions" of these special provisions relating to specific protection measures required under this contract.

Any modifications to any agreement between the Department of Transportation and the California Department of Fish and Game shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

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

5-1.23 RELATIONS WITH UNITED STATES FISH AND WILDLIFE SERVICE

This project is located within the jurisdiction of the U.S. Fish and Wildlife Service. The Fish and Wildlife Service has issued a Biological Opinion regarding the Delta Smelt, Winter-Run Chinook Salmon, Steelhead, Coho Salmon, Spring-Run Chinook Salmon and Sacramento Split Tail a federal and state endangered species protected under both the federal Endangered Species Act and the California Endangered Species Act. The Department of Transportation has entered into an agreement with the Fish and Wildlife Service regarding handling of Delta Smelt, Winter-Run Chinook Salmon, Steelhead,

Coho Salmon, Spring-Run Chinook Salmon and Sacramento Split Tail at the Benicia-Martinez Bridge Project site. The Contractor shall be fully informed of the requirements of this agreement as well as of all rules, regulations, and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's operations accordingly.

Copies of the agreement may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and are available for inspection at the office of the Toll Bridge Retrofit Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, e-mail address duty_senior_tollbridge_district04@dot.ca.gov., telephone number (510) 286-5549.

Attention is directed to Section "Environmental Work Restrictions" of these special provisions relating to specific measures required under this contract.

Any modifications to any agreement between the Department of Transportation and the United States Fish and Wildlife Service shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

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

5-1.24 RELATIONS WITH NATIONAL MARINE FISHERIES SERVICE

Copies of the agreement may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and are available for inspection at the office of the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, e-mail address duty_senior_tollbridge_district04@dot.ca.gov., telephone number (510) 286-5549.

Any modifications to any agreement between the Department of Transportation and the National Marine Fisheries Service shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

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

5-1.25 RELATIONS WITH U.S. ARMY CORPS OF ENGINEERS

The location of the Benicia-Martinez Bridge Project is within an area controlled by the U.S. Army Corps of Engineers. Permit has been issued covering work to be performed under this contract. The Contractor shall be fully informed of all rules, regulations and conditions of the permit that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly. Said document shall be considered a part of, and shall become, an integral part of the special provisions and contract for this project.

Copies of the Permit may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and are available for inspection at the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, telephone number (510) 286-5549, email duty_senior_tollbridge_district04@dot.ca.gov.

Any modifications to the permit which are proposed by the Contractor shall be submitted in writing to the Engineer for transmittal to the Army Corps of Engineers for their consideration.

When the Contractor is notified by the Engineer that a modification to the permit is under consideration, no work will be allowed on the proposed modification until the Department takes action on the proposed modification. Any modifications to any agreement between the Department of Transportation and the Army Corps of Engineers shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

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

5-1.26 RELATIONS WITH SAN FRANCISCO BAY CONSERVATION DEVELOPMENT COMMISSION (BCDC)

The location of the Benicia-Martinez Bridge Project is within an area controlled by the BCDC. Permit has been issued covering work to be performed under this contract. The Contractor shall be fully informed of all rules, regulations and conditions of the permit that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly. Said document shall be considered a part of, and shall become, an integral part of the special provisions and contract for this project.

Copies of the Permit may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916) 654-4490, and are available for inspection at the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue,

Oakland, California 94612, e-mail address duty_senior_tollbridge_district04@dot.ca.gov., telephone number (510) 286-5549.

Any modifications to the permit which are proposed by the Contractor shall be submitted in writing to the Engineer for transmittal to the BCDC for their consideration.

When the Contractor is notified by the Engineer that a modification to the permit is under consideration, no work will be allowed on the proposed modification until the Department takes action on the proposed modification. Any modifications to any agreement between the Department of Transportation and BCDC shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

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

5-1.27 RELATIONS WITH U.S. COAST GUARD

The location of the Benicia-Martinez Bridge Project is within an area controlled by the U.S. Coast Guard. The Contractor acting on behalf of the Department shall be fully informed of all rules, regulations and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly. Further information is included in the U.S. Coast Guard Checklist.

Copies of the Checklist may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, Telephone No. (916)654-4490, and are available for inspection at the Toll Bridge Program Duty Senior at District 04 Office, 111 Grand Avenue, Oakland, California 94612, e-mail address duty_senior_tollbridge_district04@dot.ca.gov., telephone number (510) 286-5549.

Attention is directed to Sections 7-1.11, "Preservation of Property," and 7-1.12, "Responsibility for Damage," of the Standard Specifications.

Any debris, material, plant or machinery that incidentally dropped into the waters of the Bay during the progress of work, which may present a hazard or which may obstruct navigation shall be promptly recovered or removed in accordance with the conditions specified in the Preconstruction Checklist.

Attention is directed to Section 8-1.06, "Time of Completion," of the Standard Specifications. Days during which the Contractor's operations are restricted in the navigation channel by others shall be considered to be nonworking days if, in the opinion of the Engineer, these restrictions cause a delay in the current controlling operation or operations.

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

5-1.28 RELATIONS WITH CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

The location of the Benicia-Martinez Bridge Project is within an area controlled by the Regional Water Quality Control Board. Regional Water Quality Control Board Order No. 99-06-DWQ and No. 99-08-DWQ has been issued covering work to be performed under this contract. The Contractor shall be fully informed of all rules, regulations and conditions that may govern the Contractor's operations in said area and shall conduct the Contractor's work accordingly.

Copies of the agreement may be obtained at the Department of Transportation, Plans and Bid Documents, Room 0200, Transportation Building, 1120 N Street, P.O. Box 942874, Sacramento, California 94274-0001, e-mail address duty_senior_tollbridge_district04@dot.ca.gov., Telephone No. (916)654-4490, and are available for inspection at the office of the Toll Bridge Program Duty Senior at 111 Grand Avenue, Oakland California 94612, telephone number (510) 286-5549.

Attention is directed to Sections 7-1.11, "Preservation of Property," and 7-1.12, " Indemnification And Insurance," of the Standard Specifications.

Attention is directed to Section 8-1.06, "Time of Completion," of the Standard Specifications. Days during which the Contractor's operations are restricted in the floodway by the requirements of this section, shall be considered to be nonworking days if these restrictions cause a delay in the current controlling operation or operations.

Any modifications to the permit which are proposed by the Contractor shall be submitted in writing to the Engineer for transmittal to the Regional Water Quality Control Board for their consideration.

When the Contractor is notified by the Engineer that a modification to the permit is under consideration, no work will be allowed on the proposed modification until the Department takes action on the proposed modification.

Any modifications to any agreement between the Department of Transportation and the Regional Water Quality Control Board shall be fully binding on the Contractor, and the provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

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

5-1.29 TIDAL CONDITIONS AND ELEVATION DATUM

Attention is directed to Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work."

Tidal conditions may present significant problems in constructing the work as depicted in the contract plans. Tidal fluctuations may be severe and different from those shown in published tidal and current data due to differences in datum, winter runoff and other causes. Strong currents exist over portions of the project site. Limited time periods of slack water may restrict diving and other underwater activities.

The Contractor is responsible for being knowledgeable of such tidal difficulties, and no payment will be made by the State for any costs incurred by the Contractor in connection with the variations in actual tidal or current conditions during the course of this contract. Any reference to Mean Higher High and Mean Lower Low tides shall be understood to be an estimate used for permit purposes, actual mean tide data shall be determined by the Contractor.

All vertical control data are based on the National Geodetic Vertical Datum (NGVD) of 1929.

SECTION 6. (BLANK)

SECTION 7. (BLANK)

SECTION 8. MATERIALS

SECTION 8-1. MISCELLANEOUS

8-1.01 SUBSTITUTION OF NON-METRIC MATERIALS AND PRODUCTS

Only materials and products conforming to the requirements of the specifications shall be incorporated in the work. When metric materials and products are not available, and when approved by the Engineer, and at no cost to the State, materials and products in the United States Standard Measures which are of equal quality and of the required properties and characteristics for the purpose intended, may be substituted for the equivalent metric materials and products, subject to the following provisions:

A. Materials and products shown on the plans or in the special provisions as being equivalent may be substituted for the metric materials and products specified or detailed on the plans.
B. Before other non-metric materials and products will be considered for use, the Contractor shall furnish, at the Contractor's expense, evidence satisfactory to the Engineer that the materials and products proposed for use are equal to or better than the materials and products specified or detailed on the plans. The burden of proof as to the quality and suitability of substitutions shall be upon the Contractor and the Contractor shall furnish necessary information as required by the Engineer. The Engineer will be the sole judge as to the quality and suitability of the substituted materials and products and the Engineer's decision will be final.
C. When the Contractor elects to substitute non-metric materials and products, including materials and products shown on the plans or in the special provisions as being equivalent, the list of sources of material specified in Section 6-1.01, "Source of Supply and Quality of Materials," of the Standard Specification shall include a list of substitutions to be made and contract items involved. In addition, for a change in design or details, the Contractor shall submit plans and working drawings in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The plans and working drawings shall be submitted at least 7 days before the Contractor intends to begin the work involved.

Unless otherwise specified, the following substitutions of materials and products will be allowed:

SUBSTITUTION TABLE FOR SIZES OF HIGH STRENGTH STEEL FASTENERS
ASTM Designation: A 325M

METRIC SIZE SHOWN ON THE PLANS mm x thread pitch	SIZE TO BE SUBSTITUTED inch
M16 x 2	5/8
M20 x 2.5	3/4
M22 x 2.5	7/8
M24 x 3	1
M27 x 3	1-1/8
M30 x 3.5	1-1/4
M36 x 4	1-1/2

SUBSTITUTION TABLE FOR PLAIN WIRE REINFORCEMENT
ASTM Designation: A 82

METRIC SIZE SHOWN ON THE PLANS mm^2	SIZE TO BE SUBSTITUTED $inch^2$ x 100
MW9	W1.4
MW10	W1.6
MW13	W2.0
MW15	W2.3
MW19	W2.9
MW20	W3.1
MW22	W3.5
MW25	W3.9, except W3.5 in piles only
MW26	W4.0
MW30	W4.7
MW32	W5.0
MW35	W5.4
MW40	W6.2
MW45	W6.5
MW50	W7.8
MW55	W8.5, except W8.0 in piles only
MW60	W9.3
MW70	W10.9, except W11.0 in piles only
MW80	W12.4
MW90	W14.0
MW100	W15.5

SUBSTITUTION TABLE FOR BAR REINFORCEMENT

METRIC BAR DESIGNATION NUMBER[1] SHOWN ON THE PLANS	BAR DESIGNATION NUMBER[2] TO BE SUBSTITUTED
10	3
13	4
16	5
19	6
22	7
25	8
29	9
32	10
36	11
43	14
57	18

[1]Bar designation numbers approximate the number of millimeters of the nominal diameter of the bars.
[2]Bar numbers are based on the number of eighths of an inch included in the nominal diameter of the bars.
No adjustment will be required in spacing or total number of reinforcing bars due to a difference in minimum yield strength between metric and non-metric bars.

SUBSTITUTION TABLE FOR SIZES OF:

(1) STEEL FASTENERS FOR GENERAL APPLICATIONS (ASTM Designation: A 307 or AASHTO Designation: M 314, Grade 36 or 55), and

(2) HIGH STRENGTH STEEL FASTENERS (ASTM Designation: A 325 or A 449)

METRIC SIZE SHOWN ON THE PLANS mm	SIZE TO BE SUBSTITUTED inch
6 or 6.35	1/4
8 or 7.94	5/16
10 or 9.52	3/8
11 or 11.11	7/16
13 or 12.70	1/2
14 or 14.29	9/16
16 or 15.88	5/8
19 or 19.05	3/4
22 or 22.22	7/8
24, 25, or 25.40	1
29 or 28.58	1-1/8
32 or 31.75	1-1/4
35 or 34.93	1-3/8
38 or 38.10	1-1/2
44 or 44.45	1-3/4
51 or 50.80	2
57 or 57.15	2-1/4
64 or 63.50	2-1/2
70 or 69.85	2-3/4
76 or 76.20	3
83 or 82.55	3-1/4
89 or 88.90	3-1/2
95 or 95.25	3-3/4
102 or 101.60	4

SUBSTITUTION TABLE FOR NOMINAL THICKNESS OF SHEET METAL

UNCOATED HOT AND COLD ROLLED SHEETS		HOT-DIPPED ZINC COATED SHEETS (GALVANIZED)	
METRIC THICKNESS SHOWN ON THE PLANS mm	GAGE TO BE SUBSTITUTED inch	METRIC THICKNESS SHOWN ON THE PLANS mm	GAGE TO BE SUBSTITUTED inch
7.94	0.3125	4.270	0.1681
6.07	0.2391	3.891	0.1532
5.69	0.2242	3.510	0.1382
5.31	0.2092	3.132	0.1233
4.94	0.1943	2.753	0.1084
4.55	0.1793	2.372	0.0934
4.18	0.1644	1.994	0.0785
3.80	0.1495	1.803	0.0710
3.42	0.1345	1.613	0.0635
3.04	0.1196	1.461	0.0575
2.66	0.1046	1.311	0.0516
2.28	0.0897	1.158	0.0456
1.90	0.0747	1.006 or 1.016	0.0396
1.71	0.0673	0.930	0.0366
1.52	0.0598	0.853	0.0336
1.37	0.0538	0.777	0.0306
1.21	0.0478	0.701	0.0276
1.06	0.0418	0.627	0.0247
0.91	0.0359	0.551	0.0217
0.84	0.0329	0.513	0.0202
0.76	0.0299	0.475	0.0187
0.68	0.0269	--------	--------
0.61	0.0239	--------	--------
0.53	0.0209	--------	--------
0.45	0.0179	--------	--------
0.42	0.0164	--------	--------
0.38	0.0149	--------	--------

SUBSTITUTION TABLE FOR WIRE

METRIC THICKNESS SHOWN ON THE PLANS mm	WIRE THICKNESS TO BE SUBSTITUTED inch	GAGE NO.
6.20	0.244	3
5.72	0.225	4
5.26	0.207	5
4.88	0.192	6
4.50	0.177	7
4.11	0.162	8
3.76	0.148	9
3.43	0.135	10
3.05	0.120	11
2.69	0.106	12
2.34	0.092	13
2.03	0.080	14
1.83	0.072	15
1.57	0.062	16
1.37	0.054	17
1.22	0.048	18
1.04	0.041	19
0.89	0.035	20

SUBSTITUTION TABLE FOR PIPE PILES

METRIC SIZE SHOWN ON THE PLANS mm x mm	SIZE TO BE SUBSTITUTED inch x inch
PP 360 x 4.55	NPS 14 x 0.179
PP 360 x 6.35	NPS 14 x 0.250
PP 360 x 9.53	NPS 14 x 0.375
PP 360 x 11.12	NPS 14 x 0.438
PP 406 x 12.70	NPS 16 x 0.500
PP 460 x T	NPS 18 x T"
PP 508 x T	NPS 20 x T"
PP 559 x T	NPS 22 x T"
PP 610 x T	NPS 24 x T"
PP 660 x T	NPS 26 x T"
PP 711 x T	NPS 28 x T"
PP 762 x T	NPS 30 x T"
PP 813 x T	NPS 32 x T"
PP 864 x T	NPS 34 x T"
PP 914 x T	NPS 36 x T"
PP 965 x T	NPS 38 x T"
PP 1016 x T	NPS 40 x T"
PP 1067 x T	NPS 42 x T"
PP 1118 x T	NPS 44 x T"
PP 1219 x T	NPS 48 x T"
PP 1524 x T	NPS 60 x T"

The thickness in millimeters (T) represents an exact conversion of the thickness in inches (T").

SUBSTITUTION TABLE FOR STRUCTURAL TIMBER AND LUMBER

METRIC MINIMUM DRESSED DRY, SHOWN ON THE PLANS mm x mm	METRIC MINIMUM DRESSED GREEN, SHOWN ON THE PLANS mm x mm	NOMINAL SIZE TO BE SUBSTITUTED inch x inch
19x89	20x90	1x4
38x89	40x90	2x4
64x89	65x90	3x4
89x89	90x90	4x4
140x140	143x143	6x6
140x184	143x190	6x8
184x184	190x190	8x8
235x235	241x241	10x10
286x286	292x292	12x12

SUBSTITUTION TABLE FOR NAILS AND SPIKES

METRIC COMMON NAIL, SHOWN ON THE PLANS Length, mm Diameter, mm	METRIC BOX NAIL, SHOWN ON THE PLANS Length, mm Diameter, mm	METRIC SPIKE, SHOWN ON THE PLANS Length, mm Diameter, mm	SIZE TO BE SUBSTITUTED Penny-weight
50.80 2.87	50.80 2.51	_____	6d
63.50 3.33	63.50 2.87	_____	8d
76.20 3.76	76.20 3.25	76.20 4.88	10d
82.55 3.76	82.55 3.25	82.55 4.88	12d
88.90 4.11	88.90 3.43	88.90 5.26	16d
101.60 4.88	101.60 3.76	101.60 5.72	20d
114.30 5.26	114.30 3.76	114.30 6.20	30d
127.00 5.72	127.00 4.11	127.00 6.68	40d
_____	_____	139.70 7.19	50d
_____	_____	152.40 7.19	60d

SUBSTITUTION TABLE FOR IRRIGATION COMPONENTS

METRIC WATER METERS, TRUCK LOADING STANDPIPES, VALVES, BACKFLOW PREVENTERS, FLOW SENSORS, WYE STRAINERS, FILTER ASSEMBLY UNITS, PIPE SUPPLY LINES, AND PIPE IRRIGATION SUPPLY LINES SHOWN ON THE PLANS DIAMETER NOMINAL (DN) mm	NOMINAL SIZE TO BE SUBSTITUTED inch
15	1/2
20	3/4
25	1
32	1-1/4
40	1-1/2
50	2
65	2-1/2
75	3
100	4
150	6
200	8
250	10
300	12
350	14
400	16

Unless otherwise specified, substitutions of United States Standard Measures standard structural shapes corresponding to the metric designations shown on the plans and in conformance with the requirements in ASTM Designation: A 6/A 6M, Annex 2, will be allowed.

8-1.02 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 in 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 in 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

A. Apex, Model 921 (100 mm x 100 mm)
B. Ray-O-Lite, Models SS (100 mm x 100 mm), RS (100 mm x 100 mm) and AA (100 mm x 100 mm)

C. Stimsonite, Models 88 (100 mm x 100 mm), 911 (100 mm x 100 mm), 953 (70 mm x 114 mm)
D. 3M Series 290 (89 mm x 100 mm)

Retroreflective With Abrasion Resistant Surface (ARS)

A. Apex, Model 921AR (100 mm x 100 mm)
B. Ray-O-Lite "AA" ARS (100 mm x 100 mm)
C. Stimsonite, Models 911 (100 mm x 100 mm), 953 (70 mm x 114 mm)
D. 3M Series 290 (89 mm x 100 mm)

Retroreflective With Abrasion Resistant Surface (ARS)

(Used for recessed applications)
A. Stimsonite, Model 948 (58 mm x 119 mm)
B. Ray-O-Lite, Model 2002 (58 mm x 117 mm)
C. Stimsonite, Model 944SB (51 mm x 100 mm)*
D. Ray-O-Lite, Model 2004 ARS (51 mm x 100 mm)*
*For use only in 114 mm wide (older) recessed slots

Non-Reflective For Use With Epoxy Adhesive, 100 mm Round

A. Apex Universal (Ceramic)
B. Highway Ceramics, Inc. (Ceramic)

Non-Reflective For Use With Bitumen Adhesive, 100 mm Round

A. Alpine Products, "D-Dot" and "ANR" (ABS)
B. Apex Universal (Ceramic)
C. Apex Universal, Model 929 (ABS)
D. Elgin Molded Plastics, "Empco-Lite" Model 900 (ABS)
E. Highway Ceramics, Inc. (Ceramic)
F. Hi-Way Safety, Inc., Models P20-2000W and 2001Y (ABS)
G. Interstate Sales, "Diamond Back" (ABS) and (Polypropylene)
H. Novabrite Models Adot-w (White) Adot-y (Yellow), (ABS)
I. Road Creations, Model RCB4NR (Acrylic)
J. Zumar Industries, "Titan TM40A" (ABS)

PAVEMENT MARKERS, TEMPORARY TYPE

Temporary Markers For Long Term Day/Night Use (6 months or less)

A. Apex Universal, Model 924 (100 mm x 100 mm)
B. Elgin Molded Plastics, "Empco-Lite" Model 901 (100 mm x 100 mm)
C. Road Creations, Model R41C (100 mm x 100 mm)
D. Vega Molded Products "Temporary Road Marker" (75 mm x 100 mm)

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

(For seal coat or chip seal applications, clear protective covers are required)
A. Apex Universal, Model 932
B. Davidson Plastics, Models T.O.M., T.R.P.M., and "HH" (High Heat)
C. Hi-Way Safety, Inc., Model 1280/1281

STRIPING AND PAVEMENT MARKING MATERIAL

Permanent Traffic Striping and Pavement Marking Tape

A. Advanced Traffic Marking, Series 300 and 400
B. Brite-Line, Series 1000
C. Brite-Line "DeltaLine XRP"
D. Swarco Industries, "Director 35" (For transverse application only)
E. Swarco Industries, "Director 60"
F. 3M, "Stamark" Series 380 and 5730
G. 3M, "Stamark" Series 420 (For transverse application only)

Temporary (Removable) Striping and Pavement Marking Tape (6 months or less)

A. Advanced Traffic Marking, Series 200
B. Brite-Line, Series 100
C. P.B. Laminations, Aztec, Grade 102
D. Swarco Industries, "Director-2"
E. 3M, "Stamark," Series 620
F. 3M Series A145 Removable Black Line Mask
(Black Tape: For use only on Asphalt Concrete Surfaces)
G. Advanced Traffic Marking Black "Hide-A-Line"
(Black Tape: For use only on Asphalt Concrete Surfaces)
H. Brite-Line "BTR" Black Removable Tape
(Black Tape: For use only on Asphalt Concrete Surfaces)

Preformed Thermoplastic (Heated in place)

A. Flint Trading, "Premark" and "Premark 20/20 Flex"
B. Pavemark, "Hotape"

Removable Traffic Paint

A. Belpro, Series 250/252 and No. 93 Remover

Ceramic Surfacing Laminate, 150 mm x 150 mm

A. Safeline Industries/Highway Ceramics, Inc.

CLASS 1 DELINEATORS

One Piece Driveable Flexible Type, 1700 mm

A. Carsonite, Curve-Flex CFRM-400
B. Carsonite, Roadmarker CRM-375
C. Davidson Plastics, "Flexi-Guide Models 400 and 566"
D. FlexStake, Model 654 TM
E. GreenLine Models HWD1-66 and CGD1-66
F. J. Miller Industries, Model JMI-375 (with soil anchor)

Special Use Flexible Type, 1700 mm

A. Carsonite, "Survivor" (with 450 mm U-Channel base)
B. FlexStake, Model 604
C. GreenLine Models HWD and CGD (with 450 mm U-Channel base)
D. Safe-Hit with 200 mm pavement anchor (SH248-GP1)
E. Safe-Hit with 380 mm soil anchor (SH248-GP2) and with 450 mm soil anchor (SH248-GP3)

Surface Mount Flexible Type, 1200 mm

A. Bent Manufacturing Company, Masterflex Model MF-180EX-48
B. Carsonite, "Super Duck II"
C. FlexStake, Surface Mount, Models 704 and 754 TM

CHANNELIZERS

Surface Mount Type, 900 mm

A. Bent Manufacturing Company, Masterflex Models MF-360-36 (Round) and MF-180-36 (Flat)
B. Carsonite, "Super Duck" (Flat SDF-436, Round SDR-336)
C. Carsonite, "Super Duck II" Model SDCF203601MB "The Channelizer"
D. Davidson Plastics, Flex-Guide Models FG300LD and FG300UR
E. FlexStake, Surface Mount, Models 703 and 753 TM
F. GreenLine, Model SMD-36
G. Hi-Way Safety, Inc. "Channel Guide Channelizer" Model CGC36
H. The Line Connection, "Dura-Post" Model DP36-3 (Permanent)
I. The Line Connection, "Dura-Post" Model DP36-3C (Temporary)

J. Repo, Models 300 and 400
K. Safe-Hit, Guide Post, Model SH236SMA

CONICAL DELINEATORS, 1070 mm
(For 700 mm Traffic Cones, see Standard Specifications)
A. Bent Manufacturing Company "T-Top"
B. Plastic Safety Systems "Navigator-42"
C. Roadmaker Company "Stacker"
D. TrafFix Devices "Grabber"

OBJECT MARKERS
Type "K", 450 mm
A. Carsonite, Model SMD-615
B. FlexStake, Model 701 KM
C. Repo, Models 300 and 400
D. Safe-Hit, Model SH718SMA
E. The Line Connection, Model DP21-4K

Type "K-4" / "Q" Object Markers, 600 mm
A. Bent Manufacturing "Masterflex" Model MF-360-24
B. Carsonite, Super Duck II
C. FlexStake, Model 701KM
D. Repo, Models 300 and 400
E. Safe-Hit, Models SH8 24SMA_WA and SH8 24GP3_WA
F. The Line Connection, Model DP21-4Q

TEMPORARY RAILING (TYPE K) REFLECTORS AND CONCRETE BARRIER MARKERS
Impactable Type
A. ARTUK, "FB"
B. Davidson Plastics, Model PCBM-12
C. Duraflex Corp., "Flexx 2020" and "Electriflexx"
D. Hi-Way Safety, Inc., Model GMKRM100

Non-Impactable Type
A. ARTUK, JD Series
B. Stimsonite, Model 967 (with 83 mm Acrylic cube corner reflector)
C. Stimsonite, Model 967LS
D. Vega Molded Products, Models GBM and JD

THRIE BEAM BARRIER MARKERS
(For use to the left of traffic)
A. Duraflex Corp., "Railrider"
B. Davidson Plastics, "Mini" (75 mm x 254 mm)

CONCRETE BARRIER DELINEATORS, 400 mm
(For use to the right of traffic. When mounted on top of barrier, places top of reflective element at 1200 mm)
A. Davidson Plastics, Model PCBM T-16
B. Safe-Hit, Model SH216RBM
C. Sun-Lab Technology, "Safety Guide Light, Model TM," 130 mm x 130 mm x 80 mm

CONCRETE BARRIER-MOUNTED MINI-DRUM (260 mm x 360 mm x 570 mm)
A. Stinson Equipment Company "SaddleMarker"

SOUND WALL DELINEATOR
(Applied vertically. Place top of 75 mm x 300 mm reflective element at 1200 mm above roadway)
A. Davidson Plastics, PCBM S-36
B. Sun-Lab Technology, "Safety Guide Light, Model SM12," 130 mm x 130 mm x 80 mm

GUARD RAILING DELINEATOR
(Top of reflective element at 1200 mm above plane of roadway)

Wood Post Type, 686 mm

A. Carsonite, Model 427
B. Davidson Plastics FG 427 and FG 527
C. FlexStake, Model 102 GR
D. GreenLine GRD 27
E. J.Miller Model JMI-375G
F. Safe-Hit, Model SH227GRD

Steel Post Type

A. Carsonite, Model CFGR-327 with CFGRBK300 Mounting Bracket

RETROREFLECTIVE SHEETING

Channelizers, Barrier Markers, and Delineators

A. 3M, High Intensity
B. Reflexite, PC-1000 Metalized Polycarbonate
C. Reflexite, AC-1000 Acrylic
D. Reflexite, AP-1000 Metalized Polyester
E. Reflexite, AR-1000 Abrasion Resistant Coating
F. Avery Dennison T-6500 Series (Formerly Stimsonite, Series 6200) (For rigid substrate devices only)

Traffic Cones, 330 mm Sleeves

A. Reflexite SB (Polyester), Vinyl or "TR" (Semi-transparent)

Traffic Cones, 100 mm and 150 mm Sleeves

A. 3M Series 3840
B. Reflexite Vinyl, "TR" (Semi-transparent) or "Conformalite"

Barrels and Drums

A. Reflexite, "Super High Intensity" or "High Impact Drum Sheeting"
B. 3M Series 3810

Barricades: Type I, Engineer Grade

A. American Decal, Adcolite
B. Avery Dennison, T-1500 and T-1600
C. 3M, Scotchlite, Series CW

Barricades: Type II, Super Engineer Grade

A. Avery Dennison, T-2500 Series
B. Kiwalite Type II
C. Nikkalite 1800 Series

Signs: Type II, Super Engineer Grade

A. Avery Dennison, T-2500 Series
B. Kiwalite, Type II
C. Nikkalite 1800 Series

Signs: Type III, High-Intensity Grade

A. 3M Series 3800
B. Nippon Carbide, Nikkalite Brand Ultralite Grade II

Signs: Type IV, High-Intensity Prismatic Grade

A. Avery Dennison T-6500 (Formerly Stimsonite Series 6200)

Signs: Type VII, High-Intensity Prismatic Grade

A. 3M Series 3900

Signs: Type VI, Roll-Up Signs

A. Reflexite, Vinyl (Orange)
B. Reflexite "SuperBright" (Fluorescent orange)
C. Reflexite "Marathon" (Fluorescent orange)
D. 3M Series RS34 (Orange) and RS20 (Fluorescent orange)

SPECIALTY SIGN (All Plastic)

A. All Sign Products, STOP Sign, 750 mm

SIGN SUBSTRATE FOR CONSTRUCTION AREA SIGNS

Aluminum

Fiberglass Reinforced Plastic (FRP)

A. Sequentia, "Polyplate"
B. Fiber-Brite

8-1.03 STATE-FURNISHED MATERIALS

Attention is directed to Section 6-1.02, "State-Furnished Materials," of the Standard Specifications and these special provisions.

The following materials will be furnished to the Contractor:

A. Sign panels for roadside signs and overhead sign structures.
B. Hardware for mounting sign panels as follows:

    1. Blind rivets for mounting overlapping legend at sign panel joints.
    2. Closure inserts.
    3. Aluminum bolts, nuts, and washers for mounting overhead formed panels.

C. Loop detector unit sensors.
D. Model 170 controller assemblies including controller unit, completely wired controller cabinet, and inductive loop detector sensor units where applicable.
E. Multi-Service Access Router (CISCO 3640)
F. Ethernet Switch Hub (CISCO WS-3548-XL)
G. CDPD Frame-Relay Router (CISCO 2620)
H. Multi-Port Traffic Controller Translator (MTCT) (AIRLINK MTCT)
I. Metropolitan Transportation Commission (MTC) standard call boxes.
J. Communication Harness I.
K. Force balance accelerometer (FBA) pigtails
L. Seismic sensor mounting plates
M. “Bishops Hat” Downhole Specially formed sealed cap

Controller cabinets, with auxiliary equipment but without controller unit, and MTC standard call boxes will be furnished to the Contractor at the Caltrans Maintenance Station, 30 Rickard Street, San Francisco, CA 94134.

8-1.04 MISCELLANEOUS METAL

The table in the tenth paragraph of Section 75-1.02, "Miscellaneous Iron and Steel," of the Standard Specifications is amended to read:

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 except Grade 1017)
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: 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 [450-240], Class 1
Malleable iron castings	ASTM Designation: A 47, Grade 32510 or A 47M, Grade 22010
Gray iron castings	ASTM Designation: A 48, Class 30B
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.

The table in the eighteenth paragraph of Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications is amended to read:

Stud Diameter (millimeters)	Sustained Tension Test Load (kilonewtons)
29.01-33.00	137.9
23.01-29.00	79.6
21.01-23.00	64.1
* 18.01-21.00	22.2
15.01-18.00	18.2
12.01-15.00	14.2
9.01-12.00	9.34
6.00-9.00	4.23

* Maximum stud diameter permitted for mechanical expansion anchors.

The table in the nineteenth paragraph of Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications is amended to read:

Stud Diameter (millimeters)	Ultimate Tensile Load (kilonewtons)
30.01-33.00	112.1
27.01-30.00	88.1
23.01-27.00	71.2
20.01-23.00	51.6
16.01-20.00	32.0
14.01-16.00	29.4
12.00-14.00	18.7

The table in the twenty-second paragraph of Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications is amended to read:

Installation Torque Values, (newton meters)

Stud Diameter (millimeters)	Shell Type Mechanical Expansion Anchors	Integral Stud Type Mechanical Expansion Anchors	Resin Capsule Anchors and Cast-in-Place Inserts
29.01-33.00	—	—	540
23.01-29.00	—	—	315
21.01-23.00	—	—	235
18.01-21.00	110	235	200
15.01-18.00	45	120	100
12.01-15.00	30	65	40
9.01-12.00	15	35	24
6.00-9.00	5	10	—

8-1.05 ENGINEERING FABRICS

Engineering fabrics shall conform to the provisions in Section 88, "Engineering Fabrics," of the Standard Specifications and these special provisions.

Filter fabric for this project shall be ultraviolet (UV) ray protected.

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.

References to Section 90-2.01, "Portland Cement," of the Standard Specifications shall mean Section 90-2.01, "Cement," of the Standard Specifications.

Mineral admixture shall be combined with cement in conformance with the provisions in Section 90-4.08, "Required Use of Mineral Admixtures," of the Standard Specifications for the concrete materials specified in Section 56-2, "Roadside Signs," of the Standard Specifications.

The requirements of Section 90-4.08, "Required Use of Mineral Admixture," of the Standard Specifications shall not apply to Section 19-3.025C, "Soil Cement Bedding," of the Standard Specifications.

The Department maintains a list of sources of fine and coarse aggregate that have been approved for use with a reduced amount of mineral admixture in the total amount of cementitious material to be used. A source of aggregate will be considered for addition to the approved list if the producer of the aggregate submits to the Transportation Laboratory certified test results from a qualified testing laboratory that verify the aggregate complies with the requirements. Prior to starting the testing, the aggregate test shall be registered with the Department. A registration number can be obtained by calling (916) 227-7228. The registration number shall be used as the identification for the aggregate sample in correspondence with the Department. Upon request, a split of the tested sample shall be provided to the Department. Approval of aggregate will depend upon compliance with the specifications, based on the certified test results submitted, together with any replicate testing the Department may elect to perform. Approval will expire 3 years from the date the most recent registered and evaluated sample was collected from the aggregate source.

Qualified testing laboratories shall conform to the following requirements:

A. Laboratories performing ASTM Designation: C 1293 shall participate in the Cement and Concrete Reference Laboratory (CCRL) Concrete Proficiency Sample Program and shall have received a score of 3 or better on all tests of the previous 2 sets of concrete samples.
B. Laboratories performing ASTM Designation: C 1260 shall participate in the Cement and Concrete Reference Laboratory (CCRL) Pozzolan Proficiency Sample Program and shall have received a score of 3 or better on the shrinkage and soundness tests of the previous 2 sets of pozzolan samples.

Aggregates on the list shall conform to one of the following requirements:

A. When the aggregate is tested in conformance with the requirements in California Test 554 and ASTM Designation: C 1293, the average expansion at one year shall be less than or equal to 0.040 percent; or
B. When the aggregate is tested in conformance with the requirements in California Test 554 and ASTM Designation: C 1260, the average of the expansion at 16 days shall be less than or equal to 0.15 percent.

The amounts of cement and mineral admixture used in cementitious material shall be sufficient to satisfy the minimum cementitious material content requirements specified in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," of the Standard Specifications and shall conform to the following:

A. The minimum amount of cement shall not be less than 75 percent by mass of the specified minimum cementitious material content.
B. The minimum amount of mineral admixture to be combined with cement shall be determined using one of the following criteria:

    1. When the calcium oxide content of a mineral admixture is equal to or less than 2 percent by mass, the amount of mineral admixture shall not be less than 15 percent by mass of the total amount of cementitious material to be used in the mix.
    2. When the calcium oxide content of a mineral admixture is greater than 2 percent by mass, and any of the aggregates used are not listed on the approved list as specified in these special provisions, then the amount of mineral admixture shall not be less than 25 percent by mass of the total amount of cementitious material to be used in the mix.
    3. When the calcium oxide content of a mineral admixture is greater than 2 percent by mass and the fine and coarse aggregates are listed on the approved list as specified in these special provisions, then the amount of mineral admixture shall not be less than 15 percent by mass of the total amount of cementitious material to be used in the mix.

4. When a mineral admixture that conforms to the provisions for silica fume in Section 90-2.04, "Admixture Materials," of the Standard Specifications is used, the amount of mineral admixture shall not be less than 10 percent by mass of the total amount of cementitious material to be used in the mix.
5. When a mineral admixture that conforms to the provisions for silica fume in Section 90-2.04, "Admixture Materials," of the Standard Specifications is used and the fine and coarse aggregates are listed on the approved list as specified in these special provisions, then the amount of mineral admixture shall not be less than 7 percent by mass of the total amount of cementitious material to be used in the mix.

C. The total amount of mineral admixture shall not exceed 35 percent by mass of the total amount of cementitious material to be used in the mix. Where Section 90-1.01, "Description," of the Standard Specifications specifies a maximum cementitious content in kilograms per cubic meter, the total mass of cement and mineral admixture per cubic meter shall not exceed the specified maximum cementitious material content.

Unless otherwise specified, mineral admixture will not be required in portland cement concrete used for precast concrete girders.

The Contractor will be permitted to use Type III portland cement for concrete used in the manufacture of precast concrete members.

8-2.02 CEMENT AND WATER CONTENT

Unless otherwise indicated in this special provisions, the amount of free water used in concrete for deck slabs of bridges and structure approach slabs shall not exceed 195 kg/m^3, plus 20 kg for each required 100 kg of cementitious material in excess of 400 kg/m^3.

The amount of free water used in concrete for deck slabs of bridges and structure approach slabs at the following bridges: NB 680/WB 780 Connector &OH, Bridge No. 23-0212G, NB 680/WB 780 Connector, Bridge No 23-0214G, and Benicia-Martinez Approach Structure, Bridge No. 23-0215R, shall not exceed 180 kg/m^3, plus 20 kg for each required 100 kg of cementitious material in excess of 400 kg/m^3.

The temperature of mixed concrete for deck slabs of bridges, immediately before placing, shall be not less than 10°C nor more than 27°C. 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 65°C. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.

SECTION 8-3. WELDING

8-3.01 WELDING

GENERAL

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

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	2000
D1.4	1998
D1.5	1995
D1.5 (metric only)	1996
D1.6	1998

Requirements of the AWS welding codes shall apply unless specified otherwise 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 ANSI/AASHTO/AWS.

Sections 6.1.2 through 6.1.4.3 of AWS D 1.1, Sections 7.1.1 and 7.1.2 of AWS D 1.4, and Sections 6.1.1.1 through 6.1.3.3 of AWS D 1.5 are replaced with the following:

Quality Control (QC) shall be the responsibility of the Contractor. As a minimum, the Contractor shall perform inspection and testing prior to welding, during welding, and after welding as specified in this section and additionally as necessary to ensure that materials and workmanship conform to the requirements of the contract documents.

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.

Each QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship, and shall be currently certified as an AWS Certified Welding Inspector (CWI) in conformance with the requirements in AWS QC1, "Standard and Guide for Qualification 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 and Guide for Qualification of Welding Inspectors," or has equivalent qualifications. The QC Inspector shall monitor the Assistant QC Inspector's work, and shall be responsible for signing all reports.

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

Section 6.14.6, "Personnel Qualification," of AWS D 1.1, Section 7.7.6, "Personnel Qualification," of AWS D 1.4, and Section 6.1.3.4, "Personnel Qualification," of AWS D 1.5 are replaced with the following:

Personnel performing nondestructive testing (NDT) shall be qualified 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 requirements of the ASNT Recommended Practice No. SNT-TC-1A. Only individuals who are 1) qualified for NDT Level II, or 2) Level III technicians who have been directly certified by the ASNT and are authorized to perform the work of Level II technicians, shall perform NDT, review the results, and prepare the written reports.

Section 6.5.4, "Scope of Examination," of AWS D 1.1 and Section 7.5.4 of AWS D 1.4 are replaced with the following:

The QC Inspector shall inspect and approve the joint preparation, assembly practice, welding techniques, and 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.

Section 6.5.4 of AWS D 1.5 is replaced with the following:

The QC Inspector shall inspect and approve the joint preparation, assembly practice, welding techniques, and performance of each welder, welding operator, and tack welder to make certain that the applicable requirements of this code and the approved WPS are met. The QC Inspector shall examine the work to make certain that it meets the requirements of Sections 3 and 9.21. The size and contour of welds shall be measured using suitable gages. Visual inspection for cracks in welds and base metal, and for other discontinuities should 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.

Section 6.6.5, "Nonspecified Nondestructive Testing Other Than Visual," of AWS D 1.1, Section 6.6.5 of AWS D 1.4 and Section 6.6.5 of AWS D 1.5 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 welding codes, in the Standard Specifications, or in these special provisions. Additional NDT required by the Engineer, will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications. Should any welding deficiencies be discovered by this additional NDT, the cost of the testing will not be paid for as extra work but shall be at the Contractor's expense.

Required repair work to correct welding deficiencies, whether discovered by the required visual inspection or NDT, or by additional NDT directed by the Engineer, and any associated delays or expenses caused to the Contractor by performing these repairs, shall be at the Contractor's expense.

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.

A sufficient number of QC Inspectors shall be provided to ensure continuous inspection when any welding is being performed. Continuous inspection, as a minimum, shall include (1) having QC Inspectors continually present when any welding operation is being performed, or (2) having a QC Inspector within such close proximity of all welding operations that inspections by the QC Inspector of each operation, at each welding location, shall not lapse for a period exceeding 30 minutes.

Inspection and approval of the joint preparation, assembly practice, welding techniques, and performance of each welder, welding operator, and tack welder shall be documented by the QC Inspector on a daily basis for each day that welding is performed.

When joint details that are not prequalified by the applicable AWS codes are proposed for use in the work, welders using these details shall perform a qualification test plate using the approved WPS variables and the joint detail to be used in production. The test plate shall be the maximum thickness to be used in production. The test plate shall be mechanically or radiographically tested as directed by the Engineer. Mechanical and radiographic testing and acceptance criteria shall be as specified in the applicable AWS codes.

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. 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 work remains satisfactory.

WELDING QUALITY CONTROL

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

Unless otherwise specified, welding quality control shall apply when any work is welded in conformance with the provisions in Section 49, "Piling," Section 52, "Reinforcement," Section 55, "Steel Structures," Section 56-1, "Overhead Sign Structures," Section 75-1.035, "Bridge Joint Restrainer Units," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

The welding of fracture critical members (FCMs) shall conform to the provisions specified in the Fracture Control Plan (FCP) and herein.

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, 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 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.

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 welding is performed at a permanent fabrication facility which is certified under the AISC Quality Certification Program, Category Cbr, Major Steel Bridges.
B. The welding is performed at a permanent fabrication facility which is certified under the AISC Quality Certification Program, Category Sbd, Conventional Steel Building Structures. This condition shall apply only 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.

For welding performed at such certified facilities, the inspection personnel or NDT firms may be employed or compensated by the fabrication facility performing the welding.

Prior to submitting the Welding Quality Control Plan (WQCP) required herein, a pre-welding meeting between the Engineer, Contractor, and any entity performing welding for this project, shall be held to discuss the requirements for the WQCP.

Except for work that is welded in conformance with Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, prior to performing any welding, 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 WQCP for each item of work for which welding is to be performed.

Prior to furnishing materials welded in conformance with Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, 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 WQCP for each fabrication facility supplying these materials or proof of previous Engineer approval of a WQCP for such a facility no more than one year prior to the delivery of materials for inspection.

As a minimum, each WQCP shall include the following:

A. The name of the welding firm and any required NDT firms;
B. A manual prepared by the NDT firm that shall include equipment, testing procedures, code of safe practices, the Written Practice of the NDT firm, 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 Inspectors and Assistant QC Inspectors 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 QC inspection forms to be used, as required by the specifications including:

    1. all visual inspections;
    2. all NDT including radiographic geometry, penetrameter and shim selection, film quality, film processing, radiograph identification and marking system, and film interpretation and reports; and
    3. calibration procedures and calibration frequency for all NDT equipment;

F. A system for the identification and tracking of all welds, NDT, and any required repairs, and a procedure for the reinspection of repaired welds. The system shall have provisions for 1) permanently identifying each weld and the person who performed the weld, 2) placing all identification and tracking information on each radiograph, 3) a method of reporting nonconforming welds to the Engineer, and 4) a method of documentation of repairs and reinspection of nonconforming welds;
G. Standard procedures for performing noncritical repair welds. Noncritical repair welds are–defined as welds to deposit additional weld beads or layers to compensate for insufficient weld size and to fill limited excavations that were performed to remove unacceptable edge or surface discontinuities, rollover or undercut. The depth of these excavations shall not exceed 65 percent of the specified weld size;
H. The WPS, including documentation of all supporting Procedure Qualification Record (PQR) tests performed, and the name of the testing laboratory who performed the tests, to verify the acceptability of the WPS. The submitted WPS shall be within the allowable period of effectiveness;
I. Documentation of all certifications for welders for each weld process and position that will be used. Certifications shall list the electrodes used, test position, base metal and thickness, tests performed, and the witnessing authority. All certifications shall be within the allowable period of effectiveness;
J. One copy each of all AWS welding codes and the FCP which are applicable to the welding to be performed. These codes and the FCP shall become the permanent property of the Department; and
K. Forms to be used for Certificates of Compliance, daily production logs, and daily reports.

The Engineer shall have 10 working days to review the WQCP submittal after a complete plan has been received. Except for work that is welded in conformance with Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, no welding shall be performed until the WQCP is approved in writing by the Engineer. No materials welded in conformance with Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, shall be incorporated into the work until the WQCP is approved in writing 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 WQCP, 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.

An amended WQCP or addendum 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 or procedures, QC, or NDT personnel, or updated systems for tracking and identifying welds. The Engineer shall have 3 working days to complete the review of the amended WQCP or addendum. Work that is affected by any of the proposed revisions shall not be performed until the amended WQCP or addendum has been approved. 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 amended WQCP or addendum, 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.

After final approval of the WQCP, amended WQCP, 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 WQCP 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 Engineer's approval shall not constitute a waiver of any requirement 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 WQCP.

A daily production log for welding shall be kept by the QCM for each day that welding is performed. The log shall clearly indicate the locations of all welding, except partial penetration longitudinal seam welds performed in conformance with Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications. 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 7 days following the performance of any welding. For work welded in conformance with Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, the following items shall be included in a Welding Report that is to be submitted to the Engineer 48 hours prior to the Contractor furnishing a Certificate of Compliance for the material:

A. Reports of all visual weld inspections and NDT;
B. Radiographs and radiographic reports, and other required NDT reports;
C. Documentation that the Contractor has evaluated all radiographs and other nondestructive tests and corrected all rejectable deficiencies, and all repaired welds have been reexamined by the required NDT and found acceptable; and
D. Daily production log.

Radiographic envelopes shall have clearly written on the outside of the envelope the following information: 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 or a report number, as detailed in the WQCP. In addition, all innerleaves shall have clearly written on them the part description and all included weld numbers, as detailed in the WQCP.

Reports regarding NDT, including radiographs, shall be signed by both the NDT technician and the person that performed the review, and then submitted directly 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.

The Engineer will review the Welding Report to determine if the Contractor is in conformance with the WQCP. Unless otherwise specified, the Engineer shall be allowed 7 working days to review the report and respond in writing after a 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 a 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. Should the Contractor elect to wait to encase or cover welds pending notification by the Engineer, and should the Engineer fail to complete the review and provide notification 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 notification, 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 QC Inspector shall provide reports to the QCM on a daily basis for each day that welding is performed.

Except for noncritical weld repairs, 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. The Engineer shall have 5 working days to review these procedures. No remedial work shall begin until the repair procedures are approved in writing 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 proposed repair procedures, 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 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 and the provisions of the Standard Specifications and these special provisions.

PAYMENT

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.

SECTION 9. DESCRIPTION OF BRIDGE WORK

The bridge work consists, in general, of widening existing bridge, constructing five new bridges and six retaining walls at the following locations:

WEST ARSENAL UC (WIDENING)
(Bridge No. 23- 0127L)

PARK ROAD UNDERCROSSING
(Bridge No. 23-0226R)

EB 780 / NB 680 CONNECTOR
(Bridge No. 23-0211G)

NB 680 / WB 780 CONNECTOR & OH
(Bridge No. 23-0212G)

NB 680 / WB 780 CONNECTOR
(Bridge No. 23-0214G)

BENICIA – MARTINEZ APPROACH STRUCTURE
(Bridge No. 23-0215R)

MSE RETAINING WALL NO. 1
(Bridge No. 23-0224)

RETAINING WALL NO. 2

RETAINING WALL NO. 3

MSE RETAINING WALL NO. 4
(Bridge No. 23-0225)

RETAINING WALL NO. 5

RETAINING WALL NB 20

SECTION 10. CONSTRUCTION DETAILS
SECTION 10-1. GENERAL

10-1.00 CONSTRUCTION PROJECT INFORMATION SIGNS

Before any major physical construction work readily visible to highway users is started on this contract, the Contractor shall furnish and erect 3 Type 2 Construction Project Information signs at the locations designated by the Engineer.

The signs and overlays shall be of a type and material consistent with the estimated time of completion of the project and shall conform to the details shown on the plans.

The sign letters, border and the Department's construction logos shall conform to the colors (non-reflective) and details shown on the plans, and shall be on a white background (non-reflective). The colors blue and orange shall conform to PR Color Number 3 and Number 6, respectively, as specified in the Federal Highway Administration's Color Tolerance Chart.

The sign message to be used for fund types shall consist of the following, in the order shown:

NEW BENICIA-MARTINEZ BRIDGE FUNDED BY: BAY AREA TOLL AUTHORITY REGIONAL MEASURE 1 TOLL FUNDS

The sign message to be used for type of work shall consist of the following:

HIGHWAY CONSTRUCTION

The sign message to be used for the Year of Completion of Project Construction will be furnished by the Engineer. The Contractor shall furnish and install the "Year" sign overlay within 10 working days of notification of the year date to be used.

The letter sizes to be used shall be as shown on the plans. The information shown on the signs shall be limited to that shown on the plans.

The signs shall be kept clean and in good repair by the Contractor.

Upon completion of the work, the signs shall be removed and disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

Full compensation for furnishing, erecting, maintaining, and removing and disposing of the construction project information signs shall be considered as included in the contract lump sum price paid for construction area signs and no additional compensation will be allowed therefor.

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.

Temporary railing (Type K) and temporary crash cushions shall be secured in place prior to commencing work for which the temporary railing and crash cushions are required.

Constructing frames 1 and 2 at EB 780 / 680 Connector, bridge number 23-0211G, shall be first order of work.

Bent 20 at NB 680/WB 780 Connector & OH, Bridge No. 23-0212G, and Bent 20 at Benicia-Martinez Approach Structure, Bridge No. 23-0215R, shall be constructed completely before constructing Benicia-Martinez RW NB20.

Last order of work shall be constructing the superstructure at NB 680/WB 780 Connector & OH, Bridge No. 23-0212G, and the superstructure of frame 2 at Benicia-Martinez Approach Structure, Bridge No. 23-0215R,

Attention is directed to “Move in/Move-out (Temporary Erosion Control)” and “Move-in/move-out (Erosion Control)” elsewhere in these special provisions regarding the mobilization of equipment and materials for erosion control work.

The first order of work shall be to place the order for the electrical equipment. The Engineer shall be furnished a statement from the vendor that the order for the electrical systems has been received and accepted by the vendor.

For the seismic monitoring electrical system, the first order of electrical work shall include installation of seismic steel pipes in caissons at Bent 19 (NB Line), concrete embedment of conduits in bents, pile caps, and through any other concrete structures, and any additional contract work as recommended and approved by the Engineer. Placement of seismic steel pipes and embedment of conduits shall be coordinated with the Engineer and California Division of Mines and Geology (CDMG) personnel.

For the seismic monitoring electrical system, the second order of electrical work shall include installation of the remainder of the contract items, installation of seismic equipment by CDMG personnel, testing of the seismic monitoring, and any additional work required for the complete installation of the seismic monitoring system as shown on the plans and specified herein.

The uppermost layer of new pavement shall not be placed until all underlying conduits and loop detectors have been installed.

No overhead sign panel shall be installed until the overhead sign lighting is completely operational.

No above ground electrical work shall be performed on any system within the project site until all Contractor-furnished electrical materials for that individual system have been tested and delivered to Contractor.

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

Attention is directed to "Progress Schedule (Critical Path)" of these special provisions regarding the submittal of an interim baseline project schedule within 15 days after approval of the contract.

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 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 pavement delineation shall be considered as included in the contract prices paid for new pavement delineation and no additional compensation will be allowed therefor.

At those locations exposed to public traffic where 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 railing or barrier posts installed without the blocks and rail elements assembled and mounted thereon.

10-1.02 ENVIRONMENTALLY SENSITIVE AREA (GENERAL)

The Contractors attention is directed to the designated Environmentally Sensitive Area (ESA), shown on the plans. The exact location of the boundaries of environmentally sensitive area shall be established by the Engineer and clearly delineated by the placement of Temporary fence (Type ESA) as described in these special provisions.

Within the boundaries of an ESA, no project related activities shall take place. This specifically prohibits vehicle access, storage or transport of any materials, including hydrocarbon and lead contaminated material, or any other project related activities.

10-1.03 NON-STORM WATER DISCHARGES

Non-storm water discharges shall conform to the requirements in Section 7-1.01G, “Water Pollution” of the Standard Specifications and these special provisions

Conformance with the requirements of this section shall in no way relieve the Contractor from the Contractor's responsibilities, as provided in Section 7-1.11, "Preservation of Property," and Section 7-1.12, "Responsibility for Damage," of the Standard Specifications.

STOCKPILE DEWATERING

The Contractor shall prevent the flow of water, including groundwater, surface runoff and tidal flow from entering any temporary stockpiles on land.

The Contractor shall depict and describe within the Storm Water Pollution Prevention Plan (SWPPP), as specified in “Water Pollution Control” of these special provisions, the methods and measures that will be used to dewater the temporary stockpiles when free liquids are present, to seal the sides and bottom of the temporary stockpiles, and to prevent the flow of water into the stockpiles. Operations producing water will not be permitted until the Engineer has approved the plan.

All water removal from temporary stockpiles shall be handled in accordance with National Pollutant Discharge Elimination System (NPDES) Permits CAS000002 and CAS000003, issued by the State Water Resources Control Board. Copies of the permit and its amendments will be available for inspection and purchase at the Department of Transportation, Toll Bridge Duty Senior’s Desk, 111 Grand Avenue, Oakland, California. Please call the Toll Bridge Duty Senior, telephone number (510) 286-5549 to reserve a copy of the document at least 24 hours in advance.

The Contractor is responsible for all work, records, reports, and costs involved in handling the water in accordance with the NPDES permit. The Contractor shall supply all analytical data, dewatering volume records, and written requests for discharge to the Engineer for approval prior to discharging any water. The Engineer shall have up to 7 calendar days for review and approval of discharge. Water that does not meet discharge permit requirements shall not be discharged on the site, to the storm drainage, or to the sanitary sewer systems. The Contractor is responsible for either treating the water to meet the permit requirements for discharge or hauling the water off site to an appropriately licensed liquid disposal facility. Penalties assessed against the State for permit non-compliance by the Contractor will be borne by the Contractor. Such penalties will be deducted from the monthly progress payment.

LAND-BASED EXCAVATION DEWATERING

This work shall consist of dewatering and discharging water from land-based excavations including, but not limited to, footing excavations, and excavations for retaining walls, storm drainage systems, sanitary sewer systems and their appurtenances. The Contractor shall test groundwater prior to discharge for conformance with NPDES permits CAS000002 and CAS000003 and these special provisions. At the Contractor’s option, test samples to confirm contaminant concentrations may be collected from the groundwater in the excavation or from closed-top watertight, transportable holding tanks furnished by the Contractor. The holding tanks shall have sufficient capacity to prevent delay of other work. Groundwater that has contaminant concentrations above the allowable concentrations specified in these special provisions shall be treated prior to discharge. Surface runoff shall not be permitted to enter the excavation. Groundwater contaminated by the Contractor’s operations, such as use of slurry cement backfill to construct cast-in-drilled-hole piles, shall be treated to meet the permit requirements for discharge or hauled off site to an appropriately licensed liquid disposal facility. A meter that has been approved by the Engineer shall be used to measure all excavation discharges.

The Contractor shall submit to the Engineer, as provided in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, a plan which details the methods and measures that will be used to seal the sides and bottom of excavations, prevent the flow of water into excavations, and remove known or introduced groundwater contaminants. The plan shall, at a minimum, contain a graphic for the dewatering operation showing both a sectional and plan view that details the removal techniques for suspended solids and known or introduced groundwater contaminants. The graphic shall define the flow path and placement of pipes, hoses, pumps, and other equipment used to convey the discharge. In addition, the Contractor shall provide a drawing that depicts the general position of the dewatering measures relative to the excavations undergoing dewatering and the point of effluent discharge. The written descriptions of the dewatering operation shall include, but are not limited to, an estimate of the discharge volume, flow rate, and frequency; location of discharge; performance capabilities of treatment measures; and the inspection and monitoring procedures related to the discharge.

The plan shall be submitted, at least, 3 weeks prior to beginning excavation operations. The Contractor shall allow 10 days for the Engineer to review and approve the plan. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the plan within 5 days of receipt of the Engineer's comments and shall allow 5 days for the Engineer to review the revisions. Excavation operations shall not be allowed until the Engineer has approved the plan.

Suspended solids shall be removed during the dewatering operation of any excavation, as specified in these special provisions.

Suspended solids shall be removed to the extent that visible, floating products are not apparent within the discharge. In addition, the discharge shall be of purity such that turbidity and color beyond present natural background levels are not apparent within the receiving water body. The turbidity, measured in Nephelometric Turbidity Units (NTU), of the discharge shall not be greater than a 10 percent increase of the background turbidity of the receiving water body. The point of effluent discharge shall not cause bottom sediments, aquatic vegetation, or surface soils to become dislodged or disturbed.

Petroleum hydrocarbons shall be removed during the dewatering operation in conformance with these special provisions.

The discharge into the receiving water body shall not contain total petroleum hydrocarbons beyond a maximum allowable concentration of 50 μg/L nor polynuclear aromatic hydrocarbons at concentrations above the standard method detection limit for each constituent Samples obtained from the discharge shall be analyzed in accordance with EPA methods 8015M. The detection limits for the analyses shall be equal to or less than the allowable discharge concentration.

The Contractor shall conduct a daily inspection of the dewatering equipment, when in use, and ensure that all components are functional and routinely maintained to prevent leakage prior to removal of suspended solids and petroleum hydrocarbons. Should any component of the dewatering equipment be damaged or affect the performance of the equipment, the dewatering operation shall be discontinued and the component shall be repaired or replaced with substitute equipment.

The Contractor shall monitor both the discharge and the receiving water body. The observations made during monitoring shall include the color, size of affected area, presence of suspended material, presence of water fowl or aquatic wildlife, wind direction and velocity, atmospheric condition, time, date, a turbidity measurement in NTU, and pH. The Contractor shall supplement the observations with photographs. The Contractor shall conduct monitoring, at a minimum of one hour prior to discharge, during the first 10 minutes of initiating discharge, and upon cessation of the discharge. The observations shall be recorded on the inspection forms to be provided by the Engineer. Completed inspection forms, including photographs, shall be provided to the Engineer, on a weekly basis or as directed by the Engineer.

Observations that indicate that the discharge is of a visible purity such that turbidity and apparent color are beyond the present natural background shall be immediately reported to the Engineer. The discharge activity shall cease so that corrective actions are undertaken to repair, modify or replace the equipment. The commencement of discharge activities shall be upon approval by the Engineer.

All water removed from excavations and dewatering operations in conformance with this section shall be handled as provided in 'Effluent Treatment Systems' elsewhere in this specification and in accordance with the discharge permit for contaminated groundwater issued by the San Francisco Bay Regional Water Board. Copies of the permit are available for inspection and purchase at the Department of Transportation, Toll Bridge Duty Senior's Desk, 111 Grand Avenue, Oakland, California, telephone (510) 286-5549. Penalties assessed against the State for permit non-compliance by the Contractor shall be borne by the Contractor. The Department will deduct those penalty amounts from any moneys due, or that may become due, the Contractor under the contract.

EFFLUENT TREATMENT SYSTEMS

Effluent treatment systems shall be provided to treat groundwater discharged from excavations or dewatering operations as shown on the plans and in accordance with these special provisions. Effluent shall be considered as the water and any other material discharged from the pumping operations.

The Contractor shall use the effluent treatment systems to treat groundwater from excavations prior to discharging into the approved dedicated discharge site. Protection shall be provided at the outlet of treated effluent into the receiving water body to ensure that bottom sediments, aquatic vegetation, or surface soils do not become dislodged or disturbed.

Materials shall conform to the provisions in Section 6, "Control of Materials," Section 7-1.16, "Contractor's Responsibility for the Work and Materials," and Section 74-2, "Drainage Pump Equipment" of the Standard Specifications and these special provisions.

Holding tanks shall be transportable, totally enclosed, with a minimum holding capacity sufficient to prevent delay of other work and capable of connecting multiple tanks in series. Holding tanks shall have an inlet and outlet capable of receiving and discharging minimum flows, at a rate of 318 L/min. Holding tanks shall be able to accommodate temporary installation of submersible pumps capable of discharging water at a rate of 318 L/min. All tanks shall be of the same make and manufacturer and shall remain on the jobsite until dewatering operations are no longer necessary as determined by the Engineer.

A granulated activated carbon (GAC) system shall be used to treat groundwater contaminated with petroleum hydrocarbons, including diesel, oil, and polynuclear aromatic hydrocarbons. The GAC treatment system shall consist of at least two vessels having an inlet and outlet capable of receiving and discharging water at a flow rate of 318 L/min. The GAC treatment system shall be capable of treating total petroleum hydrocarbons at an inflow concentration of 2 mg/L, such that the effluent concentration for total petroleum hydrocarbons is less than or equal to an allowable concentration of 50 μg/L for and polynuclear aromatic hydrocarbons are not detected above the standard method detection limit for each constituent. GAC treatment vessels shall be readily capable of removal and replacement or interchange when required. The GAC treatment system shall have appropriate fittings for pipe connections designed to accommodate the flow rate. Throughout the operation, the Contractor shall have one additional GAC vessel available for transport and use at the site within one hour after being directed by the Engineer.

Sampling ports shall be spigots attached to the piping system and capable of obtaining a representative sample of water at each location of the GAC treatment system shown on the plans. The GAC treatment system shall be capable of sustaining temporary fluctuations in water pressure due to monitoring activities.

Pumps shall be capable of being submerged in water and discharging water and other materials including, but not limited to small rocks, gravel, sand and sediments. Two submersible pumps will be required for this project and shall be capable, at all times, of discharging at a flow rate of 318 L/min. In addition, a third submersible pump shall be provided by the Contractor that is capable of discharging treated effluent from the temporary holding container to the dedicated discharge location.

Plastic piping may be approved for use as determined by the Engineer in writing. If plastic piping is used, it shall conform to the provisions in section 20-5.03E, "Pipe" of the Standard Specifications. The Contractor shall be responsible for providing all piping required to circulate the effluent through the treatment system and all piping required to convey the treated effluent from the temporary holding container to the point of release at the dedicated discharge location.

A temporary holding container shall be provided with a minimum holding capacity of 1892 L. The holding container shall have an inlet and outlet capable of receiving and discharging minimum flows of 318 L/min. The holding container shall be open to the air and sealed on all sides and the bottom to prevent any leakage.

MONITORING

Monitoring shall occur daily for the first 7 days of operating GAC treatment system, and then be reduced to a frequency of once every 7 days thereafter. Upon relocation replacement, interchange, or maintenance of the GAC vessels the Contractor shall conduct daily monitoring for the first 7 days of resuming treatment operation, and then reduce the monitoring frequency to once every 7 days thereafter. The Contractor shall collect water samples from each sampling port of the GAC treatment system as depicted in the plans. Four samples shall be obtained from each sampling port during each monitoring event. The first of the 4 samples shall be analyzed for total suspended solids (TSS) in accordance with EPA method 160.1. The detection limit for the TSS analysis shall be at a maximum of 1 mg/L. The second sample shall be analyzed for total metals in accordance with EPA method 6010, the third sample shall be analyzed for total petroleum hydrocarbons in accordance with EPA method 8015M, and the fourth shall be analyzed for polynuclear aromatic hydrocarbons in accordance with EPA method 8310. The detection limits for total metals and total petroleum hydrocarbons shall be equal to or less than the allowable discharge concentration for each contaminant. Industry accepted standard operating procedures shall be used to ensure quality assurance and quality control of sampling and analysis procedures. Analytical results for all samples shall be available to the Engineer within 24 hours of delivering the samples to the laboratory. The Contractor shall ensure that the laboratory responsible for the analysis of the samples has been properly certified by the California Department of Health Services for conducting the analyses described under these special provisions.

SPILL CONTINGENCY

The Contractor shall prepare and submit to the Engineer a contingency plan for the management of spills or leaks of any materials or wastes that may impact the water quality of the Carquinez Strait.

The spill contingency plan shall be incorporated within the Storm Water Pollution Prevention Plan (SWPPP), as specified in "Water Pollution Control" of these special provisions.

The contingency plan shall include instructions and procedures for reporting spills, and a list of spill containment and collection materials and equipment to be maintained onsite. The contingency plan shall be reviewed and updated at least every 90 calendar days.

LIQUIDS, RESIDUES AND DEBRIS

The Contractor shall prevent the discharge of slurries, liquids, residues, or debris produced during the work to storm water facilities or surface waters of the State. The SWPPP shall, at a minimum, depict and describe the procedural and structural methods of detaining, collecting, and disposing of all slurries, liquids, residues, and debris associated with the operations. Sufficient redundancy shall be incorporated into the procedural and structural methods such that the slurries, liquids, residues, and debris are not conveyed into or become present in drainage systems, San Francisco Bay, or other water bodies.

MEASUREMENT AND PAYMENT

The contract lump sum price paid for non-storm water discharges shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in non-storm water discharges, complete in place, as shown on the plans, as specified in the Standard Specifications, and these special provisions, and as directed by the Engineer.

10-1.04 WATER POLLUTION CONTROL (STORM WATER POLLUTION PREVENTION PLAN)

Water pollution control work shall conform to the provisions in Section 7-1.01G, "Water Pollution," of the Standard Specifications and these special provisions.

This project lies within the boundaries of the San Francisco Bay Regional Water Quality Control Board and shall conform to the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit for General Construction Activities No. CAS000002, Order No, 99-08-DWQ, and the NPDES Permit for the State of California Department of Transportation Properties, Facilities, and Activities, No. CAS000003, Order No, 99-06-DWQ issued by the State Water Resources Control Board. These permits, hereafter referred to as the "Permits," regulate storm water discharges associated with construction activities.

Water pollution control work shall conform to the requirements in the "Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual" and the "Construction Site Best Management Practices (BMPs) Manual," and addenda thereto issued up to, and including, the date of advertisement of the project, hereafter referred to respectively as the "Preparation Manual" and the "Construction Site BMP Manual" and collectively as the "Manuals." Copies of the Manuals and the Permits may be obtained from the Department of Transportation, Material Operations Branch, Publication Distribution Unit, 1900 Royal Oaks Drive, Sacramento, California 95815, Telephone: (916) 445-3520. Copies of the Manuals may also be obtained from the Department's Internet Web Site at: http://www.dot.ca.gov/hq/construc/stormwater.html.

In addition, a Conceptual Storm Water Pollution Prevention Plan (CSWPPP) has been prepared for this project by the Department and is available for review at the office of the Toll Bridge Duty Senior at the District 4 Office, 111 Grand Avenue, Oakland, CA 94612, email; duty_senior_tollbridge_district04@dot.ca.gov, telephone number; (510) 286-5549, fax number; (510) 286-4563. This document may be used by the Contractor for developing the actual contract Storm Water Pollution Prevention Plan (SWPPP).

The Contractor shall know and fully comply with the applicable provisions of the Manuals, Permits, and Federal, State, and local regulations that govern the Contractor's operations and storm water discharges from both the project site and areas of disturbance outside the project limits during construction. The Contractor shall maintain copies of the Permits at the project site and shall make the Permits available during construction.

Unless arrangements for disturbance or use of areas outside the project limits are made by the Department and made part of the contract, it is expressly agreed that the Department assumes no responsibility for the Contractor or property owner with respect to any arrangements made between the Contractor and property owner. The Contractor shall implement, inspect and maintain all necessary water pollution control practices to satisfy all applicable Federal, State, and Local laws and regulations that govern water quality for areas used outside of the highway right-of-way or areas arranged for the specific use of the Contractor for this project. Installing, inspecting, and maintaining water pollution control practices on areas outside the highway right-of-way not specifically arranged for and provided for by the Department for the execution of this contract will not be paid for.

The Contractor shall be responsible for the costs and for liabilities imposed by law as a result of the Contractor's failure to comply with the provisions set forth in this section "Water Pollution Control", including but not limited to, compliance with the applicable provisions of the Manuals, Permits and Federal, State and local regulations. Costs and liabilities include, but are not limited to, fines, penalties, and damages whether assessed against the State or the Contractor, including those levied under the Federal Clean Water Act and the State Porter Cologne Water Quality Act.

In addition to the remedies authorized by law, money due the Contractor under the contract, in an amount determined by the Department, may be retained by the State of California until disposition has been made of the costs and liabilities.

When a regulatory agency or other third party identifies a failure to comply with the permit or any other local, State, or federal requirement, the Engineer may retain money due the Contractor, subject to the following:

A. The Department will give the Contractor 30 days notice of the Department's intention to retain funds from partial payments which may become due to the Contractor prior to acceptance of the contract. Retention of funds from payments made after acceptance of the contract may be made without prior notice to the Contractor.
B. No retention of additional amounts out of partial payments will be made if the amount to be retained does not exceed the amount being withheld from partial payments pursuant to Section 9-1.06, "Partial Payments," of the Standard Specifications.
C. If the Department has retained funds and it is subsequently determined that the State is not subject to the costs and liabilities in connection with the matter for which the retention was made, the Department shall be liable for interest on the amount retained for the period of the retention, and the rate of interest payable shall be 6 percent per annum.

Conformance with the provisions of this section "Water Pollution Control" shall not relieve the Contractor from the Contractor's responsibilities, as provided in Section 7, "Legal Relations and Responsibilities," 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.

STORM WATER POLLUTION PREVENTION PLAN PREPARATION, APPROVAL AND AMENDMENTS

As part of the water pollution control work, a Storm Water Pollution Prevention Plan, hereafter referred to as the "SWPPP," is required for this contract. The SWPPP shall conform to the provisions in Section 7-1.01G, "Water Pollution," of the Standard Specifications, the requirements in the Manuals, the requirements of the Permits, and these special provisions. Upon the Engineer's approval of the SWPPP, the SWPPP shall be considered to fulfill the provisions in Section 7-1.01G, "Water Pollution," of the Standard Specifications for development and submittal of a Water Pollution Control Program.

No work having potential to cause water pollution, as determined by the Engineer, shall be performed until the SWPPP has been approved by the Engineer.

The Contractor shall designate a Water Pollution Control Manager. The Water Pollution Control Manager shall be responsible for the preparation of the SWPPP and any required modifications or amendments and shall be responsible for the implementation and adequate functioning of the various water pollution control practices employed. The Water Pollution Control Manager shall serve as the primary contact for all issues related to the SWPPP or its implementation. The Contractor shall submit to the Engineer a statement of qualifications, describing the training, previous work history and expertise of the individual selected by the Contractor to serve as Water Pollution Control Manager. The Engineer will reject the Contractor’s submission of a Water Pollution Control Manager if the submitted qualifications are deemed to be inadequate.

Within 30 days after the approval of the contract, the Contractor shall submit 3 copies of the draft SWPPP to the Engineer. The Engineer will have 15 days to review the SWPPP. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the SWPPP within 10 days of receipt of the Engineer's comments. The Engineer will have 10 days to review the revisions. Upon the Engineer's approval of the SWPPP, 3 approved copies of the SWPPP, incorporating the required changes, shall be submitted to the Engineer. In order to allow construction activities to proceed, the Engineer may conditionally approve the SWPPP while minor revisions are being completed. If the Engineer does not review or approve the SWPPP within the time specified, compensation will be made in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The SWPPP shall apply to all areas that are directly related to construction including, but not limited to, staging areas, storage yards, material borrow areas, and access roads within or outside of the highway right-of-way.

The SWPPP shall incorporate water pollution control practices in the following six categories:

A. Soil stabilization;
B. Sediment control;
C. Wind erosion control;
D. Tracking control;
E. Non-storm water control; and
F. Waste management and material pollution control.

The Contractor shall develop a Water Pollution Control Schedule that shall describe the timing of grading or other work activities that could affect water pollution. The Water Pollution Control Schedule shall be updated by the Contractor to

reflect any changes in the Contractor's operations that would affect the necessary implementation of water pollution control practices.

The Contractor shall incorporate the "Minimum Requirements" presented in the Preparation Manual into the SWPPP. In addition to the "Minimum Requirements" presented in the Preparation Manual, the Contractor shall complete the BMP Consideration Checklist presented in the Preparation Manual. The Contractor shall identify and incorporate into the SWPPP the water pollution control practices selected by the Contractor or as directed by the Engineer.

In addition to the Minimum Requirements presented in the Preparation Manual, special requirements shall be incorporated into the SWPPP and the Water Pollution Control Cost Break-Down as follows:

Special Requirement(s)

Category	BMP, location and quantity
Soil Stabilization Practices	SS-10 Outlet Protection/Velocity Dissipation Devices, at unfinished but functional drainage outlets, 14 EA SS-11 Slope Drains, as needed to convey runoff from unfinished embankments where there are no finished drainage facilities for concentrated runoff, 36 M
Sediment Control Practices	SC-3 Sediment Trap, at the toe of embankments where additional sediment removal is required, 3 EA SC-8 Sandbag Barrier in unlined drainage swales, at the perimeter of embankments, near drainage outlets and inlets, 54 M
Non Storm Water Control	NS-3 Paving and Grading Operations, Various, Lump Sum
Waste Management & Materials Pollution Control	WM-6 Hazardous Waste Management, Various, Lump Sum

The following contract items of work, shall be incorporated into the SWPPP as "Temporary Water Pollution Control Practices": Temporary Cover, Temporary Concrete Washout Facility, Temporary Entrance/Exit, Temporary Drainage Inlet Protection, Temporary Erosion Control, and Temporary Silt Fence. The Contractor's attention is directed to these special provisions provided for each temporary water pollution control practice.

The following contract items of work, as shown on the project plans or as specified elsewhere in these special provisions, shall be identified in the SWPPP as permanent water pollution control practices: Fiber Roll, Erosion Control Netting, Erosion Control (Blanket), Column Drain Protection, and Erosion Control (Type D). These permanent water pollution control practices shall be constructed and utilized during the construction period. The Contractor shall maintain and protect the permanent water pollution control practices throughout the duration of the project and shall restore these controls to the lines, grades and condition shown on the plans prior to acceptance of the contract.

The SWPPP shall include, but not be limited to, the items described in the Manuals, Permits and related information contained in the contract documents.

The Contractor shall prepare an amendment to the SWPPP when there is a change in construction activities or operations which may affect the discharge of pollutants to surface waters, ground waters, municipal storm drain systems, or when the Contractor's activities or operations violate any condition of the Permits, or when directed by the Engineer. Amendments shall show additional water pollution control practices or revised operations, including those areas or operations not shown in the initially approved SWPPP. Amendments to the SWPPP shall be prepared, and submitted for review and approval in the same manner as specified for the SWPPP approval. Subsequent amendments shall be submitted within a time approved by the Engineer, but in no case longer than the time specified for the initial submittal and review of the SWPPP.

The Contractor shall keep one copy of the approved SWPPP and approved amendments at the project site. The SWPPP shall be made available upon request of a representative of the Regional Water Quality Control Board, State Water Resources Control Board, United States Environmental Protection Agency or the local storm water management agency. Requests by the public shall be directed to the Engineer.

COST BREAK-DOWN

The Contractor shall submit to the Engineer a cost break-down for the contract lump sum item of water pollution control, together with the SWPPP.

The cost break-down shall be completed and furnished in the format shown in the example of the cost break-down included in this section. Unit descriptions and quantities shall be designated by the Contractor, except for the specified special requirements shown in the example. The units and quantities given in the example, if provided, are special requirements specified for the SWPPP, and shall be included in the cost break-down furnished to the Engineer. The

Contractor shall verify the estimated quantities of the special requirements and submit revised quantities in the cost break-down.

The Contractor shall determine the quantities required to complete the work of water pollution control. The quantities and their values shall be included in the cost break-down submitted to the Engineer for approval. The Contractor shall be responsible for the accuracy of the quantities and values used in the cost break-down submitted for approval. The cost break-down shall not include water pollution control practices which are shown on the plans and for which there is a separate contract item.

The sum of the amounts for the units of work listed in the cost break-down shall be equal to the contract lump sum price bid for water pollution control. Profit shall be included in each individual unit listed in the cost break-down. The cost break-down shall be submitted and approved within the same times specified for the SWPPP. Partial payment for the item of water pollution control will not be made until the cost break-down is approved, in writing, by the Engineer. Attention is directed to "Time Related Overhead" of these special provisions.

Adjustments in the items of work and quantities listed in the approved cost break-down shall be made when required to address amendments to the SWPPP, except when the adjusted items are paid for as extra work.

No adjustment in compensation will be made in the contract lump sum price paid for water pollution control due to differences between the quantities shown in the approved cost break-down and the quantities required to complete the work as shown on the approved SWPPP. No adjustment in compensation will be made for ordered changes to correct SWPPP work resulting from the Contractor's own operations or from the Contractor's negligence.

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 water pollution control due to increases or decreases of quantities ordered by the Engineer. When an ordered change increases or decreases the quantities of 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 in conformance with the provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications. If an ordered change requires a new item not on the approved cost break-down, the adjustment in compensation will be determined in the same manner specified for extra work in conformance with Section 4-1.03D, "Extra Work," of the Standard Specifications.

If requested by the Contractor and approved by the Engineer, changes to the water pollution control practices listed in the approved cost break-down, including the addition of new water pollution control practices, will be allowed. The changes shall be included in an approved amendment to the SWPPP. If the changes to the water pollution control practices requested by the Contractor would result in a net cost increase to the lump sum price for water pollution control, an adjustment in compensation will be made without change to the item of water pollution control. The net cost increase to the item of water pollution control resulting from changes requested by the Contractor will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

WATER POLLUTION CONTROL COST BREAK-DOWN

Contract No. 04-006064

UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
MINIMUM REQUIREMENTS				
SS-1 Scheduling	LS			
SS-2 Preservation of Existing Vegetation	LS			
SC-7 Street Sweeping and Vacuuming	LS			
WE-1 Wind Erosion Control	LS			
NS-6 Illicit Connection/Illegal Discharge Detection And Reporting	LS			
NS-8 Vehicle and Equipment Cleaning	LS			
NS-9 Vehicle and Equipment Fueling	LS			
NS-10 Vehicle and Equipment Maintenance	LS			
WM-1 Material Delivery and Storage	LS			
WM-2 Material Use	LS			
WM-4 Spill Prevention and Control	LS			
WM-5 Solid Waste Management	LS			
WM-9 Sanitary/Septic Waste Management	LS			
SPECIAL REQUIREMENTS				
SC-3 Sediment Trap	EA	3		
SC-8 Sandbag Barrier	M	54		
SS-10 Outlet Protection/Velocity Dissipation Devices	EA	14		
SS-11 Slope Drains	M	36		
NS-3 Paving and Grading Operations	LS	LUMP SUM		
WM-6 Hazardous Waste Management	LS	LUMP SUM		

TOTAL _____

SWPPP IMPLEMENTATION

Upon approval of the SWPPP, the Contractor shall be responsible throughout the duration of the project for installing, constructing, inspecting, maintaining, removing and disposing of the water pollution control practices included in the SWPPP and any amendments. Unless otherwise directed by the Engineer, the Contractor's responsibility for SWPPP implementation shall continue throughout any temporary suspension of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications. Requirements for installation, construction, inspection, maintenance, removal, and disposal of water pollution control practices are specified in the Manuals and these special provisions.

If the Contractor or the Engineer identifies a deficiency in any aspect of the implementation of the approved SWPPP or amendments, the deficiency shall be corrected immediately. The deficiency may be corrected at a later date and time if requested by the Contractor and approved by the Engineer in writing, but not later than the onset of precipitation. If the Contractor fails to correct the identified deficiency by the date agreed or prior to the onset of precipitation the project shall be in noncompliance. Attention is directed to Section 5-1.01, "Authority of the Engineer," of the Standard Specifications and the payment sections of these special provisions for possible noncompliance penalties.

If the Contractor fails to conform to the provisions of "Water Pollution Control," the Engineer may order the suspension of construction operations which create water pollution.

Implementation of water pollution control practices may vary by season. The Construction Site BMP Manual and these special provisions shall be followed for control practice selection of year round, rainy season and non-rainy season water pollution control practices.

Year-Round Implementation Requirements

The Contractor shall have a year-round program for implementing, inspecting and maintaining water pollution control practices for wind erosion control, tracking control, non-storm water control, and waste management and materials pollution control.

The National Weather Service weather forecast shall be monitored and used by the Contractor on a daily basis. An alternative weather forecast proposed by the Contractor may be used if approved by the Engineer. If precipitation is predicted, the necessary water pollution control practices shall be deployed prior to the onset of the precipitation.

Disturbed soil areas shall be considered active whenever the soil disturbing activities have occurred, continue to occur or will occur during the ensuing 21 days. Non-active areas shall be protected as prescribed in the Construction Site BMP Manual within 14 days of cessation of soil disturbing activities or prior to the onset of precipitation, whichever occurs first.

In order to provide effective erosion control the Contractor may be directed to apply permanent erosion control in small or multiple units as disturbed soil areas are deemed substantially complete by the Engineer. The Contractor’s attention is directed to "Erosion Control" and "Move-In Move-Out (Erosion Control)" of these special provisions.

The Contractor shall implement, maintain, and inspect the following temporary sediment control practices on a year-round basis. The listed practices shall remain in place until their use is no longer needed, as determined by the Engineer.

Year-Round Sediment Control Practices	Location used
SC-7 Street Sweeping and Vacuuming	On all public traveled roads
WE-1 Wind Erosion Control	On all unfinished and finished slopes that are untreated and subject to wind erosion

Rainy Season Requirements

Soil stabilization and sediment control practices conforming to the requirements in the Special Requirements and applicable Preparation Manual Minimum Requirements, shall be provided throughout the rainy season, defined as between October 1 and May 1.

An implementation schedule of required soil stabilization and sediment control practices for disturbed soil areas shall be completed not later than 20 days prior to the beginning of each rainy season. The implementation schedule shall identify the soil stabilization and sediment control practices to be implemented and the dates on which the implementation will be 25 percent, 50 percent and 100 percent complete, respectively. Construction activities beginning during the rainy season shall implement applicable soil stabilization and sediment control practices. The Contractor shall implement soil stabilization and sediment control practices a minimum of 10 days prior to the start of the rainy season.

Throughout the defined rainy season, the active disturbed soil area of the project site shall be not more than 2 hectares. The Engineer may approve, on a case-by-case basis, expansions of the active disturbed soil area limit. Soil stabilization and

sediment control materials shall be maintained on site sufficient to protect the unprotected disturbed soil area. A detailed plan for the mobilization of sufficient labor and equipment shall be maintained to deploy the water pollution control practices required to protect the project site prior to the onset of precipitation events.

Non-Rainy Season Requirements

The non-rainy season shall be defined as all days outside the defined rainy season. The Contractor's attention is directed to the Construction Site BMP Manual for soil stabilization and sediment control implementation requirements on disturbed soil areas during the non-rainy season. Disturbed soil areas within the project shall be protected in conformance with the requirements in the Construction Site BMP Manual with an effective combination of soil stabilization and sediment control.

MAINTENANCE

To ensure the proper implementation and functioning of water pollution control practices, the Contractor shall regularly inspect and maintain the construction site for the water pollution control practices identified in the SWPPP. The construction site shall be inspected by the Contractor as follows:

A. Prior to a forecast storm;
B. After a precipitation event which causes site runoff;
C. At 24 hour intervals during extended precipitation events;
D. Routinely, a minimum of once every two weeks outside of the defined rainy season;
E. Routinely, a minimum of once every week during the defined rainy season.

The Contractor shall use the Storm Water Quality Construction Site Inspection Checklist provided in the CSWPPP or an alternative inspection checklist provided by the Engineer. One copy of each site inspection record shall be submitted to the Engineer within 24 hours of completing the inspection.

REPORTING REQUIREMENTS

Report of Discharges, Notices or Orders

If the Contractor identifies any discharge into receiving waters in a manner causing, or potentially causing, a condition of pollution, or if the project receives a written notice or order from any regulatory agency, the Contractor shall immediately inform the Engineer. The Contractor shall submit a written report to the Engineer within 7 days of the discharge event, notice, or order. The report shall include the following information:

A. The date, time, location, nature of the operation, and type of discharge, including the cause or nature of the notice or order.
B. The water pollution control practices deployed before the discharge event, or prior to receiving the notice or order.
C. The date of deployment and type of water pollution control practices deployed after the discharge event, or after receiving the notice, or order, including additional measures installed or planned to reduce or prevent reoccurrence.
D. An implementation and maintenance schedule for any affected water pollution control practices.

Report of First-Time Non-Storm Water Discharge

The Contractor shall notify the Engineer at least 3 days in advance of each first-time non-storm water discharge event, excluding exempted discharges. The Contractor shall notify the Engineer of each different operation causing a non-storm water discharge and shall obtain field approval for each first-time non-storm water discharge. Non-storm water discharges shall be monitored at each first-time occurrence and routinely thereafter.

Annual Certifications

By June 15 of each year, the Contractor shall complete and submit an Annual Construction Activity Certification as contained in the Preparation Manual to the Engineer.

PAYMENT

The contract lump sum price paid for prepare storm water pollution prevention plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in developing, preparing, obtaining approval of, revising, and amending the SWPPP, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Attention is directed to Section 9-1.06, "Partial Payments," and Section 9-1.07, "Payment After Acceptance," of the Standard Specifications. Payments for prepare storm water pollution prevention plan will be made as follows:

A. After the SWPPP has been approved by the Engineer, 75 percent of the contract item price for prepare storm water pollution prevention plan will be included in the monthly partial payment estimate; and
B. After acceptance of the contract in conformance with the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, payment for the remaining 25 percent of the contract item price for prepare storm water pollution prevention plan will be made in conformance with the provisions in Section 9-1.07.

The contract lump sum price paid for water pollution control shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing, constructing, removing, and disposing of water pollution control practices, including non-storm water and waste management and materials pollution water pollution control practices except those shown on the plans and for which there is a contract item of work, and excluding developing, preparing, obtaining approval of, revising, and amending the SWPPP, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The cost of maintaining the temporary water pollution control practices shall be divided equally by the State and the Contractor as follows:

Soil Stabilization

All temporary water pollution control practices except:
SS-1 Scheduling
SS-2 Preservation of Existing Vegetation

Sediment Control

All temporary water pollution control practices.

Tracking Control

All temporary water pollution control practices except:
SC-7 Street Sweeping and Vacuuming

Wind Erosion Control

All temporary water pollution control practices.

Non-Storm Water Control

No sharing of maintenance costs will be allowed.

Waste Management & Material Control

No sharing of maintenance costs will be allowed.

The division of cost will be made by determining the cost of maintaining temporary water pollution control practices in conformance with the provisions in Section 9-1.03, "Force Account Payment," of the Standard Specifications and paying to the Contractor one-half of that cost. Clean-up, repair, removal, disposal, improper installation, and replacement of temporary water pollution control practices damaged by the Contractor's negligence shall not be considered as included in the cost for performing maintenance and no additional compensation will be allowed therefor.

The provisions for sharing maintenance costs shall not relieve the Contractor from the responsibility for providing appropriate maintenance on those items where maintenance costs are not shared.

Full compensation for maintenance costs of water pollution control practices not shared, as specified in these special provisions, shall be considered as included in the contract lump sum price paid for water pollution control and no additional compensation will be allowed therefor.

Those water pollution control practices which are shown on the plans and for which there is a contract item of work will be measured and paid for as that contract item of work.

The Engineer will retain an amount equal to 25 percent of the estimated value of the contract work performed during estimate periods in which the Contractor fails to conform to the provisions of this section "Water Pollution Control," as determined by the Engineer.

Retention for failure to conform to the provisions in this section "Water Pollution Control" shall be in addition to the other retention provided for in the contract. The amounts retained for failure of the Contractor to conform to the provisions in this section will be released for payment on the next monthly estimate for partial payment following the date that an

approved SWPPP has been implemented and maintained, and water pollution is adequately controlled, as determined by the Engineer.

10-1.05 COOPERATION

Attention is directed to Section 7-1.14, "Cooperation," and Section 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications and these special provisions.

It is anticipated that work by another contractor (Contract No. 04-000694) to grading and paving northbound Route 680 and Benicia-Martinez Bridge Toll Plaza site in Contra Costa County on Route 680 from north end of Mococo OH to Benicia-Martinez Bridge and OH (KP 39.4 to KP 40.1) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

It is anticipated that work by another contractor (Contract No. 04-006044) to construct Benicia-Martinez Bridge Toll Plaza and Administration Building in Contra Costa County on Route 680 from north end of Mococo OH to Benicia-Martinez Bridge and OH (KP 39.4 to KP 40.1) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

It is anticipated that work by another contractor (Contract No. 04-006054) to reconstruct Marina Vista Road Interchange and construct Mococo OH for approach to new Benicia-Martinez Bridge Toll Plaza in Contra Costa County on Route 680 from 0.5 Km south of Mococo OH to Benicia-Martinez bridge and OH (KP 38.5 to KP 40.1) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

It is anticipated that work by another contractor (Contract No. 04-006034) to construct second Benicia-Martinez Bridge(Br. No. 28-153R) in Contra Costa County and Solano County on Route 680 from 1.1 Km north of Mococo OH to 1.0 Km north of Contra Costa and Solano County Line (CC KP 40.1 to KP 41.4 and Sol KP L0.0 to L1.0) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

10-1.06 MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)

Move-in/move-out (temporary erosion control) shall include moving onto the project when an area is ready to receive erosion control as determined by the Engineer, setting up all required personnel and equipment for the application of temporary erosion control materials and moving out all personnel and equipment when temporary erosion control in that area is completed.

When areas are ready to receive applications of temporary erosion control as determined by the Engineer, the Contractor shall begin temporary erosion control work in that area within 5 working days of the Engineer’s notification to perform the temporary erosion control work.

Attention is directed to the requirements of temporary erosion control (Type D) elsewhere in these special provisions.

Quantities of move-in/move-out (temporary erosion control) will be determined as units from actual count as determined by the Engineer. For measurement purposes, a move-in followed by a move-out will be considered as one unit.

The contract unit price paid for move-in/move-out (temporary erosion control) shall include full compensation for furnishing all labor, materials (excluding 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 (Type D), as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.07 TEMPORARY EROSION CONTROL

Temporary erosion control shall conform to the provisions for erosion control in Section 20-3, "Erosion Control," of the Standard Specifications and these special provisions.

Attention is directed to "Water Pollution Control" of these special provisions.

Temporary erosion control work shall consist of applying erosion control materials to embankment slopes, excavation slopes and other inactive areas to reduce disturbed soil areas as defined in "Water Pollution Control" of these special provisions. Temporary erosion control work shall be implemented on active disturbed soil areas as directed by the Engineer.

MATERIALS

Materials shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and the following:

Straw

Straw shall be derived from wheat or barley. Wheat and barley straw shall not be derived from dry farmed cereal crops.

Stabilizing Emulsion

Stabilizing emulsion shall conform to the provisions in Section 20-2.11, "Stabilizing Emulsion," of the Standard Specifications and these special provisions.

The requirement of an effective life of at least one year for stabilizing emulsion shall not apply.

Stabilizing emulsion shall be in a dry powder form, may be re-emulsifiable, and shall be a processed organic adhesive derivative of Plantago ovata used as a soil tackifier.

APPLICATION

Temporary erosion control materials shall be applied in 2 separate applications in the following sequence:

A. Straw shall be applied at the rate of 4 tonnes per hectare based on slope measurements. Incorporation of straw will not be required.
B. The following mixture in the proportions indicated shall be applied with hydro-seeding equipment:

Material	Kilograms Per Hectare (Slope Measurement)
Fiber	1680
Stabilizing Emulsion	135

C. The ratio of total water to total stabilizing emulsion in the mixture shall be as recommended by the manufacturer.
D. Once straw work is started in an area, the remaining applications shall be completed in that area on the same working day.

At the option of the Contractor, temporary soil stabilizer (solids) may be applied instead of temporary erosion control. Temporary soil stabilizer (solids) shall be applied in conformance with these special provisions.

Temporary soil stabilizer (solids) shall consist of applying a mixture of processed gypsum plaster, color hardener, fiber, and water to slopes and other areas as provided for in this special provision.

MATERIALS

Materials shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and the following requirements for soil stabilizers:

Stabilizing Emulsion (Solids)

A. Stabilizing emulsion (solids) shall consist of a gypsum plaster processed into a dry, ground powder of calcium sulfate hemi-hydrate. Plaster shall be furnished either in bags or bulk. Plaster that has set into a lumpy or caked condition prior to use shall be rejected.
B. Stabilizing emulsion (solids) shall be formulated specifically for use in erosion control and soil stabilization. Emulsion (solids) shall be non-corrosive and water-soluble emulsion such that, upon application, cures to a water insoluble binding and cementing agent.

Color Hardener

Coloring material shall consist of a processed powdered cementitious hardener with a muted green color conforming to ASTM C 979.

APPLICATION

Temporary soil stabilizers shall be applied as follows:

A. The application shall consist of applying the following mixture in the proportions indicated with hydro-seeding equipment:

Material	Kilograms Per Hectare (Slope measurement)
Fiber	840
Stabilizing Emulsion (solids)	6740
Color Hardener (solids)	54

B. The dilution of stabilizing emulsion (solids) to water (liter) per hectare shall be as required to facilitate even application of material. Several applications may be required to apply all specified materials. Stabilizing emulsion (solids) and color hardener (solids) shall be added to the water and fiber mixture in the tank.
C. Stabilizers shall not be applied to areas with standing water.
D. The application of soil stabilizer will be applied in a down slope direction to provide uniform coverage when possible. Application of material shall be performed during dry weather with a minimum of 8 hours of dry weather predicted following application prior to any anticipated rain.
E. Due to the cementatious nature of the stabilizing emulsion (solids) and color hardener, it is recommended that application of the soil stabilizer be performed continuously without interruption to prevent setting up of the material. All equipment used to apply soil stabilizer shall be flushed immediately following application and cleaned thoroughly as soon as possible as recommended by the manufacturer.
F. Any areas disturbed or displaced by construction operations or equipment following application shall be replaced by the Contractor at no cost to the State.

MEASUREMENT AND PAYMENT

Temporary erosion control will be measured and paid for by the square meter in the same manner specified for erosion control in Sections 20-3.06 and 20-3.07 of the Standard Specifications. No additional compensation shall be provided if the Contractor elects to use temporary soil stabilizer (solids) as an alternative.

Temporary erosion control placed at locations other than as shown on the project plans or directed by the Engineer, in conformance with the Contractor's Storm Water Pollution Prevention Plan, will not be measured and will be paid for as specified in "Water Pollution Control" of these special provisions.

No adjustment of compensation will be made for any increase or decrease in the quantities of temporary erosion control required, 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 temporary erosion control.

10-1.08 TEMPORARY SILT FENCE

Temporary silt fence shall conform to the details shown on the plans and these special provisions.

Temporary silt fence shall be furnished, installed, maintained, and removed at the locations shown on the plans.

Preparation shall conform to the provisions in Section 20-3.02, "Preparation," of the Standard Specifications.

Attention is directed to "Water Pollution Control" of these special provisions.

MATERIALS

Materials for temporary silt fence shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and the following:

Temporary silt fence shall be a prefabricated silt fence of woven polypropylene with or without an integral reinforcement layer of the same material. Silt fence fabric shall have a minimum width of 900 mm and a minimum tensile strength of 0.44-kN, conforming to the requirements of ASTM Designation: D 4632.

INSTALLATION

Temporary silt fence shall be installed as shown on the plans.

When joints are necessary, the temporary silt fence shall overlap a minimum of 150 mm with both posts tied together.

Temporary silt fences shall be maintained to provide for adequate sediment holding capacity. Sediment deposits shall be removed when the sediment deposit reaches approximately one-third of the fence height. Removed sediment shall be deposited within the project in such a way that the sediment is not subject to erosion by wind or water, or as directed by the Engineer.

When no longer required for the intended purpose, as determined by the Engineer, temporary silt fence shall be removed from the site of the work.

Holes, depressions or any other ground disturbance caused by the removal of the temporary silt fence shall be backfilled and repaired in conformance with the provisions in the second paragraph of Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

The quantity of temporary silt fence will be measured by the meter as determined from actual measurements, the measurements to be made parallel with the ground slope along the line of the completed temporary silt fence, deducting the widths of openings.

The contract price paid per meter for temporary silt fence shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing temporary silt fence, complete

in place, including trench excavation and backfill, and maintenance and removal of temporary silt fence, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Temporary silt fence placed at location other than as shown on the project plans or directed by the Engineer, in conformance with the Contractor's Storm Water Pollution Prevention Plan, will not be measured and will be paid for as specified in "Water Pollution Control" of these special provisions.

No adjustment of compensation will be made for any increase or decrease in the quantities of temporary silt fence required, 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 temporary silt fence.

10-1.09 TEMPORARY FENCE AND GATE

Temporary fence and gate 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 and gate shall conform to the plan details and the specifications for permanent fence and gate 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 metal.

Galvanizing and painting of steel items will not be required.

Concrete footings for metal posts will not be required, except for the gate posts.

Temporary fence and gate 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 and gate 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 and gate 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 and gate 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 and gate shall be considered as included in the contract prices paid per meter for the temporary fence (Type CL-1.8) and by the unit for 6.10 m temporary chain link gate (Type CL-1.8) and no additional compensation will be allowed therefor.

10-1.10 TEMPORARY FENCE (TYPE ESA)

Temporary fence (Type ESA) 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.

Temporary fence (Type ESA) shall be constructed prior to any clearing and grubbing work and a sufficient distance from protected plants to enclose all of the foliage canopy and not encroach upon visible roots of the plants.

Temporary fence (Type ESA) shall be located so that it will be unobstructed from view by heavy equipment operators and other construction personnel.

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. Fabric used for Temporary fence (Type ESA) shall also conform to the following:

Material:	Polypropylene or Polyethylene
Color:	Orange
Mesh opening:	50 mm x 50 mm
UV Resistance:	Fully Stabilized
Fabric Width, min.:	1.22 m

Posts shall be either metal or wood at the Contractor's option, and shall be suitable for the purpose intended. Metal posts shall have a minimum diameter of 21.5 mm x 1600 mm in length. Wood posts shall be fir or pine and shall be a minimum of 25 mm x 50 mm x 1600 mm in length. Posts shall be driven into the soil a minimum of 400 mm. Posts shall be spaced at 2-meter centers minimum and shall at all times support the fence in a near vertical, upright position.

Galvanizing and painting of steel items will not be required.

Treating wood with a wood preservative shall not be allowed.

Concrete footings for posts will not be required.

Temporary fence (Type ESA) 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 (Type ESA) 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.

Holes caused by the removal of temporary fence (Type ESA) shall be backfilled in conformance with the provisions in the second paragraph of Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary fence (Type ESA) shall be measured in the manner specified for permanent fences in Section 80, “Fences”, of the Standard Specifications.

The contract price paid per meter for temporary fence (Type ESA) shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing temporary fence (Type ESA) complete in place, including installation, maintenance, removal and disposal of materials as specified in these special provisions and as directed by the Engineer.

10-1.11 TEMPORARY COVER

Temporary cover shall conform to the details shown on the plans. The minimum quantity of temporary cover required for this project shall be 6000 square meters.

The Contractor shall use temporary cover as one of the various measures to prevent water pollution. The Storm Water Pollution Prevention Plan shall graphically show the use of temporary cover in relation to other water pollution control work specified elsewhere in these special provisions.

MATERIALS

Materials shall conform to the following for either plastic or fabric sheeting:

If fabric is used, the fabric shall be a minimum 115 g/m2 slit film woven fabric made of monofilaments of polypropylene. The fabric shall be non biodegradable, resistant to sunlight deterioration, inert to most soil chemicals and furnished with sealed edges on all sides to prevent unraveling. The fabric shall also conform to the following:

Properties

Grab tensile strength	0.85-0.95 kn
Elongation at break (minimum)	15%

If plastic sheeting is used, the sheeting shall be polyethylene, new and a minimum of 0.33 mm thickness.

INSTALLATION

Fabric or plastic sheeting shall be placed and anchored as shown on the plans. Abutting edges shall overlap a minimum of a 0.6m. Rock bags with a weighted mass ranging from 13 kg to 22 kg shall be placed on the overlap area and along the toe at a maximum spacing of 2.4m. Anchoring temporary cover by using staples or wooden lath and anchors may be allowed instead of rock bags as determined by the Engineer. The Contractor shall submit details for any alternative anchoring system to the Engineer for approval prior to installation. Non-abutting edges shall be embedded a minimum of 150 mm in native soil.

Temporary cover damaged as a result of the Contractors operations shall be replaced by the Contractor at his expense.

MEASUREMENT AND PAYMENT

The contract price paid per square meter for temporary cover shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing, maintaining and removing temporary cover, complete in place, as shown on the plans, as specified in the Standard Specifications and these special

provisions, and as directed by the Engineer. If the Contractor removes the temporary cover in order to facilitate any other work, the temporary cover shall be replaced and secured by the contractor at no additional cost to the State.

10-1.12 TEMPORARY DRAINAGE INLET PROTECTION

Temporary drainage inlet protection shall be installed, maintained and later removed as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

Temporary drainage inlet protection shall be limited to those areas that are not adjacent to, nor drain toward, areas of active traffic.

The Contractor shall select the appropriate drainage inlet protection shown on the plans commensurate to the field condition around the drainage inlet. For all other drainage inlets within the project limits that do not conform to the details shown on the plans, the Contractor shall submit to the Engineer for approval, provisions for providing temporary drainage inlet protection.

Special attention shall be given to existing and new drainage inlets adjacent to traffic. The Engineer shall review the need for drainage inlet protection commensurate to each location. Any proposed drainage inlet protection in such cases shall be approved by the Engineer for safety related concerns.

Throughout the duration of the Contract, the Contractor shall be required to provide protection commensurate with the changing condition of the drainage inlet. It is recognized that the drainage inlet changes during the course of construction and the actual protection provided may require selecting the appropriate type or types of drainage inlet protection as it changes during the course of construction.

Some conditions may require combining materials outlined in the special provision to address conditions that cannot be accounted for at this time. The Contractor shall submit temporary drainage inlet protection drawings for such cases to the Engineer for approval prior to installation.

The Contractor shall use temporary drainage inlet protection as one of the various measures to prevent water pollution. The Storm Water Pollution Prevention Plan shall graphically show the use of temporary drainage inlet protection in relation to other water pollution control work specified elsewhere in these special provisions.

MATERIALS

Materials shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and these special provisions.

A. **SILT FENCE.—**Sedimentation control fabric for temporary silt fence shall be a prefabricated silt fence with a minimum woven polypropylene fabric width of 900 mm and a minimum tensile strength of 0.44-kN, conforming to ASTM Designation: D 4632.

B. **ROCK BAG.—**Rock bag fabric shall be non-woven polypropylene, with a minimum unit weight of 250g/m^2. The fabric shall have a mullen burst strength of at least 2500 kPa, per ASTM Designation D3786 and an ultraviolet (UV) stability exceeding 70 percent at 500 hours. Rock bags shall have a length of 600 mm to 800 mm, width of 400 mm to 500 mm, thickness of 150 mm to 200 mm, and shall be filled to a weighted mass ranging from 13 kg to 22 kg. Rock bag fill material shall be non-cohesive, gravel, free from deleterious material. After filling, the opening shall be secured such that rock shall not escape from the bag.

C. **TEMPORARY FLEXIBLE DIKE.—**Temporary flexible dike fabric cover and skirt shall be a woven polypropylene fabric with a minimum tensile strength of 0.44-kN, conforming to ASTM Designation: D 4632. The prefabricated fabric shall be high visibility orange in color that is integral to the fabric; painting shall not be allowed. The fabric shall have an ultraviolet (UV) stability exceeding 70 percent.

   Temporary flexible dike inner material shall be urethane foam and shall be shaped and dimensioned as shown on the plans.

   Adhesive for temporary flexible dike shall be a solvent free rubber modified asphalt emulsion. The color of the emulsion shall be brown when wet and shall have a drying period of not more than 3 hours.

   Anchoring nails or spikes for temporary flexible dike shall be a minimum of 25 mm in length and capable of penetrating concrete and asphalt surfaces.

D. **EROSION CONTROL BLANKET.—**Erosion control blanket shall consist of straw and coconut or wood excelsior blanket secured in place with wire staples and shall conform to one of the following:

E. **EXCELSIOR BLANKET.—**Excelsior blanket material shall consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 150 mm or longer. The erosion control blanket shall be of consistent thickness and the wood fiber shall be evenly distributed over the entire area of the blanket. The top surface of the blanket

shall be covered with an extruded plastic mesh. The blanket shall be smolder resistant without the use of chemical additives and shall be non-toxic and non-injurious to plant and animal life. Erosion control blanket shall be furnished in rolled strips, 1220 mm -2440 mm in width, and shall have an average mass of 0.5-kg/m^2, ± 10 percent, at the time of manufacture.

F. **STRAW AND COCONUT BLANKET.—**Straw and coconut blanket shall be machine produced mats of straw and coconut with a light weight netting on top. The straw and coconut shall be adhered to the netting with biodegradable thread or glue strip. The straw and coconut erosion control blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the blanket. Straw and coconut erosion control blanket shall be furnished in rolled strips with a minimum width of 1.8 meters, minimum length of 20 meters (± 1 meter) and a minimum mass of 0.27-kg/m^2.

G. **STAPLES.—**Staples for erosion control blankets shall be made of 3.05-mm minimum steel wire and shall conform to the dimensions shown on the plans.

H. **SEDIMENT BAG.—**Sedimentation control fabric for sediment bags shall be a prefabricated sedimentation control fabric envelop with a woven polypropylene fabric and sewn with a double stitched seam using nylon thread. The fabric shall have a grab tensile strength of at least 120 kg and grab elongation of 20 percent, per ASTM Designation: D4632. The fabric shall have a mullen burst strength of at least 2895 kPa, per ASTM Designation: D3786 and an ultraviolet (UV) stability exceeding 90 percent. The sedimentation control fabric shall be capable of a flow rate of 70.3 L/minute/m^2, per ASTM Designation: D4491.

The sediment bag shall be sized to fit the catch basin or drop inlet and be complete with lifting loops and dump straps attached at the bottom to facilitate emptying of the sediment bag. The sediment bags shall have a restraint cord approximately halfway up the bag to keep the sides away from the catch basin walls.

INSTALLATION AND MAINTENANCE

Temporary flexible dike consists of individual sections of dike installed in conjunction with one another adjacent to existing drainage inlets as shown on the plans. The spacing and angle of placement shall be in accordance with the table shown on the plans. Temporary flexible dike shall be installed flush against the sides of concrete or asphalt curbs, dikes and pavement with the inner material and fabric cover cut smoothly and evenly to provide a tight flush joint.

Temporary flexible dike and rock bag dike installed as part of temporary drainage inlet protection shall be maintained to provide for adequate sediment holding capacity. Sediment deposits shall be removed when the deposit reaches one-half of the temporary flexible dike height. Removed sediment shall be deposited within the project in such a way that it is not subject to erosion by wind or water, or as directed by the Engineer.

Temporary rock bag dike consisting of filled rock bags placed in multiple layers shall be installed as shown on the plans.

When no longer required for the purpose, as determined by the Engineer, temporary drainage inlet protection facilities shall be removed. Removed facilities shall become the property of the Contractor and shall be removed from the site of the work.

Temporary drainage inlet protection damaged due to storms or as a result of the Contractors operations shall be replaced at the Contractor's at expense.

Sediment bags shall be installed by removing the drainage inlet grate, placing the sediment bag in the opening, and replacing the grate to secure the sediment bag in place. Removal of the bag shall be facilitated by the use of 25 mm steel reinforcing bars placed through the lifting loops.

Sediment bags installed as part of temporary drainage inlet protection shall be emptied when the restraint cords are no longer visible. Emptying of the bag shall be facilitated by the use of 25mm steel reinforcing bars placed through the dump loops. The sediment bag shall be emptied of material with a shovel and rinsed before replacement in the catch basin or drop inlet.

MEASUREMENT AND PAYMENT

The quantity of temporary drainage inlet protection to be paid for will be determined from each drainage inlet protected conforming to the details shown on the plans. The protection is measured one time only and no additional measurement is recognized, and no additional compensation made, if it changes during the course of construction.

The contract price paid per temporary drainage inlet protection shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing temporary drainage inlet protection, complete in place, including excavation and backfill, all modifications occurring during the course of construction, and maintenance and removal of temporary drainage inlet protection, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Temporary drainage inlet protection for protection at drainage inlets other than as shown on the project plans or directed by the Engineer, in accordance with the Contractor's Storm Water Pollution Prevention Plan will not be measured as temporary drainage inlet protection. Payment for drainage inlet protection that is required as part of the SWPPP, but is not shown on the project plans, will be paid for as specified in "Water Pollution Control" elsewhere in these special provisions.

10-1.13 TEMPORARY CONCRETE WASHOUT FACILITY

Temporary concrete washout facilities shall be constructed, maintained, and later removed as shown on the plans, in conformance with these special provisions and as directed by the Engineer. Alternative temporary concrete washout facilities may be used. The Contractor shall provide drawings, both sectional and plan view, of the alternative temporary concrete washout facilities to the Engineer for approval.

Temporary concrete washout facilities shall be installed prior to beginning any placement of concrete and located a minimum of 15 m from storm drain inlets, open drainage facilities, and watercourses, unless determined infeasible by the Engineer. Each facility shall be located away from construction traffic or access areas to prevent disturbance or tracking.

A sign shall be installed as shown on the plans adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.

Temporary concrete washout facilities shall be constructed on grade or below grade at the option of the Contractor. These facilities shall be constructed to contain all liquid and concrete waste without seepage, spillage or overflow.

MATERIALS

Materials used in the construction of temporary concrete washout facility shall conform to the following:

A. **PLASTIC SHEETING.—**Plastic sheeting shall be new and a minimum of 0.33 mm thick polyethylene sheeting and shall be free of holes, tears or other defects that compromise the impermeability of the material. Plastic sheeting shall not have seams or overlapping joints.

B. **ROCK BAG.—**Rock bag fabric shall be non-woven polypropylene, with a minimum unit weight of $250 g/m^2$. The fabric shall have a mullen burst strength of at least 2500 kPa, per ASTM Designation D3786 and an ultraviolet (UV) stability exceeding 70 percent at 500 hours. Rock bags shall have a length of 600 mm to 800 mm, width of 400 mm to 500 mm, thickness of 150 mm to 200 mm, and shall be filled to a weighted mass ranging from 13 kg to 22 kg. Rock bag fill material shall be non-cohesive, gravel, free from deleterious material. After filling, the opening shall be secured such that rock shall not escape from the bag.

C. **STRAW BALES.—**Straw for straw bales shall conform to the provisions in Section 20-2.06, "Straw," of the Standard Specifications.

Each straw bale shall be a minimum of 360 mm wide, 450 mm in height, 900 mm in length and shall have a minimum mass of 23 kg. The straw bale shall be composed entirely of vegetative matter, except for binding material.

Bales shall be bound by either wire, nylon or polypropylene string. Jute and cotton binding shall not be used. Wire shall be a minimum of 1.57 mm (16-gage) baling wire. Nylon or polypropylene string shall be approximately 2 mm in diameter with 360 N of breaking strength.

D. **STAKES.—**Stakes shall be 50 mm x 50 mm wood posts. Each stake shall have a minimum length of one meter. Metal stakes may be used as an alternative. The Contractor shall submit a sample of the metal stake to the Engineer for approval prior to installation. The tops of the metal stakes shall be bent over at a 90-degree angle. No additional compensation will be allowed for the use of a metal stake.

E. **STAPLES.—**Staples shall be made of 3.05-mm minimum steel wire and shall be U-shaped with 200-mm legs and 50-mm crown.

TEMPORARY CONCRETE WASHOUT FACILITY (TYPE ON GRADE)

Temporary concrete washout facility (type on grade) shall be constructed as shown on the plans with a minimum length of 3 m and a minimum width of 4.5 m. The length and width of a facility may be increased, at the Contractor’s expense, upon approval of the Engineer.

TEMPORARY CONCRETE WASHOUT FACILITY (TYPE BELOW GRADE)

Temporary concrete washout facility (type below grade) shall be constructed as shown on the plans with a minimum length of 3 m and a minimum width of 4.5 m. The length and width of a facility may be increased, at the Contractor’s expense, upon approval of the Engineer.

MAINTENANCE AND REMOVAL

Temporary concrete washout facilities shall be maintained to provide adequate holding capacity with a minimum freeboard of 100 mm for on grade facilities and 300 mm for below grade facilities. Maintaining temporary concrete washout facilities shall include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials shall be removed and disposed of in conformance with the provisions in Section 15-3.02, "Removal Methods," of the Standard Specifications. Minor holes and tears in the plastic sheeting may be taped as long as the repair does not compromise the impermeability of the material.

When temporary concrete washout facilities are no longer required for the work, as determined by the Engineer, the hardened concrete shall be removed and disposed of in conformance with the provisions in Section 15-3.02 of the Standard Specifications. Materials used to construct temporary concrete washout facilities shall become the property of the Contractor, shall be removed from the site of the work, and shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities shall be backfilled and repaired in conformance with the provisions in Section 15-1.02, "Preservation of Property," of the Standard Specifications.

PAYMENT

The contract price paid for temporary concrete washout facilities shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing, maintaining and removing temporary concrete washout facilities, complete in place, including straw bales, plastic lining, sign, portable delineators, lath and flagging, rock bags, stakes, staples, excavation, and backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.14 TEMPORARY ENTRANCE/EXITS

This work shall consist of constructing and maintaining the temporary entrance/exits as shown on the plans, as directed by the Engineer, and as specified in these special provisions. When no longer required for the work, temporary entrance/exits shall be removed as specified in these special provisions.

Each temporary entrance/exits shall include a clean out sump.

The type of temporary entrance/exits shall be either Type 1 or Type 2 at the option of the Contractor.

The Contractor shall provide as many temporary entrance/exits, as shall be required for the duration of the contract. Attention is directed to "Water Pollution Control" of these special provisions.

The Contractor shall use temporary entrance/exits as one of the various measures to prevent water pollution. The Storm Water Pollution Prevention Plan shall graphically show the use of temporary entrance/exits in relation to other water pollution control work specified elsewhere in these special provisions.

MATERIALS

Materials shall conform to the following:

Temporary Stabilization Fabric

Temporary stabilization fabric shall be manufactured from one or more of the following materials: polyester, nylon or polypropylene. Temporary stabilization fabric shall be, at the option of the Contractor, either a woven filament or nonwoven type fabric conforming to the following:

	Woven	Non-Woven
Weight, grams per Square Meter, Min. ASTM Designation: D3776	200	200
Grab Tensile Strength, Newtons (N), Min. ASTM Designation: D4632	890	650
Elongation at Break, Percent, Max. ASTM Designation: D4632	35 Max.	50 Min.

Temporary stabilization fabric shall be furnished in an appropriate protective cover, which shall protect it from ultraviolet radiation and from abrasion due to shipping and handling, and shall remain covered until installation. Temporary

stabilization fabric shall be accompanied by a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificate of Compliance" of the Standard Specifications.

Aggregate

Aggregate shall be uniformly graded angular rock or cobble ranging in size from 76.2 mm to 180 mm, and shall conform to the provisions in Section 26, "Aggregate Base," of the Standard Specifications and these special provisions.

Corrugated Steel Panels

Manufactured corrugated steel panels with raised bars shall be provided in individual sections. Steel plate shall be a minimum 12.7 mm thick. Bars shall be a minimum of 38.1 mm in height, approximately 12.7 mm thick at the base and tapered to 6.35 mm thick at the top of the bar, and shall be uniformly distributed 190.5 mm apart longitudinally throughout the full section of each panel. Raised bars shall be welded to the bottom plate. Each panel shall have a nominal dimension of 3 m x 2.43 m with an approximate weight of 1454 kg for each panel. Each end of the panel shall have a slot or hooked section to facilitate coupling at the ends.

CONSTRUCTION

Temporary entrance/exits shall be installed as shown on the plans and as follows:

A. Prior to placing the temporary stabilization fabric, the areas shall be cleared of all trash and debris. Vegetation shall be removed to the ground level. Cleared trash, debris, and removed vegetation shall be disposed of outside the highway right of way in accordance with the provisions in Section 7-1.13, Disposal of Material Outside the Highway Right of Way, of the Standard Specifications.
B. Temporary stabilization fabric shall be handled and placed in accordance with the manufacturer's recommendation and shall be positioned longitudinally along the alignment, pulled taut to form a tight, wrinkle-free mat. The ground to receive temporary stabilization fabric shall be graded to a uniform plane, watered and compacted, and shall be free of sharp objects that may damage the temporary stabilization fabric.
C. Adjacent borders of the fabric shall be overlapped a minimum of 450 mm.
D. Temporary stabilization fabric placed shall be covered with aggregate within 72 hours.
E. Aggregate to be placed directly over the fabric shall be spread in the direction of fabric overlaps. Stockpiling aggregate directly on the temporary stabilization fabric is not allowed. Once a sufficient working platform has been constructed, all remaining materials shall be uniformly placed and spread with 1:4 (V:H) tapers at the perimeter edges of the temporary entrance/exits where it conforms to existing roadway
F. During spreading of the aggregate, vehicles or equipment shall not be driven directly on the fabric. A sufficient thickness of aggregate shall be maintained between the fabric and the equipment to prevent damage to the fabric. Damage to the fabric resulting from the Contractor's vehicles, equipment, or operations shall be repaired at the Contractor's expense.
G. Should the fabric be damaged during placing, the damaged section shall be repaired by placing a new piece of fabric over the damaged area. The piece of fabric shall be large enough to cover the damaged area and provide a minimum 900 mm overlap on all edges.

For Type 2 temporary entrance/exits, a minimum of 3 panel sections coupled to one another is required at each temporary entrance/exits. Prior to installing panels, the ground surface shall be cleared of all debris which may prevent uniform contact with the ground surface.

Each Type 2 temporary entrance/exits shall include a clean out sump. The sump shall e constructed within 6 m of the temporary entrance/exits. The sump shall be as shown on the plans to hold soil removed from the temporary entrance/exits in order to maintain efficiency.

MAINTENANCE

The Contractor shall maintain temporary entrance/exits, throughout the contract period. The Contractor shall prevent displacement or migration of the aggregate surfacing or corrugated steel panels. Any significant depressions, as determined by the Engineer, which form due to settling or heavy traffic shall be repaired by the Contractor.

Temporary entrance/exits, shall be maintained to minimize tracking of soil and sediment onto paved roads. If the efficiency of a temporary entrance/exits to minimize tracking of soil and sediment is compromised by the buildup of soil and sediment, or by other means, as determined by the Engineer, the Contractor shall remove and dispose of the soil and sediment in conformance with Section 19, "Earthwork," of the Standard Specifications and these special provisions, install additional corrugated steel panels, or spread additional aggregate.

Pavement cleaning shall be required at all locations where construction equipment is visibly tracking sediments onto the roadway.

Pavement cleaning shall be required each and every day when temporary entrance/exits are in use. Soil and sediment or other extraneous material tracked onto pavement shall not be allowed to enter drainage facilities and shall be removed at least once each day.

Once the temporary entrance/exits are no longer needed, the aggregate, temporary stabilization fabric, and any soil and sediments shall be removed and disposed of as provided for in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way" of the Standard Specifications. Following removal of the temporary entrance/exits, areas shall be graded smooth and compacted to conform with adjacent areas.

PAYMENT

The contract price paid for temporary entrance/exit shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing temporary entrance/exit, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.15 COOPERATION

Attention is directed to Section 7-1.14, "Cooperation," and Section 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications and these special provisions.

It is anticipated that work by another contractor (Contract No. 04-000694) to grading and paving northbound Route 680 and Benicia-Martinez Bridge Toll Plaza site in Contra Costa County on Route 680 from north end of Mococo OH to Benicia-Martinez Bridge and OH (KP 39.4 to KP 40.1) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

It is anticipated that work by another contractor (Contract No. 04-006044) to construct Benicia-Martinez Bridge Toll Plaza and Administration Building in Contra Costa County on Route 680 from north end of Mococo OH to Benicia-Martinez Bridge and OH (KP 39.4 to KP 40.1) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

It is anticipated that work by another contractor (Contract No. 04-006054) to reconstruct Marina Vista Road Interchange and construct Mococo OH for approach to new Benicia-Martinez Bridge Toll Plaza in Contra Costa County on Route 680 from 0.5 Km south of Mococo OH to Benicia-Martinez bridge and OH (KP 38.5 to KP 40.1) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

It is anticipated that work by another contractor (Contract No. 04-006034) to construct second Benicia-Martinez Bridge (Br. No. 28-153R) in Contra Costa County and Solono County on Route 680 from 1.1 Km north of Mococo OH to 1.0 Km north of Contra Costa and Solono County Line (CC KP 40.1 to KP 41.4 and Sol KP L0.0 to L1.0) may be in progress adjacent to or within the limits of this project during progress of the work on this contract.

10-1.16 ELECTRONIC MOBILE DAILY DIARY SYSTEM DATA DELIVERY

Attention is directed to Sections 5-1.10, "Equipment and Plants," and 7-1.01A(3), "Payroll Records," of the Standard Specifications, and these special provisions.

The Contractor shall submit to the Engineer a list of each piece of equipment and its identifying number, type, make, model and rate code in accordance with the Department of Transportation publication entitled “Labor Surcharge and Equipment Rental Rate” which is in effect on the date the work is performed, and the names, labor rates and work classifications for all field personnel employed by the Contractor and all subcontractors in connection with the public work, together with such additional information as is identified below. This information shall be updated and submitted to the Engineer weekly through the life of the project.

This personnel information will only be used for this mobile daily diary computer system and it will not relieve the Contractor and subcontractors from all the payroll records requirements as required by Section 7-1.01A(3), "Payroll Records," of the Standard Specifications.

The Contractor shall provide the personnel and equipment information not later than 11 days after the contract award for its own personnel and equipment, and not later than 5 days before start of work by any subcontractor for the labor and equipment data of that subcontractor.

The minimum data to be furnished shall comply with the following specifications:

DATA CONTENT REQUIREMENTS

A. The Contractor shall provide the following basic information for itself and for each subcontractor that will be used on the contract:

Caltrans contract ID	Alphanumeric; up to 15 characters.
Company name.	Alphanumeric; up to 30 characters.
Federal tax ID	Alphanumeric; up to 10 characters.
State contractor license	Alphanumeric; up to 20 characters.
Company type (prime or sub)	Alphanumeric; up to 10 characters.
Address (line 1).	Alphanumeric; up to 30 characters.
Address (line 2).	Alphanumeric; up to 30 characters.
Address (city).	Alphanumeric; up to 30 chars.
Address (2-letter state code).	Alphanumeric; up to 2 characters.
Address (zip code)	Alphanumeric; up to 14 characters.
Contact FirstNname.	Alphanumeric; up to 15 characters
Contact LastName	Alphanumeric; up to 20 characters
Telephone number (with area code).	Alphanumeric; up to 20 characters.
Company code: short company name.	Alphanumeric; up to 10 characters.
Type of work (Department-supplied codes)	Alphanumeric; up to 30 characters
DBE status (Department-supplied codes)	Alphanumeric; up to 20 characters.
Ethnicity for DBE status (Department-supplied codes).	Alphanumeric; up to 20 characters.
List of laborers to be used on this contract (detail specified below).	
List of equipment to be used on this contract (detail specified below).	

For example, one such set of information for a company might be:
04-072359
XYZ CONSTRUCTION, INC.
94-2991040
AL1649T
SUB
1240 9TH STREET
SUITE 600
OAKLAND
CA
94612
JOHN
SMITH
(510) 834-9999
XYZ
PAVING
MBE
BLACK

B. The Contractor shall provide the following information for each laborer who will be used on the contract:

Caltrans contract ID	Alphanumeric; up to 15 characters.
Company code (as defined above).	Alphanumeric; up to 10 characters.
Employee ID	Alphanumeric; up to 10 characters.
Last name.	Alphanumeric; up to 20 characters.
First name.	Alphanumeric; up to 15 characters.
Middle name.	Alphanumeric; up to 15 characters.
Suffix	Alphanumeric; up to 15 characters
Labor trade (Department-provided codes).	Alphanumeric; up to 10 characters.
Labor classification (Department-provided codes).	Alphanumeric; up to 10 characters.
Regular hourly rate.	Alphanumeric; up to (6,2)
Overtime hourly rate.	Alphanumeric; up to (6,2)
Doubletime hourly rate	Alphanumeric; up to (6,2)
Standby hourly rate.	Alphanumeric; up to (6,2)
Ethnicity (Department-provided codes).	Alphanumeric; up to 20 characters.
Gender.	Alphanumeric; up to 1 characters.

For example, one such set of information might be:
04-072359
XYZ
1249
GONZALEZ
HECTOR
VINCENT
JR.
OPR
JNY
12.50
18.75
25.00
0.00
HISPANIC
M

C. The Contractor shall provide the following information for each piece of equipment that will be used on the contract:

Caltrans contract ID	Alphanumeric; up to 15 characters.
Company code (as defined above).	Alphanumeric; up to 10 characters.
Company's equipment ID number.	Alphanumeric; up to 10 characters.
Company's equipment description.	Alphanumeric; up to 60 characters.
Equipment type (from Department ratebook).	Alphanumeric; up to 60 characters.
Equipment make (from Department ratebook).	Alphanumeric; up to 60 characters.
Equipment model (from Department ratebook).	Alphanumeric; up to 60 characters.
Equipment rate code (from Department ratebook).	Alphanumeric; up to 10 characters
Regular hourly rate.	Alphanumeric; up to (6,2)
Overtime hourly rate.	Alphanumeric; up to (6,2)
Standby hourly rate	Alphanumeric; up to (6,2)
Idle hourly rate.	Alphanumeric; up to (6,2)
Rental flag.	Alphanumeric; up to 1 character.

For example, one such set of information might be:
04-072359
XYZ
B043
CAT TRACTOR D-6C
TRACC
CAT
D-6C
3645
75.00
75.00
0.00
0.00
N

DATA DELIVERY REQUIREMENTS

A. All data described in "Data Requirements" of this section shall be delivered to the Department electronically, on 3 1/2" floppy disks compatible with the Microsoft Windows operating system. The Contractor shall provide a weekly disk and hard copy of the required correct updated personnel and equipment information for the Contractor and all the subcontractors and verified correct by the Engineer.

B. Data of each type described in the previous section (contractor, labor, and equipment information) will be delivered separately, each type in one or more files on floppy disk. Any given file may contain information from one contractor or from multiple contractors, but only one type of data (contractor, labor, or equipment information).

C. The file format for all files delivered to Caltrans shall be standard comma-delimited, plain text files. This type of file (often called “CSV”) is the most standard type for interchange of formatted data; it can be created and read by all desktop spreadsheet and desktop database applications. Characteristics of this type of file are:

1. All data is in the form of plain ASCII characters.
2. Each row of data (company, person, equipment) is delimited by a carriage return character.
3. Within rows, each column (field) of data is delimited by a comma character.

D. The files shall have the following columns (i.e., each row shall have the following fields):

1. Contractor info: 17 columns (fields) as specified in "Data Requirements #1", above.
2. Labor info: 15 columns (fields) as specified in "Data Requirements #2", above.
3. Equipment info: 13 columns (fields) as specified in "Data Requirements #3", above.

For every one type of file, columns (fields) must be in the order specified under "Data Requirements", above. All columns (fields) described under "Data Requirements" must be present for all rows, even if some column (field) values are empty. The first row of each file must contain column headers (in plain text).

E. Column (field) contents must conform to the data type and length requirements described in the "Data Requirement" section, above. In addition, column (field) data must conform to the following restrictions:

1. All data shall be uppercase.
2. Company type shall be either “PRIME” or “SUB”.
3. Labor trade and classification codes must conform to a list of standard codes that will be supplied by Department.
4. Contractor type of work codes and DBE status codes must conform to a list of standard codes that will be supplied by Department.
5. Ethnicity codes must conform to standard codes that will be supplied by Department.
6. Data in the "gender" column must be either "M" or "F".
7. Data in the "rental equipment" column must be either "Y" or "N".
8. Equipment owner's description may not be omitted. (The description, together with the equipment number, is how the equipment will be identified in the field.) Include manufacturer, rated capacity & trade description
9. Equipment type, make, model, and ratebook code shall conform to the Department of Transportation Publication entitled “Labor Surcharge and Equipment Rental Rate”, which is in effect on the date the work is

performed. If the equipment in question does not have an entry in the book then alternate, descriptive entries may be made in these fields as directed by the Engineer.

F. The name of each file must indicate its contents, e.g., "labor.csv" for laborers, “equipment.csv” for equipment, and “contractor.csv” for contractors. Each floppy disk supplied to Caltrans must be accompanied by a printed list of the files it contains with a brief description of the contents of each file.

PAYMENT

Payment for providing electronic mobile daily diary computer system data delivery will be made on a lump sum basis. The lump sum bid price for electronic mobile daily diary computer system data delivery will be made according to the following schedule:

The Contractor will receive not more than 3.6 per cent per month of the total bid price for electronic mobile daily diary computer system data delivery.

After the completion of the work, 100 per cent payment will be made for electronic mobile daily diary computer system data delivery less the permanent deduction, if any, for failure to deliver complete weekly electronic mobile daily diary computer system data in each month.

The contract lump sum price paid for electronic mobile daily diary computer system data delivery shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in electronic mobile daily diary computer system data delivery as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The Department will retain an amount equal to 25 percent of the estimated value of the work performed during the first estimate period in which the Contractor fails to submit electronic mobile daily diary computer system data delivery conforming to the requirements of this section, as determined by the Engineer. Thereafter, on subsequent successive estimate periods the percentage the Department will retain will be increased at the rate of 25 percent per estimate period in which acceptable electronic mobile daily diary computer system data have not been submitted to the Engineer. Retentions for failure to submit acceptable electronic mobile daily diary computer system data shall be additional to all other retentions provided for in the contract. The retention for failure to submit acceptable electronic mobile daily diary computer system data will be released for payment on the next monthly estimate for partial payment following the date that acceptable electronic mobile daily diary computer system data is submitted to the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications, shall not apply to the item of electronic mobile daily diary computer system data delivery. Adjustments in compensation for electronic mobile daily diary computer system data delivery will not be made for any increased or decreased work ordered by the Engineer in furnishing electronic mobile daily diary computer system data.

10-1.17 ELECTRONIC EXTRA WORK REPORT

Attention is directed to Sections 5-1.10, “Equipment and Plants,” 7-1.01A(3), “Payroll Records,” Section 9-1.03C, “Records,” and 9-1.06, “Partial Payments,” of the Standard Specifications.

All extra work reports shall be furnished to the Engineer using the department’s electronic Extra Work Billing System. The Contractor shall conform to all the requirements set forth in the “Extra Work Billing System User’s Guide.” The Guide is available from the Department, and is also found on the Internet at xxxxx@dot.ca.gov. The Department will provide electronic Extra Work Billing System accounts to a Contractor’s representatives only after they have received training. The Department will provide system training to the Contractor’s authorized representatives within 30 days of the Contractor’s request for training.

An account, user identification assigned by the Department and password, used by the Contractor’s representative is deemed to meet the following signature requirement in Section 9-1.03C of the Standard Specifications: “Daily extra work reports shall be signed by the Contractor or the Contractor’s authorized representative.”

Extra work reports that include materials shall be substantiated by a valid copy of a vendor’s invoice as required in Section 9-1.03C, “Records,” of the Standard Specifications. Each invoice shall clearly identify the relative electronic extra work report and associated amount. In addition to postal service and parcel service, invoices may be sent via FAX or as an e-mail attachment if approved by the Engineer.

The Engineer will compare the Engineer’s records with the completed electronic daily extra work report, will reject a report that has an error that affects payment, and will indicate the necessary adjustments the Contractor must make prior to re-sending a corrected electronic extra work report. A daily extra work report that the Contractor’s representative sends to the Department using the electronic Extra Work Billing System is deemed signed by the Contractor. A daily extra work report that the Engineer approves using the electronic Extra Work Billing System is deemed signed by the Engineer.

Electronic submittals via the file transfer process shall conform to the Department’s specified format. The Contractor is responsible for maintaining the required data file format and satisfying criteria in the file transfer process. The Contractor is responsible for maintaining and operating the Contractor’s interface with the Department’s Extra Work Billing System.

There will be no additional compensation to the Contractor for furnishing daily extra work reports using the Department's electronic Extra Work Billing System.

10-1.18 PROGRESS SCHEDULE (CRITICAL PATH)

Progress schedules will be required for this contract. Progress schedules shall utilize the Critical Path Method (CPM). Attention is directed to "Cooperation," and "Obstructions" of these special provisions. Nothing in theses special provisions shall be construed as relieving the Contractor from the responsibilities specified in Section 7, "Legal Relations and Responsibility," of the Standard Specifications.

DEFINITIONS

The following definitions apply to this section "Progress Schedule (Critical Path)":

A. Activity: Any task, or portion of a project, which takes time to complete.
B. Baseline Schedule: The initial CPM schedule representing the Contractor's original work plan, as accepted by the Engineer.
C. Controlling Operation: The activity considered at the time by the Engineer, within that series of activities defined as the critical path, which if delayed or prolonged, will delay the time of completion of the contract.
D. Critical Path: The series of activities, which determines the earliest completion of the contract (Forecast Completion Date). This is the longest path of activities having the least amount of float.
E. Critical Path Method: A mathematical calculation to determine the earliest completion of the contract represented by a graphic representation of the sequence of activities that shows the interrelationships and interdependencies of the elements composing a project.
F. Current Contract Completion Date: The extended date for completion of the contract shown on the weekly statement of working days furnished by the Engineer in accordance with Section 8-1.06, "Time of Completion," of the Standard Specifications.
G. Early Completion Time: The difference in time between the current contract completion date and the Contractor's scheduled early forecast completion date as shown on the accepted baseline schedule, or schedule updates and revisions.
H. Float: The amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any activity or group of activities in the network.
I. Forecast Completion Date: The completion date of the last scheduled work activity identified on the critical path.
J. Fragnet: A section or fragment of the network diagram comprised of a group of activities.
K. Free Float: The amount of time an activity can be delayed before affecting a subsequent activity.
L. Hammock Activity: An activity added to the network to span an existing group of activities for summarizing purposes.
M. Milestone: A marker in a network, which is typically used to mark a point in time or denote the beginning or end of a sequence of activities. A milestone has zero duration, but will otherwise function in the network as if it were an activity.
N. Revision: A change in the future portion of the schedule that modifies logic, adds or deletes activities, or alters activities, sequences, or durations.
O. Tabular Listing: A report showing schedule activities, their relationships, durations, scheduled and actual dates, and float.
P. Total Float: The amount of time that an activity may be delayed without affecting the total project duration of the critical path.
Q. Update: The modification of the CPM progress schedule through a regular review to incorporate actual progress to date by activity, approved time adjustments, and projected completion dates.
R. Time Scaled Logic Diagram: A schematic display of the logical relationships of project activities, drawn from left to right to reflect project chronology with the positioning and length of the activity representing its duration.
S. Bar Chart (Gantt Chart): A graphic display of scheduled-related information, activities or other project elements are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.

PRECONSTRUCTION SCHEDULING CONFERENCE

The Engineer shall schedule and conduct a Preconstruction Scheduling Conference with the Contractor's Project Manager and Construction Scheduler within seven days after the bidder has received the contract for execution. At this meeting, the requirements of this section of the special provisions will be reviewed with the Contractor. The Contractor shall be prepared to discuss its schedule methodology, proposed sequence of operations, the activity identification system for labeling all work activities, the schedule file numbering system, and any deviations it proposes to make from the Stage

Construction Plans. The Engineer shall submit a diskette of a scheduling shell project, displaying an activity code dictionary consisting of fields populated with the Caltrans Scope Breakdown Structure (SBS) Code. The SBS structure will be finalized after submittal of the accepted Baseline schedule. The Contractor shall utilize these codes, and may add other codes as necessary, to group and organize the work activities. Periodically the Engineer may request the Contractor to utilize additional filters, layouts or activity codes to be able to further group or summarize work activities.

Also, the Engineer and the Contractor shall review the requirements for all submittals applicable to the contract and discuss their respective preparation and review durations. All submittals and reviews are to be reflected on the Interim Baseline Schedule and the Baseline Schedule.

INTERIM BASELINE SCHEDULE

Within 15 days after approval of the contract, the Contractor shall submit to the Engineer an Interim Baseline Project Schedule which will serve as the progress schedule for the first 120 days of the project, or until the Baseline Schedule is accepted, whichever is sooner. The Interim Baseline Schedule shall utilize the critical path method. The Interim Baseline Schedule shall depict how the Contractor plans to perform the work for the first 120 days of the contract. Additionally, the Interim Baseline Schedule shall show all submittals required early in the project, and shall provide for all permits, and other non-work activities necessary to begin the work. The Interim Baseline Schedule submittal shall include a 3 l/2 inch floppy diskette which contains the data files used to generate the schedule.

The Engineer shall be allowed 10 days to review the schedule and to provide comments, including the Contractor's application of the supplied scope breakdown structure. The Interim Baseline Schedule does not require Caltrans acceptance but all comments are to be implemented into the Baseline Schedule. Re-submittal of the Interim Baseline Schedule is not required. Late review of the Interim Baseline Schedule shall not restrain the submittal of the Baseline Schedule.

BASELINE SCHEDULE

Within 30 days, after approval of the contract, the Contractor shall submit to the Engineer a Baseline Project Schedule including the incorporation of all comments provided to the Interim Baseline Schedule. The Baseline Schedule shall have a data date of the day prior to the first working day of the contract. The schedule shall not include any actual start dates, actual finish dates, or constraint dates (except for Contract Milestone dates.) The Baseline Schedule shall meet interim milestone dates, contract milestone dates, stage construction requirements, internal time constraints, show logical sequence of activities, and must not extend beyond the number of days originally provided for in the contract.

All task activities shall be assigned to a project calendar. Each calendar shall identify a workweek, and holidays. Use different calendars for work activities that occur on different work schedules. Activities for the preparation and the review of submittals plus fabrication are to be assigned to the same calendar.

The Contractor shall not add job inefficiencies or weather days to a project calendar without prior approval by the Engineer.

The Contractor shall not assign negative lags to any activities.

The Baseline CPM Schedule submitted by the Contractor shall have a sufficient number of activities to assure adequate planning of the project and to permit monitoring and evaluation of progress and the analysis of time impacts. The Baseline Schedule shall depict how the Contractor plans to complete the whole work involved, and shall show all activities that define the critical path. Each activity shall have durations of not more than 20 working days, and not less than one working day unless permitted otherwise by the Engineer. All activities in the schedule, with the exception of the first and last activities, shall have a minimum of one predecessor and a minimum of one successor.

The Baseline Schedule shall not attribute negative float to any activity. Float shall not be considered as time for the exclusive use of or benefit of either the State or the Contractor but shall be considered as a jointly owned, expiring resource available to the project and shall not be used to the financial detriment of either party. Any accepted schedule, revision or update having an early completion date shall show the time between the early completion date and the current Contract Completion Date as "total float".

The Contractor shall be responsible for assuring that all work sequences are logical and the network shows a coordinated plan for complete performance of the work. Failure of the Contractor to include any element of work required for the performance of the contract in the network shall not relieve the Contractor from completing all work within the time limit specified for completion of the contract. If the Contractor fails to define any element of work, activity or logic, the Contractor in the next monthly update or revision of the schedule shall correct it.

The Baseline Schedule shall be supplemented with resource allocations for every task activity to a level of detail that facilitates report generation based on labor craft and equipment class for the Contractor and subcontractors. The Contractor shall use average composite crews to display the labor loading of on-site construction activities. On the P3 resource dictionary, each resource should have the normal and maximum limits for the specified period of time. Based on the resource limits, the Contractor shall 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. Along with the baseline progress schedule, the

Contractor shall also submit to the Engineer time-scaled resource histograms of the labor crafts and equipment classes to be utilized on the contract.

The Contractor shall not create hammock activities for the purpose of resources loading.

The Contractor shall require each subcontractor to submit in writing a statement certifying that the subcontractor has concurred with the Contractor's CPM, including major updates, and that the subcontractor's related schedule has been incorporated accurately, including the duration of activities, labor and equipment loading. Should the Baseline Schedule or schedule update, submitted for acceptance, show variances from the requirements of the contract, the Contractor shall make specific mention of the variations in the letter of transmittal, in order that, if accepted, proper adjustments to the project schedule can be made. The Contractor will not be relieved of the responsibility for executing the work in strict accordance with the requirements of the contract documents. In the event of a conflict between the requirements of the contract documents and the information provided or shown on an accepted schedule, the requirements of the contract documents shall take precedence.

Each schedule submitted to the Engineer shall comply with all limits imposed by the contract, with all specified intermediate milestone and contract completion dates, and with all constraints, restraints or sequences included in the contract. The degree of detail shall include factors including, but not limited to:

A. Physical breakdown of the project;
B. Contract milestones and completion dates, substantial completion dates, constraints, restraints, sequences of work shown in the contract, the planned substantial completion date, and the final completion date;
C. Type of work to be performed, the sequences, and the major subcontractors involved;
D. All purchases, submittals, submittal reviews, manufacture, fabrication, tests, delivery, and installation activities for all major materials and equipment, including submittal of requests for audits of manufacturers and fabricators in conformance with "Manufacturing and Fabrication Qualification Audit for Materials" of these special provisions;
E. Preparation, submittal and approval of shop and working drawings and material samples, showing time, as specified elsewhere, for the Engineer's review. The same time frame shall be allowed for at least one resubmittal on all major submittals so identified in the contract documents;
F. Identification of interfaces and dependencies with preceding, concurrent and follow-on contractors, railroads, and utilities as shown on the plans or specified in the specifications;
G. Identification of each and every utility relocation and interface as a separate activity, including activity description and responsibility coding that identifies the type of utility and the name of the utility company involved;
H. Actual tests, submission of test reports, and approval of test results;
I. All start-up, testing, training, and assistance required under the Contract;
J. Punchlist and final clean-up;
K. Identification of any manpower, material, or equipment restrictions, as well as any activity requiring unusual shift work, such as double shifts, 6-day weeks, specified overtime, or work at times other than regular days or hours;
L. Identification of each and every ramp closing and opening event as a separate one-day activity, including designation by activity coding and description that it is a north-bound, south-bound, east-bound, west-bound, and entry or exit ramp activity;
M. Separate resources graphs for the Contract's labor, equipment and critical path labor, with an accompanying analysis of each and explanation for any variances (i.e., example front-end resource loading of schedules); and
N. Equipment and labor shall be differentiated by a cost account code within the resource dictionary.

The Baseline Schedule submittal shall include a 3 l/2 inch floppy diskette which contains the data files used to generate the schedule, a schedule narrative describing the critical path, narratives providing additional schedule detail as requested by the Engineer and all schedule reports.

The Engineer shall be allowed 15 days to review and accept or reject the baseline project schedule submitted. Rejected schedules shall be resubmitted to the Engineer within 5 days, at which time a new 15 day review period by the Engineer will begin.

PROJECT SCHEDULE REPORTS

Schedules submitted to the Engineer including Interim Baseline, Baseline, and update schedules shall include time scaled network diagrams in a layout format requested by the Engineer. The network diagrams submitted to the Engineer shall also be accompanied by four computer-generated mathematical analysis tabular reports for each activity included in the project schedule. The reports (8 1/2” x 11” size) shall include a network diagram report showing the activity columns only, a predecessor and successor report, a resource report (Interim Baseline and Baseline Schedules), and a scheduling and leveling calculation report. The network diagram report~~s~~ shall include, at a minimum, the following for each activity:

A. Activity number and description;
B. Activity codes;
C. Original, actual and remaining durations;
D. Early start date (by calendar date);
E. Early finish date (by calendar date);
F. Actual start date (by calendar date);
G. Actual finish date (by calendar date);
H. Late start date (by calendar date);
I. Late finish date (by calendar date);
J. Identify activity calendar ID;
K. Total Float and Free Float, in work days; and
L. Percentage complete.

Network diagrams shall be sorted and grouped in a format requested by the Engineer reflecting the project breakdown per the Caltrans scope breakdown structure codes. They shall show a continuous flow of information from left to right per the project sorting and grouping codes. E.g., project milestones, submittals sub-grouped by description, and the construction activities sub-grouped by the scope breakdown structure. The primary paths of criticality shall be clearly and graphically identified on the networks. The network diagram shall be prepared on E-size sheets (36" x 48"), shall have a title block in the lower right-hand corner, and a timeline on each page. Exceptions to the size of the network sheets and the use of computer graphics to generate the networks shall be subject to the approval of the Engineer.

Schedule network diagrams the tabular reports shall be submitted to the Engineer for acceptance in the following quantities:

A. 2 sets of the Network Diagrams;
B. 2 copies of the tabular reports (8 1/2" x 11" size); and
C. 3 computer diskettes.

WEEKLY SCHEDULE MEETINGS

The Engineer and the Contractor shall hold weekly scheduling meetings to discuss the near term schedule activities, to address any long-term schedule issues, and to discuss any relevant technical issues. The Contractor shall develop a rolling 4-weeks schedule identifying the previous week worked and a 3-week look ahead. It shall provide sufficient detail to include the actual and planned activities of the Contractor and all the subcontractors for offsite and construction activities, addressing all activities to be performed and to identify issues requiring engineering action or input.

Each activity in the 4 week rolling schedule should be identified by an associated CPM schedule activity ID numbering system. This schedule should not be hand written. To create the 4 weeks rolling schedules, the Contractor should utilize the use of EXCEL spreadsheet, or Primavera scheduling software, as acceptable by the Engineer. The Engineer will provide the format of the schedule. This schedule should be electronically submitted to the Engineer one day prior to the scheduled meeting date.

MONTHLY UPDATE SCHEDULES

The Contractor shall submit a Monthly Update Schedule to the Engineer once in each month within 5 days of the data date. The proposed update schedule prepared by the Contractor shall include all information available as of the 20th calendar day of the month, or other data date as established by the Engineer. A detailed list of all proposed schedule changes such as logic, duration, lead/lag, forecast completion date, additions and deletions shall be submitted with the update.

The monthly update of the schedule shall focus on the period from the last update to the current cut-off data date. Changes to activities or logic beyond the data date are classified as revisions and need to be addressed per the schedule revision section of this specification. Activities that have either started or finished shall be reported as they actually occurred and designated as complete, if actually completed. For activities in progress that are forecasted to complete longer than planned, the remaining durations shall be revised, not the original durations. All out of sequence activities are to be reviewed and their relationships either verified or changed.

The Monthly Update Schedule submitted to the Engineer shall be accompanied by a Schedule Narrative Report. The report shall describe the physical progress during the report period, plans for continuing the work during the forthcoming report period, actions planned to correct any negative float, and an explanation of potential delays or problems and their estimated impact on performance, milestone completion dates, forecast completion date, and the overall project completion date. In addition, alternatives for possible schedule recovery to mitigate any potential delay or cost increases shall be included for consideration by the Engineer. The report shall follow the outline set forth below:

Contractor's Schedule Narrative Report Outline:

A. Contractor's Transmittal Letter;
B. Work completed during the period;
C. Description of the current critical path;
D. Description of current problem areas;
E. Current and anticipated delays;
    1. Cause of the delay;
    2. Corrective action and schedule adjustments to correct the delay; and
    3. Impact of the delay on other activities, milestones, and completion dates;
F. Changes in construction sequences;
G. Pending items and status thereof;
    1. Permits;
    2. Change Orders;
    3. Time Extensions; and
    4. Non-Compliance Notices;
H. Contract completion date(s) status;
    1. Ahead of schedule and number of days; and
    2. Behind schedule and number of days; and
I. Include updated Network Diagram and Reports.

The Contractor shall provide to the Engineer a 3 1/2” electronic disk of the schedule, together with printed copies of the network diagrams and tabular reports described under "Project Schedule Reports", and the Schedule Narrative Report.

Portions of the network diagram on which all activities are complete need not be reprinted and submitted in subsequent updates. However, the electronic disk file of the submitted schedule and the related reports shall constitute a clear record of progress of the work from award of contract to final completion.

On a date determined by the Engineer, the Contractor shall meet with the Engineer to review the monthly schedule update. At the monthly progress meeting, the Contractor and the Engineer shall review the updated schedule and shall discuss the content of the Narrative Report. The Engineer shall be allowed 10 days after the meeting to review and accept or reject the update schedule submitted. Rejected schedules shall be resubmitted to the Engineer within 5 days, at which time a new 5 day review period by the Engineer will begin. All efforts shall be made between the Engineer and the Contractor to complete the review and the acceptance process prior to the next update schedule data date. To expedite the process a second meeting between the Engineer and the Contractor shall be held.

SCHEDULE REVISIONS

If the Contractor desires to make a change to the accepted schedule, the Contractor shall request permission from the Engineer in writing, stating the reasons for the change, and proposed revisions to activities, logic and duration. The Contractor shall submit for acceptance an analysis showing the effect of the revisions on the entire project. The analysis shall include:

A. An updated schedule not including the revisions. The schedule shall have a data date just prior to implementing the proposed revisions and includes a project completion date;
B. A revised schedule that includes the proposed revisions. The schedule will have the same data date as the updated schedule and include a project completion date;
C. The Contractor should add resources for all new activities, also adjust resources for those activities that their remaining duration were changed;
D. A narrative explanation of the revisions and their impact to the schedule; and
E. Computer files of the updated schedule and the revised schedule sequentially numbered or renamed for archive (record) purposes.

The Engineer will provide a response within 10 days. No revision to the accepted baseline schedule or the schedule updates shall be made without the prior written approval of the Engineer.

The Engineer will request the Contractor to submit a proposed revised schedule within 15 days when:

A. there is a significant change in the Contractor's operations that will affect the critical path;
B. the current updated schedule indicates that the contract progress is 4 weeks or more behind the planned schedule, as determined by the Engineer; or

C. the Engineer determines that an approved or anticipated change will impact the critical path, milestone or completion dates, contract progress, or work by other contractors.

The Engineer shall be allowed 10 days to review and accept or reject a schedule revision. Rejected schedule revisions shall be revised and resubmitted to the Engineer within 10 days, at which time a new 10 day review period by the Engineer will begin. Only upon approval of a change by the Engineer shall it be reflected in the next schedule update submitted by the Contractor.

SCHEDULE TIME EXTENSION REQUESTS

When the Contractor requests a time extension due to contract change orders or delays, the Contractor shall submit to the Engineer a written Time Impact Analysis illustrating the influence of each change or delay on the current contract completion date or milestone completion date, utilizing the current accepted schedule. Each Time Impact Analysis shall include a schedule update and schedule revision, both with the same data dates, demonstrating how the Contractor proposes to incorporate the Change Order or delay into the current schedule. The schedule revision shall include the sequence of activities and any revisions to the existing activities to demonstrate the influence of the delay, the proposed method for incorporating the delay, and its impact into the schedule.

Each Time Impact Analysis shall demonstrate the estimated time impact based on the events of delay, the anticipated or actual date of the contract change order work performance, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest update of the current schedule in effect at the time the change or delay was encountered.

Time extensions will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total or remaining float along the critical path of activities at the time of actual delay, or at the time the contract change order work is performed. Float time is not for the exclusive use or benefit of the Engineer or the Contractor, but is an expiring resource available to all parties as needed to meet contract milestones and the contract completion date. Time extensions will not be granted nor will delay damages be paid unless:

A. the delay is beyond the control and without the fault or negligence of the Contractor and its subcontractors or suppliers, at any tier; and
B. the delay extends the actual performance of the work beyond the applicable current contract completion date and the most recent date predicted for completion of the project on the accepted schedule update current as of the time of the delay or as of the time of issuance of the contract change order.

Time Impact Analyses shall be submitted in triplicate within 15 days after the delay occurs or after issuance of the contract change order. A schedule file diskette is also to be submitted.

Acceptance or rejection of each Time Impact Analysis by the Engineer will be made within 15 days after receipt of the Time Impact Analysis, unless subsequent meetings and negotiations delay the review. A copy of the Time Impact Analysis accepted by the Engineer shall be returned to the Contractor and the accepted schedule revisions illustrating the influence of the contract change orders or delays shall be incorporated into the project schedule during the first update after acceptance.

FINAL SCHEDULE UPDATE

Within 15 days after the acceptance of the contract by the Director, the Contractor shall submit a final update of the schedule with actual start and actual finish dates for all activities. This schedule submission shall be accompanied by a certification, signed by an officer of the company and the Contractor's Project Manager stating "To the best of my knowledge, the enclosed final update of the project schedule reflects the actual start and completion dates of the activities contained herein."

EQUIPMENT AND SOFTWARE

The Contractor shall provide for the State's exclusive possession and use a complete computer system specifically capable of creating, storing, updating and producing CPM schedules. Before delivery and setup of the computer system, the Contractor shall submit to the Engineer for approval a detailed list of all computer hardware and software the Contractor proposes to furnish. The minimum computer system to be furnished shall include the following:

A. Complete computer system, including keyboard, mouse, 20 inch color SVGA monitor (1024x768 pixels), Intel Pentium III 850 MHz microprocessor chip, or equivalent;
B. Computer operating system software, compatible with the selected processing unit, for Windows 95 or later or equivalent;
C. Minimum one-twenty-eight (128) megabytes of random access memory (RAM);

D. A 6.4 gigabytes minimum hard disk drive, a 1.44 megabyte 3 1/2 inch floppy disk drive, 32x speed minimum CD-ROM drive, Ethernet card and 56k modem;
E. A color-ink-jet plotter with a minimum 36 megabyte RAM, capable of 300 dots per inch color, 600 dots per inch monochrome, or equivalent, capable of printing fully legible, time scaled charts, and network diagrams, in four colors, with a minimum size of 36inches by 48 inches (E size) and is compatible with the selected system, an HP Design Jet 1055 CM or equivalent, plotter stand, roll paper assembly and automatic paper cutter, and provide plotter paper and ink cartridges throughout the contract;
F. CPM software shall be Primavera Project Planner, the latest version for Windows 95, or later;
G. Scheduler Analyzer Pro or equivalent (a suite of programs to assist in schedule analysis) in the latest version for Windows 95, Windows NT or later; and
H. Microsoft Office Software, the latest version for Windows 95, Windows NT or later and McAfee Virus software or equivalent.

The computer hardware and software furnished shall be compatible with that used by the Contractor for the production of the CPM progress schedule required by the Contract, and shall include original instruction manuals and other documentation normally provided with the software.

The Contractor shall furnish, install, set up, maintain and repair the computer hardware and software ready for use at a location determined by the Engineer. The hardware and software shall be installed and ready for use by the first submission of the baseline schedule. The Contractor shall provide 24 hours of formal training for the Engineer, and three other agents of the department designated by the Engineer, in the use of the hardware and software to include schedule analysis, reporting, and resource and cost allocations. An authorized vendor of Project Primavera shall perform the training.

All computer hardware and software furnished shall remain the property of the Contractor and shall be removed by the Contractor upon acceptance of the contract when no claims involving contract progress are pending. When claims involving contract progress are pending, computer hardware or software shall not be removed until the final estimate has been submitted to the Contractor.

PAYMENT

Progress schedule (critical path) will be paid for at a lump sum price. The contract lump sum price paid for progress schedule (critical path) shall include full compensation for furnishing all labor, materials (including computer hardware and software), tools, equipment, and incidentals; and for doing all the work involved in preparing, furnishing, updating and revising CPM progress schedules. Also for maintaining and repairing the computer hardware and training the Engineer in the use of the computer hardware and software as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Payments for progress schedule (critical path) will be made as follows:

A. Interim baseline schedule accepted, then 10 percent payment for progress schedule (critical path) will be made.
B. Baseline schedule accepted, then 10 percent payment for progress schedule (critical path) will be made.
C. Monthly update schedules accepted, then 75 percent payment for progress schedule (critical path) will be made equally for each update.
D. Final schedule update accepted, then 5 percent payment for progress schedule (critical path) will be made.

The Department will retain an amount equal to 25 percent of the estimated value of the work performed during the first estimate period in which the Contractor fails to submit an interim baseline, baseline, revised or updated CPM schedule conforming to the requirements of this section, as determined by the Engineer. Thereafter, on subsequent successive estimate periods the percentage the Department will retain will be increased at the rate of 25 percent per estimate period in which acceptable CPM progress schedules have not been submitted to the Engineer. Retention's for failure to submit acceptable CPM progress schedules shall be additional to all other retention's provided for in the contract. The retention for failure to submit acceptable CPM progress schedules will be released for payment on the next monthly estimate for partial payment following the date that acceptable CPM progress schedules are submitted to the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications, shall not apply to the item of progress schedule (critical path). Adjustments in compensation for the project schedule will not be made for any increased or decreased work ordered by the Engineer in furnishing project schedules.

10-1.19 OVERHEAD

The Contractor will be compensated for overhead in accordance with these special provisions.

Attention is directed to "Force Account Payment" and "Progress Schedule (Critical Path)" of these special provisions.

Section 9-1.08, "Adjustment of Overhead Costs," 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 costs shall not include costs that are not related to time, including but not limited to mobilization, licenses, permits, and any other charges incurred only once during duration of the contract.

The contract price paid per working day for time related overhead shall include full compensation for time related overhead incurred by the Contractor and by any joint venture partner, subcontractor, supplier or other party associated with the Contractor.

The contract price per working day bid for time related overhead will be adjusted only as a result of suspensions and adjustments of time which revise the current contract completion date and which are also any of the following:

A. suspensions of work ordered in accordance with Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications, except:

    1. suspensions ordered due to the failure on the part of the Contractor to carry out orders given, or to perform any provision of the contract; and
    2. suspensions ordered due to unsuitable weather conditions;

B. extensions of time granted by the State in accordance with the provisions of the fifth paragraph of Section 8-1.07, "Liquidated Damages," of the Standard Specifications; or
C. reductions in contract time set forth in approved contract change orders, in accordance with Section 4-1.03, "Changes," of the Standard Specifications.

For each day the number of working days bid to complete the contract, in conformance with the provisions in Section 4, "Beginning Of Work, Time Of Completion And Liquidated Damages," of these special provisions, is adjusted due to suspensions or adjustments as specified above, the price per working day for time related overhead will be adjusted by an amount equal to the contract price per working day bid for time related overhead divided by the number of working days bid to complete the contract. 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 time related overhead.

For the purpose of making partial payments pursuant to Section 9-1.06, “Partial Payments,” of the Standard Specifications, time related overhead to be paid in each monthly estimate will be based on the number of working days that occurred during that monthly estimate period. The amount earned per day for time related overhead shall be the lesser of the following amounts:

A. the contract price per working day for time related overhead, divided by the number of working days bid to complete the contract, in conformance with the provisions in Section 4, "Beginning Of Work, Time Of Completion And Liquidated Damages," of these special provisions; or
B. fifteen percent of the original contract amount, divided by the number of working days bid to complete the contract, in conformance with the provisions in Section 4, "Beginning Of Work, Time Of Completion And Liquidated Damages," of these special provisions.

After acceptance of the contract pursuant to Section 7-1.17, “Acceptance of Contract,” of the Standard Specifications, the amount, if any, of the contract price per working day for time related overhead not yet paid will be included for payment in the first estimate made after acceptance of the contract in accordance with Section 9-1.07, “Payment after Acceptance,” of the Standard Specifications.

Full compensation for all overhead costs, including overhead costs for increases in the quantity of contract items of work; other than time related overhead 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.

10-1.20 OBSTRUCTIONS

Attention is directed to Section 8-1.10, "Utility and Non-Highway Facilities," and Section 15, "Existing Highway Facilities," of the Standard Specifications and these special provisions.

Attention is directed to the existence of certain underground facilities that may require special precautions be taken by the Contractor to protect the health, safety and welfare of workers and of the public. Facilities requiring special precautions include, but are not limited to: conductors of petroleum products, oxygen, chlorine, and toxic or flammable gases; natural gas in pipelines greater than 150 mm in diameter or pipelines operating at pressures greater than 415 kPa (gage); underground electric supply system conductors or cables, with potential to ground of more than 300 V, either directly buried or in a duct or conduit which do not have concentric grounded or other effectively grounded metal shields or sheaths.

If these facilities are not located on the plans in both alignment and elevation, no work shall be performed in the vicinity of the facilities, except as provided herein for conduit to be placed under pavement, until the owner, or the owner's representative, has located the facility by potholing, probing or other means that will locate and identify the facility. Conduit to be installed under pavement in the vicinity of these facilities shall be placed by the trenching method in conformance with the provisions in "Conduit" of these special provisions. If, in the opinion of the Engineer, the Contractor's operations are delayed or interfered with by reason of the utility facilities not being located by the owner or the owner's representative, 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, and not otherwise, except as provided in Section 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications.

The Contractor shall notify the Engineer and the appropriate regional notification center for operators of subsurface installations at least 2 working days, but not more than 14 calendar days, prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire or other structure. Regional notification centers include, but are not limited to, the following:

Notification Center	Telephone Number
Underground Service Alert-Northern California (USA)	1-800-642-2444 1-800-227-2600
Underground Service Alert-Southern California (USA)	1-800-422-4133 1-800-227-2600

It is anticipated that the following utility facilities will be relocated prior to the dates shown:

Utility	Location	Date
PG&E/Pac Bell - Relocate OH Elect & Telephone Lines	12.31 Rt "EN" 12+38.2 to 50.56 Rt "EN" 18+45.2	9/30/01
PG&E/Pac Bell - Relocate OH Elect & Telephone Lines	(PG&E Portion) 24.11 Rt "SW" 22+69.27 to 9.6 Rt "EN" 15+51.60 (Pac Bell Portion) 16.03 Lt "PR" 4+82.78 to 9.6 Rt "EN" 15+51.6	9/30/01
PG&E - Remove OH Elect Lines	9 Lt "SW" 23+42 to 4.0 Lt "SW" 22+19	9/30/01
PG&E - Remove OH Elect Lines	24.11 Rt "SW" 22+69.27 to 18.5 Lt "EN" 16+40	9/30/01
PG&E/Pac Bell - Remove OH Elect & Telephone Lines	104 Rt "EN" 22+40 to 18.5 Rt "NW" 22+00	9/30/01
PG&E/Pac Bell - Remove OH Elect & Telephone Lines	5 Lt "NW" 21+65 to 38.5 Lt "NB" 21+50	9/30/01
PG&E/Pac Bell - Remove OH Elect & Telephone Lines	12.31 Rt "EN" 12+38.2 to 1.5 Rt "EN" 17+66.5	9/30/01
PG&E/Pac Bell - Remove OH Elect & Telephone Lines	9.6 Rt "EN" 15+51.60 to 16.03 Lt "PR" 4+82.78	9/30/01
PG&E - Remove OH Elect Lines	13 Lt “EN 15+13.5 to 32.5 Rt “EN” 15+08	9/30/01
PG&E - Remove OH Elect Lines	13 Lt “EN 15+13.5 to 9.0 Rt “EN” 15+26	9/30/01
PG&E - Remove OH Elect Lines	1.5 Lt “EN 17+66.5 to 27 Rt “EN” 17+85	9/30/01
PG&E - Remove OH Elect Lines	1.5 Lt “EN 17+66.5 to 50.56 Rt “EN” 18+45.2	9/30/01

In the event that the utility facilities mentioned above are not removed or relocated 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 utility facilities not being removed or relocated 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, and not otherwise, except as provided in Section 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications.

10-1.21 MOBILIZATION

Mobilization shall conform to the provisions in Section 11, "Mobilization," of the Standard Specifications.

10-1.22 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES

Flagging, signs, and all other 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 traffic control devices are defined as those devices that are small and lightweight (less than 45 kg), and have been in common use for many years. The devices shall be known to be crashworthy by crash testing, crash testing of similar devices, or years of demonstrable safe performance. Category 1 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 traffic control devices. Self-certification shall be provided by the manufacturer or Contractor and shall include the following: date, Federal Aid number (if applicable), expenditure authorization, district, county, route and kilometer post of project limits; company name of certifying vendor, street address, city, state and zip code; printed name, signature and title of certifying person; and an indication of which Category 1 traffic control devices will be used on the project. The Contractor may obtain a standard form for self-certification from the Engineer.

Category 2 traffic control devices are defined as those items that are small and lightweight (less than 45 kg), that are not expected to produce significant vehicular velocity change, but may otherwise be potentially hazardous. Category 2 traffic control devices include: barricades and portable sign supports.

Category 2 devices purchased on or after October 1, 2000 shall be on the Federal Highway Administration (FHWA) Acceptable Crashworthy Category 2 Hardware for Work Zones list. This list is maintained by FHWA and can be located at the following internet address: http://safety.fhwa.dot.gov/fourthlevel/hardware/listing.cfm?code=workzone. The Department maintains a secondary list at the following internet address: http://www.dot.ca.gov/hq/traffops/signtech/signdel/pdffiles.htm.

Category 2 devices that have not received FHWA acceptance, and were purchased before October 1, 2000, may continue to be used until they complete their useful service life or until January 1, 2003, whichever comes first. Category 2 devices in use that have received FHWA acceptance shall be labeled with the FHWA acceptance letter number and the name of the manufacturer by the start of the project. The label shall be readable. After January 1, 2003, all Category 2 devices without a label shall not be used on the project.

If requested by the Engineer, the Contractor shall provide a written list of Category 2 devices to be used on the project at least 5 days prior to beginning any work using the devices. For each type of device, the list shall indicate the FHWA acceptance letter number and the name of the manufacturer.

Full compensation for providing self-certification for crashworthiness of Category 1 traffic control devices and for providing a list of Category 2 devices used on the project and labeling Category 2 devices as specified shall be considered as included in the prices paid for the various contract items of work requiring the use of the Category 1 or Category 2 traffic control devices and no additional compensation will be allowed therefor.

10-1.23 CONSTRUCTION AREA SIGNS

Construction area signs 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 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.

Attention is directed to "Construction Project Information Signs" of these special provisions regarding the number and type of construction project information signs to be furnished, erected, maintained, and removed and disposed of.

The Contractor shall notify the appropriate regional notification center for operators of subsurface installations at least 2 working days, but not more than 14 calendar 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-Northern California (USA)	1-800-642-2444 1-800-227-2600
Underground Service Alert-Southern California (USA)	1-800-422-4133 1-800-227-2600

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.

Sign substrates for stationary mounted construction area signs may be fabricated from fiberglass reinforced plastic as specified under "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

10-1.24 MAINTAINING TRAFFIC

Attention is directed to Sections 7-1.08, "Public Convenience," 7-1.09, "Public Safety," and 12, "Construction Area Traffic Control Devices," of the Standard Specifications and to the provisions in "Public Safety" of these special provisions and these special provisions. Nothing in these special provisions shall be construed as relieving the Contractor from the responsibilities specified in Section 7-1.09.

Lane closures shall conform to the provisions in section "Traffic Control System for Lane Closure" of these special provisions.

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 meters between fixtures.

EB 780/NB 680 CONNECTOR
(Bridge No. 23-0211G) at ES alignment (EB 780 to SB 680)

	Number	Width	Height
Vehicle Openings	1	11.1	4.6
	Location	Spacing	
Falsework Pavement Lighting	R and L	12 staggard 1/2 space	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

EB 780/NB 680 CONNECTOR
(Bridge No. 23-0211G) at NW alignment

	Number	Width	Height
Vehicle Openings	1	14.7	4.6
	Location	Spacing	
Falsework Pavement Lighting	R and L	9	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

EB 780/NB 680 CONNECTOR
(Bridge No. 23-0211G) at SB alignment

	Number	Width	Height
Vehicle Openings	1	11.1	4.6
	Location	Spacing	
Falsework Pavement Lighting	R and L	12 staggered 1/2 space	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

EB 780/NB 680 CONNECTOR
(Bridge No. 23-0211G) at NB alignment

	Number	Width	Height
Vehicle Openings	1	18.3	4.6
	Location	Spacing	
Falsework Pavement Lighting	R and L	12 with C 12 staggered 1/2 space	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

EB 780/NB 680 CONNECTOR
(Bridge No. 23-0211G) at Park Road

	Number	Width	Height
Vehicle Openings	1	6	4.6
	Location	Spacing	
Falsework Pavement Lighting	R	7	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

EB 780/NB 680 CONNECTOR
(Bridge No. 23-0211G) at Oak Road

	Number	Width	Height
Vehicle Openings	1	6	4.6
	Location	Spacing	
Falsework Pavement Lighting	R	7	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

EB 780/NB 680 CONNECTOR
(Bridge No. 23-0211G) at Park Road

	Number	Width	Height
Pedestrian Openings	1	1.23	2.44

NB 680/ WB 780 CONNECTOR &OH
(Bridge No. 23-0212G) at Bay Shore Road

	Number	Width	Height
Vehicle Openings	1	7.2	4.6
	Location	Spacing	
Falsework Pavement Lighting	R and L	12 with C 12 staggered 1/2 space	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

NB 680/ WB 780 CONNECTOR
(Bridge No. 23-0214G) at existing SB 680

	Number	Width	Height
Vehicle Openings	1	7.2	4.6
	Location	Spacing	
Falsework Pavement Lighting	R	7	

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

BENICIA-MARTINEZ APPROACH STRUCTURE
(Bridge No. 23-0215R) at Bay Shore Road

	Number	Width	Height
Vehicle Openings	1	7.2	4.6

	Location	Spacing
Falsework Pavement Lighting	R and L	12 with C 12 staggered 1/2 space

(Width and Height in meters)
(R = Right side of traffic. L = Left side of traffic)
(C = Centered overhead)

The exact location of openings will be determined by the Engineer.

Personal vehicles of the Contractor's employees shall not be parked within the right of way.

The Contractor shall notify local authorities of the Contractor's intent to begin work at least 5 days before work is begun. The Contractor shall cooperate with local authorities relative to handling traffic through the area and shall make arrangements relative to keeping the working area clear of parked vehicles.

Whenever vehicles or equipment are parked on the shoulder within 1.8 m of a traffic lane, the shoulder area shall be closed as shown on the plans.

Lanes shall be closed only during the hours shown on the charts included in this section "Maintaining Traffic." Except work required under Sections 7-1.08 and 7-1.09, work that interferes with public traffic shall be performed only during the hours shown for lane closures and the following:

Park Road - No lane closure on Friday and Saturday between 7:00 a.m. and 6:00 p.m. At all other times, a minimum of one paved traffic lane, not less than 3 m wide, shall be open for use by public traffic. When construction operations are not actively in progress, not less than 2 of these lanes shall be open to public traffic.

Hospital Road - No lane closure on Wednesday and Sunday between 7:00 a.m. and 5:30 p.m. At all other times, a minimum of one paved traffic lane, not less than 3 m wide, shall be open for use by public traffic. When construction operations are not actively in progress, not less than 2 of these lanes shall be open to public traffic.

Bayshore Road - No lane closure on Monday through Friday between 8:00 a.m. and 5:00 p.m., unless approved in writing by the Engineer. At all other times, a minimum of one paved traffic lane, not less than 3 m wide, shall be open for use by public traffic. When construction operations are not actively in progress, not less than 2 of these lanes shall be open to public traffic.

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.

Minor deviations from the requirements of this section concerning hours of work which do not significantly change the cost of the work may be permitted upon the written request of the Contractor, if in the opinion of the Engineer, public traffic will be better served and the work expedited. These deviations shall not be adopted by the Contractor until the Engineer has approved the deviations in writing. All other modifications will be made by contract change order.

Chart No. 1
Multilane Lane Requirements

Location: Route 680 NB -On the mainline, from WB Rte. 780 Off to EB Rte. 780 On.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	1																	1	1	1	
Fridays	x	x	x	x	1																			1	
Saturdays	1	x	x	x	x	1	1																	1	
Sundays	1	x	x	x	x	x	1	1	1															1	
Day before designated legal holiday	x	x	x	x	1																			1	
Designated legal holidays	1	x	x	x	x	x	1	1	1															1	

Legend:

x	Freeway may be completely closed and traffic detoured or one lane may be closed.
1	One lane may be closed.
	No freeway, lane or shoulder closure allowed.

REMARKS: Complete freeway closure for installation of falsework only. To be used with detour Plan #1 in Contract Plans.

Chart No. 2
Multilane Lane Requirements

Location: Route 680 NB -On the mainline, from EB Rte. 780 On to Bayshore Rd. Off-Ramp.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	1																	1	1	1	
Fridays	x	x	x	x	1																			1	
Saturdays	1	x	x	x	x	1	1																	1	
Sundays	1	x	x	x	x	x	1	1	1															1	
Day before designated legal holiday	x	x	x	x	1																			1	
Designated legal holidays	1	x	x	x	x	x	1	1	1															1	

Legend:

x	Freeway may be completely closed and traffic detoured or one lane may be closed.
1	One lane may be closed.
	No freeway, lane or shoulder closure allowed.

REMARKS: Complete freeway closure for installation of sign structure only. To be used with detour Plan #2 in Contract Plans.

Chart No. 3
Multilane Lane Requirements

Location: Route 680 SB -On the mainline, from Bayshore Rd. On-Ramp to WB Rte. 780 Off.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	1																	1	1	x	
Fridays	x	x	x	x	1																	1	1	1	
Saturdays	x	x	x	x	x	1	1																1	1	
Sundays	x	x	x	x	x	x	1	1	1															1	
Day before designated legal holiday	x	x	x	x	1																	1	1	1	
Designated legal holidays	x	x	x	x	x	x	1	1	1															1	

Legend:

x	Freeway may be completely closed and traffic detoured or one lane may be closed.
1	One lane may be closed.
	No freeway, lane or shoulder closure allowed.

REMARKS: Complete freeway closure for installation of sign structure only. To be used with detour Plan #3 in Contract Plans.

Chart No. 4
Multilane Lane Requirements

Location: Route 680 SB -On the mainline, from WB Rte. 780 Off to EB Rte. 780 On.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	1																1	1	1	x	
Fridays	x	x	x	x	1																	1	1	1	
Saturdays	x	x	x	x	x	1	1																	1	
Sundays	x	x	x	x	x	x	1	1	1															1	
Day before designated legal holiday	x	x	x	x	1																	1	1	1	
Designated legal holidays	x	x	x	x	x	x	1	1	1															1	

Legend:

x	Freeway may be completely closed and traffic detoured or one lane may be closed.
1	One lane may be closed.
	No freeway, lane or shoulder closure allowed.

REMARKS: Complete freeway closure for installation of sign structure only. To be used with detour Plan #4 in Contract Plans.

Chart No. 5
Multilane Lane Requirements

Location: Route 780 WB -From Junction SB Rte. 680/WB Rte. 780 to East 5th St. Off-Ramp.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	1	1																	1	x	
Fridays	x	x	x	x	1	1																	1	1	
Saturdays	1	x	x	x	x	1	1	1															1	1	
Sundays	1	x	x	x	x	x	1	1	1													1	1	1	
Day before designated legal holiday	x	x	x	x	1	1																	1	1	
Designated legal holidays	1	x	x	x	x	x	1	1	1													1	1	1	

Legend:

x	Freeway may be completely closed and traffic detoured or one lane may be closed.
1	One lane may be closed.
	No freeway, lane or shoulder closure allowed.

REMARKS: Complete freeway closure for installation of sign structure only. To be used with detour Plan #5 in Contract Plans.

Chart No. 6
Multilane Lane Requirements

Location: Route 780 EB -From East 5th St. On-Ramp to Junction NB Rte. 680/SB Rte. 680.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	1																1	1	1	x	
Fridays	x	x	x	x	1																	1	1	1	
Saturdays	x	x	x	x	x	1																		1	
Sundays	x	x	x	x	x	x	1															1	1	1	
Day before designated legal holiday	x	x	x	x	1																	1	1	1	
Designated legal holidays	x	x	x	x	x	x	1															1	1	1	

Legend:

x	Freeway may be completely closed and traffic detoured or one lane may be closed.
1	One lane may be closed.
	No freeway, lane or shoulder closure allowed.

REMARKS: Complete freeway closure for installation of sign structure and placement of precast/prestressed "I" girders only. To be used with detour Plan #6 in Contract Plans.

Chart No. 7
Multilane Lane Requirements

Location: The EB Rte. 780/SB Rte. 680 Connector.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	x																	x	x	x	
Fridays	x	x	x	x	x																			x	
Saturdays	x	x	x	x	x	x																		x	
Sundays	x	x	x	x	x	x	x																x	x	
Day before designated legal holiday	x	x	x	x	x																			x	
Designated legal holidays	x	x	x	x	x	x	x																x	x	

Legend:

x	Connector may be completely closed and traffic detoured.
	No connector closure allowed.

REMARKS: Complete connector closure for installation of falsework only. To be used with detour Plan #7 in Contract Plans.

Chart No. 8
Multilane Lane Requirements

Location: The NB Rte. 680/WB Rte. 780 Connector.

	a.m.												p.m.											
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x	x	x																			x
Fridays	x	x	x	x	x	x																			x
Saturdays		x	x	x	x	x	x																		
Sundays		x	x	x	x	x	x	x																	
Day before designated legal holiday	x	x	x	x	x	x																			x
Designated legal holidays		x	x	x	x	x	x	x																	

Legend:

x	Connector may be completely closed and traffic detoured.
	No connector closure allowed.

REMARKS: Complete connector closure for installation of sign structure and falsework only. To be used with detour Plan #8 in Contract Plans.

Chart No. 9
Multilane Lane Requirements

Location: The EB Rte. 780/NB Rte. 680 Connector.

	a.m.												p.m.												
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x																					
Fridays	x	x	x	x																					
Saturdays	x	x	x	x	x																				
Sundays	x	x	x	x	x	x																			
Day before designated legal holiday	x	x	x	x																					
Designated legal holidays	x	x	x	x	x	x																			

Legend:

x	Connector may be completely closed and traffic detoured.
	No connector closure allowed.

REMARKS: Complete connector closure for installation of sign structure only. To be used with detour Plan #9 in Contract Plans.

Chart No. 10
Multilane Lane Requirements

Location: The SB Rte. 680/WB Rte. 780 Connector.

	a.m.												p.m.												
FROM HOUR TO HOUR	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays	x	x	x	x																					x
Fridays	x	x	x	x																					
Saturdays	x	x	x	x	x																				
Sundays	x	x	x	x	x	x																			
Day before designated legal holiday	x	x	x	x																					
Designated legal holidays	x	x	x	x	x	x																			

Legend:

x	Connector may be completely closed and traffic detoured.
	No connector closure allowed.

REMARKS: Complete connector closure for installation of sign structure only. To be used with detour Plan #10 in Contract Plans.

Pedestrian access facilities shall be provided through construction areas within the right of way as shown on the plans and as specified herein. Pedestrian walkways shall be surfaced with asphalt concrete, portland cement concrete or timber. The surface shall be skid resistant and free of irregularities. Hand railings shall be provided on each side of pedestrian walkways as necessary to protect pedestrian traffic from hazards due to construction operations or adjacent vehicular traffic. Protective overhead covering shall be provided as necessary to insure protection from falling objects and drip from overhead structures.

In addition to the required openings through falsework, pedestrian facilities shall be provided during pile driving, footing, wall, and other bridge construction operations. At least one walkway shall be available at all times. If the Contractor's operations require the closure of one walkway, then another walkway shall be provided nearby, off the traveled roadway.

Railings shall be constructed of wood, S4S, and shall be painted white. Railings and walkways shall be maintained in good condition. Walkways shall be kept clear of obstructions.

Full compensation for providing pedestrian facilities 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.

10-1.25 CLOSURE REQUIREMENTS AND CONDITIONS

Lane closures shall conform to the provisions in "Maintaining Traffic" of these special provisions and these special provisions.

The term closure, as used herein, is defined as the closure of a traffic lane or lanes, including ramp or connector lanes, within a single traffic control system.

CLOSURE SCHEDULE

By noon Monday, the Contractor shall submit a written schedule of planned closures for the following week period, defined as Friday noon through the following Friday noon.

The Closure Schedule shall show the locations and times when the proposed closures are to be in effect. The Contractor shall use the Closure Schedule request forms furnished by the Engineer. Closure Schedules submitted to the Engineer with incomplete, unintelligible or inaccurate information will be returned for correction and resubmittal. The Contractor will be notified of disapproved closures or closures that require coordination with other parties as a condition of approval.

Amendments to the Closure Schedule, including adding additional closures, shall be submitted to the Engineer, in writing, at least 3 working days in advance of a planned closure. Approval of amendments to the Closure Schedule will be at the discretion of the Engineer.

The Contractor shall confirm, in writing, all scheduled closures by no later than 8:00 a.m. 3 working days prior to the date on which the closure is to be made. Approval or denial of scheduled closures will be made no later than 4:00 p.m. 2 working days prior to the date on which the closure is to be made. Closures not confirmed or approved will not be allowed.

Confirmed closures that are cancelled due to unsuitable weather may be rescheduled at the discretion of the Engineer for the following working day.

CONTINGENCY PLAN

The Contractor shall prepare a contingency plan for reopening closures to public traffic. The Contractor shall submit the contingency plan for a given operation to the Engineer within one working 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. The Contractor shall not make any further closures 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 working days to accept or reject the Contractor's proposed work plan. The Contractor will not be entitled to any 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 $2900.00 per interval from moneys due or that may become due the Contractor under the contract.

COMPENSATION

The Contractor shall notify the Engineer of any delay 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 within the meaning of Section 8-1.09, "Right of Way Delays," and compensation for the delay will be determined in conformance with the provisions in Section 8-1.09:

A. 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 any compensation for amendments to the Closure Schedule that are not approved.
B. The Contractor is denied a confirmed closure.

Should the Engineer direct the Contractor to remove a closure prior to the time designated in the approved Closure Schedule, any delay to the Contractor's schedule due to removal of the closure will be considered a right of way delay within the meaning of Section 8-1.09, "Right of Way Delays," and compensation for the delay will be determined in conformance with the provisions in Section 8-1.09.

10-1.26 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE

A traffic control system shall consist of closing traffic lanes and connector 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 connector 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.

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 2.1 m above the ground, but should be as high as practicable.

Truck-mounted attenuators (TMA) for use in moving lane closures shall be any of the following approved models, or equal:

A. Hexfoam TMA Series 3000, Alpha 1000 TMA Series 1000 and Alpha 2001 TMA Series 2001, manufactured by Energy Absorption Systems, Inc., One East Wacker Drive, Chicago, IL 60601-2076, Telephone (312) 467-6750.

   1. Distributor (Northern): Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828, Telephone 1-800-884-8274, FAX (916) 387-9734.
   2. Distributor (Southern): Traffic Control Service, Inc., 1881 Betmor Lane, Anaheim, CA 92805, Telephone 1-800-222-8274.

B. Cal T-001 Model 2 or Model 3, manufacturer and distributor: Hexcel Corporation, 11711 Dublin Boulevard, P.O. Box 2312, Dublin, CA 94568, Telephone (510) 828-4200.
C. 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 1-800-654-8182.

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 13 mm 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 13 mm high letters which states, "The bottom of this TMA shall be _____ mm ± _____ mm 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 (except for flagging costs), 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. Flagging costs will be paid for as provided in Section 12-2.02, "Flagging Costs," of the Standard Specifications.

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.

10-1.27 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 Manual of Traffic Controls published by the Department or as relieving the Contractor from the responsibilities specified in Section 7-1.09, "Public Safety," of the Standard Specifications.

GENERAL

Whenever the work causes obliteration of pavement delineation, temporary or permanent pavement delineation shall be in place prior to opening the traveled way to public traffic. Laneline or centerline pavement delineation shall be provided at all times for traveled ways open to public traffic. On multilane roadways (freeways and expressways) edgeline delineation shall be provided at all times 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 marks. Surfaces to receive 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.

Temporary pavement markers, including underlying adhesive, and removable traffic tape which are applied to the final layer of surfacing or existing pavement to remain in place or which 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

Whenever 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 7.3 m. 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 (6 months 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 (6 months 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 7.3 m and shall be used for a maximum of 14 days on lanes opened to public traffic. Prior to 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.

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) 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.

TEMPORARY EDGELINE DELINEATION

On multilane roadways (freeways and expressways), whenever 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:

A. Temporary pavement delineation for right edgelines shall, at the option of the Contractor, consist of either a solid 100-mm wide traffic stripe of the same color as the stripe the temporary edgeline delineation replaces, or traffic cones, portable delineators or channelizers placed at longitudinal intervals not to exceed 30 m.
B. Temporary pavement delineation for left edgelines shall, at the option of the Contractor, consist of either solid 100-mm wide traffic stripe of the same color as the stripe the temporary edgeline delineation replaces, traffic cones, portable delineators or channelizers placed at longitudinal intervals not to exceed 30 m or temporary pavement markers placed at longitudinal intervals of not more than 1.8 m. Temporary pavement markers used for temporary left edgeline delineation shall be one of the types of temporary pavement markers listed for short term day/night use (14 days or less) or long term day/night use (6 months or less) in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Traffic stripe (100-mm wide) placed as temporary edgeline delineation which will require removal shall conform to the provisions of "Temporary Traffic Stripe (Tape)" of these special provisions. Where removal of the 100-mm 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 quantity of temporary traffic stripe (tape) or temporary traffic stripe (paint) used for this temporary edgeline delineation will not be included in the quantities of tape or paint to be paid for.

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 (900 mm) 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.

The quantity of channelizers used as temporary edgeline delineation will not be included in the quantity of channelizers to be paid for. Full compensation for furnishing, placing, maintaining and removing temporary edgeline delineation for those areas where temporary edgeline delineation is 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.

TEMPORARY TRAFFIC STRIPE (PAINT)

Temporary traffic stripe consisting of painted traffic stripe shall be applied and maintained at the locations shown on the plans. The painted temporary traffic stripe shall be complete in place at the location shown prior to 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 Section 84-3, "Painted Traffic Stripes And Pavement Markings," of the Standard Specifications, except for payment. At the option of the Contractor, either one or 2 coats shall be applied regardless of whether on new or existing pavement.

At the Contractor's option, temporary removable striping tape listed in "Prequalified and Tested Signing and Delineation Materials" of these special provisions may be used instead of painted temporary traffic stripes. When traffic stripe tape is used in place of painted temporary traffic stripes, the tape will be measured and paid for by the meter as temporary traffic stripe (paint).

When painted traffic stripe is specified for temporary left edgeline delineation, temporary pavement markers placed at longitudinal intervals of not more than 1.8 m may be used in place of the temporary painted traffic stripe. Temporary pavement markers shall be one of the types of temporary pavement markers listed for long term day/night use (6 months or less) in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. When temporary reflective pavement markers are used in place of temporary painted traffic stripe, payment for those temporary pavement markers will be made on the basis of the theoretical quantity of temporary traffic stripe (paint) required for the left edgeline the temporary pavement markers replace.

TEMPORARY PAVEMENT MARKERS

Temporary pavement markers shall be applied at the locations shown on the plans. The pavement markers shall be applied complete in place at the locations shown prior to opening the traveled way to public traffic.

Temporary pavement markers shown on the plans shall be, at the option of the Contractor, one of the temporary pavement markers for long term day/night use (6 months or less) listed in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Temporary pavement markers shall be placed in conformance with the manufacturer's instructions and shall be cemented to the surfacing with the adhesive recommended by the manufacturer, except epoxy adhesive shall not be used in areas where removal of the pavement markers will be required.

Where the temporary pavement delineation shown on the plans for lanelines or centerlines consists entirely of a pattern of broken traffic stripe and pavement markers, the Contractor may use groups of the temporary pavement markers for long term day/night use (6 months or less) in place of the temporary traffic stripe tape or painted temporary traffic stripe. The groups of pavement markers shall be spaced as shown on the plans for a similar pattern of permanent traffic line, except pavement markers shown to be placed in the gap between the broken traffic stripe shall be placed as part of the group to delineate the pattern of broken temporary traffic stripe. The kind of laneline and centerline delineation selected by the Contractor shall be continuous within a given location. Payment for those temporary pavement markers used in place of temporary traffic stripe will be made on the basis of the theoretical length of the patterns of temporary traffic stripe (tape) or temporary traffic stripe (paint).

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 (6 months 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 asphalt concrete 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 (paint) will be measured and paid for in the same manner specified for paint traffic stripe (1-coat) in Section 84-3.06, "Measurement," and Section 84-3.07, "Payment," of the Standard Specifications.

Temporary pavement markers, shown on the plans, will be measured and paid for by the unit in the same manner specified for retroreflective pavement markers in Section 85-1.08, "Measurement," and Section 85-1.09, "Payment," of the Standard Specifications. Temporary pavement markers used for temporary laneline and centerline delineation for areas which are not shown on the plans will not be included in the quantities of temporary pavement markers to be paid for. Full

compensation for removing temporary pavement markers, when no longer required, shall be considered as included in the contract unit price paid for temporary pavement marker and no separate payment will be made therefor.

10-1.28 PORTABLE CHANGEABLE MESSAGE SIGN

Portable changeable message signs shall be furnished, placed, operated, and maintained for detours at those locations shown on the plans or where designated by the Engineer in conformance with the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Portable changeable message signs shall be placed in advance of each traffic control system as provided in “Traffic Control System for Lane Closure,” elsewhere in these special provisions.

Portable changeable message signs shall be on the project at all times and available for public awareness information purposes and uses as directed by the Engineer.

Placement, operation, maintaining and removal of portable changeable message signs for public awareness information purposes and uses as directed by the Engineer will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

10-1.29 TEMPORARY RAILING

Temporary railing (Type K) shall be placed as shown on the plans, as specified in the Standard Specifications or these special provisions or where ordered by the Engineer and shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Reflectors on temporary railing (Type K) shall conform to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Temporary railing (Type K) shall conform to the details shown on Standard Plan T3. Temporary railing (Type K) fabricated prior to January 1, 1993, and conforming to 1988 Standard Plan B11-30 may be used, provided the fabrication date is printed on the required Certificate of Compliance.

Attention is directed to "Public Safety" and "Order of Work" of these special provisions.

Temporary railing (Type K) placed in conformance with the provisions in "Public Safety" of these special provisions will be neither measured nor paid for.

10-1.30 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.

At the time of completion of the project, channelizers shall be left in place as determined by the Engineer. The cost of leaving the channelizers in place will be paid for at the contract unit price for channelizer (surface mounted) (left in place).

10-1.31 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.

Attention is directed to "Public Safety" and "Order of Work" of these special provisions.

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 4.6 m 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.

At the Contractor's option, the modules for use in sand filled temporary crash cushions shall be either Energite III Inertial Modules, Fitch Inertial Modules or TrafFix Sand Barrels manufactured after March 31, 1997, or equal:

A. Energite III and Fitch Inertial Modules, manufactured by Energy Absorption Systems, Inc., One East Wacker Drive, Chicago, IL 60601-2076. Telephone 1-312-467-6750, FAX 1-800-770-6755

1. Distributor (North): Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828. Telephone 1-800-884-8274, FAX 1-916-387-9734
2. Distributor (South): Traffic Control Service, Inc., 1881 Betmor Lane, Anaheim, CA 92805. Telephone 1-800-222-8274, FAX 1-714-937-1070

B. TrafFix Sand Barrels, manufactured by TrafFix Devices, Inc., 220 Calle Pintoresco, San Clemente, CA 92672. Telephone 1-949 361-5663, FAX 1-949 361-9205

1. Distributor (North): United Rentals, Inc., 1533 Berger Drive, San Jose, CA 95112. Telephone 1-408 287-4303, FAX 1-408 287-1929
2. Distributor (South): Statewide Safety & Sign, Inc., P.O. Box 1440, Pismo Beach, CA 93448. Telephone 1-800-559-7080, FAX 1-805 929-5786

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 kilograms 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 shall be placed on movable pallets or frames conforming to the 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 3.6 m 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 the provisions in "Public Safety" of these special provisions 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.

10-1.32 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.

Except as otherwise provided for damaged materials in Section 15-2.04, "Salvage," of the Standard Specifications, the materials to be salvaged shall remain the property of the State, and shall be cleaned, packaged, bundled, tagged, and hauled to

the District Recycle Center at the San Francisco-Oakland Bay Bridge warehouse supply area adjacent to the San Francisco-Oakland Bay Bridge Toll Plaza and stockpiled.

The Contractor shall notify the Engineer and the District Recycle Coordinator, telephone (510) 286-6111 a minimum of 48 hours prior to hauling salvaged material to the Recycle Center.

The recycle center is open from 8:00 a.m. to 12 noon and from 1:00 p.m. to 2:30 p.m. on Mondays through Fridays, except legal holidays when it is closed.

Plans of the existing bridges may be requested by fax from the Office of Structure Maintenance and Investigations, 1801 30th Street, Sacramento, CA, Fax (916) 227-8357.

Plans of the existing bridges available to the Contractor are reproductions of the original contract plans with significant changes noted and working drawings and do not necessarily show normal construction tolerances and variances. Where dimensions of new construction required by this contract are dependent on the dimensions of the existing bridges, the Contractor shall verify the controlling field dimensions and shall be responsible for adjusting dimensions of the work to fit existing conditions.

CLEAN DRAINAGE FACILITY

Existing culverts at the locations shown on the plans shall be thoroughly cleaned to the satisfaction of the Engineer.

Earthly material, trash, cuttings and other waste material shall be removed and 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 and also the material and other waste material shall not be dispose of into the Carquinez Strait.

After the initial cleaning as provided herein, the Contractor shall maintain the culverts free from deposits of earthly material, trash, cuttings and other waste material for the remainder of the contract at his own expense.

Clean drainage facility will be measured and paid for by the unit of the size designated in the Engineer's Estimate.

STORM DRAIN VIDEO SURVEY

This work shall consist of two video surveys documenting and reporting on the structural condition of the existing storm drain crossing Bayshore Road in the City of Benicia at the locations shown on the plans. The first storm drain video survey shall not be performed until the existing storm drains are cleaned as provided in the Section "Clean Drainage Facility," elsewhere in these special provisions. The second storm drain video survey shall be performed subsequent to removal of the false work within the drainage facility.

The Contractor shall videotape with narration the condition of the storm drain to show any and all structural deficiencies including cracks, holes, exposed aggregates and reinforcing bars, honey combed areas, damaged construction joints, deteriorated concrete surfaces, infiltration's, root intrusions and missing pieces. The locations of all deficiencies shall be shown by stationing with reference points agreed upon by the Engineer. The Contractor shall provide the dimensions of all major structural deficiencies and provide supplemental photographs of such deficiencies when requested by the Engineer.

At least 10 working days prior to investigation, the Contractor shall submit for acceptance 5 copies of the proposed operations and safety procedure to the Engineer.

The Engineer will either accept or reject such procedures within 5 working days of their receipt. The procedures shall comply with the following safety provisions.

SAFETY PROCEDURES

Except to the extent that more explicit or more stringent requirements are stated herein, the Contractor shall comply with all applicable Federal, State and local safety and health requirements and standards.

Pre-entry and Confined Space Operations - Pre-entry and confined space operations shall be performed in accordance with the provisions of Article 108 of the General Industry Safety Orders and Section 1532 of the Construction Safety Orders of Title 8 of the California Code of regulations. These provisions shall govern:

1. blocking of laterals;
2. ventilation requirements;
3. entry rate work within confined spaces;
4. other related work.

The Contractor shall provide safeguards, including traffic barriers, warning signs, barricades, temporary fences and other similar safeguards that are required for the protection of all personnel during the performance of the operations.

The Contractor shall provide to all workers and inspectors, eye protection, hardhats and safety tools as required by job conditions and CAL-OSHA.

EQUIPMENT FOR TELEVISING

Closed Circuit Television Camera (CCTV) shall have a rotating lens camera with articulating head. Each joint shall be scanned 360 degrees. The CCTV shall be operative in one hundred percent (100%) humidity conditions. Lighting for the CCTV shall minimize relative glare. Lighting and CCTV quality shall be suitable to provide a clear, in focus picture of the entire periphery of the pipe for all conditions encountered during the work. Focal distance shall be adjustable through a range from 150 mm to infinity. The remote reading meter counter shall be accurate to one percent (1%) over the length of the particular section being inspected. The CCTV, television monitor and other components of the color video system shall be capable of producing a minimum of 350 line resolution.

TELEVISING PROCEDURES

The Contractor shall examine the storm drain to insure the passage of the camera through all the drain prior to any televising.

The camera operator shall slow or stop the camera at potential or actual imperfections in the pipe to obtain a high quality video image.

DOCUMENTATION OF TELEVISING

The Contractor shall prepare for the Engineer's approval a written report documenting the results of its investigation. In this report, the Contractor shall place its emphasis on first, the deficiencies discovered during this investigation, secondly the proposed measures to remedy deficiencies and thirdly the serviceability of the present pipe.

Two copies of the recorded video tape and two copies of the written report shall be delivered to the Engineer not later than 5 working days after completion of each investigation. The Engineer will review the recorded tape and written report and notify the Contractor if the recording and the written report are satisfactory.

The video tape(s) shall include the following:

1. Video:

- Report No.
- Date of TV inspection.
- Upstream and downstream access hole or station numbers.
- Current distance along reach (tape counter meter)
- Printed labels on tape container and tape cartridge with location information, date, format, and other descriptive information.

2. Audio:

- Date of TV inspection.
- Confirmation of upstream and downstream access hole or station numbers.
- Description of pipe size, type and pipe joint length.
- Description and location of each defect.
- Description and location of each service connection.

3. Written:

- Date of TV inspection.
- Tape number
- Location, size, type, and length of pipe.
- Direction of flow and measurement ("From" manhole/station number "To" manhole/station number).
- Tape counter numbers (beginning and end).
- Sketch showing the street and cross streets where the TV inspection was made.
- Description and location of each defect.
- Description and location of each service connection.

MEASUREMENT AND PAYMENT

Storm drain video survey will be measured and paid for by the unit for the two-video surveys of the entire length of the storm drain. Storm drain video survey of a quality not acceptable to the Engineer will be rejected and paid for at the Contractor's expense. If rejected, the storm drain video surveys shall be redone until it is acceptable by the Engineer

The contract unit price paid for storm drain video surveys shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in conducting the storm drain video surveys, including providing plans, reports and video tapes, safety devices and precautions, as specified in these special provisions, and as directed by the Engineer.

ABANDON CULVERT

Existing culverts, where shown on the plans to be abandoned, shall be abandoned in place or, at the option of the Contractor, the culverts shall be removed and disposed of. Resulting openings into existing structures that are to remain in place shall be plugged with commercial quality concrete containing not less than 300 kg of cement per cubic meter.

Abandoning culverts in place shall conform to the following:

A. Culverts that intersect the side slopes shall be removed to a depth of not less than one meter measured normal to the plane of the finished side slope, before being abandoned.
B. Culverts 300 mm in diameter and larger, shall, at the Contractor's option, be backfilled with either sand, controlled low strength material or slurry cement backfill conforming to the provisions in Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications by any method acceptable to the Engineer that completely fills the pipe. Sand backfill material shall be clean, free draining, and free from roots and other deleterious substances.
C. The ends of culverts shall be securely closed by a 150 mm thick tight fitting plug or wall of commercial quality concrete.

Culverts shall not be abandoned until their use is no longer required. The Contractor shall notify the Engineer in advance of any intended culvert abandonment.

If the Contractor elects to remove and dispose of a culvert which is specified to be abandoned, as provided herein, backfill specified for the pipe will be measured and paid for in the same manner as if the culvert has been abandoned in place.

Backfill will be measured by the cubic meter determined from the dimensions of the culverts to be abandoned.

The contract price paid per cubic meter for sand backfill shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in backfilling culverts with sand, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Controlled low strength material and slurry cement backfill, if used at the Contractor's option, will be measured and paid for by the cubic meter as sand backfill.

Full compensation for concrete plugs, pipe removal, structure excavation, and backfill shall be considered as included in the contract price paid per meter for abandon culvert and no additional compensation will be allowed therefor.

ABANDON INLET

Existing drainage inlets, where shown on the plans to be abandoned, shall be abandoned.

The top portion of the inlets shall be removed to a depth of one meter below finished grade.

Removed frames and grates shall be disposed of.

SALVAGE CRASH CUSHION

Existing crash cushion, where shown on the plans to be salvaged, shall be removed and salvaged. Sand from the crash cushion barrels shall be removed and disposed of.

REMOVE CHAIN LINK FENCE

Existing chain link fence, where shown on the plans to be removed, shall be removed and disposed of.

Access control shall be maintained at all times. Before leaving any work area, all fencing necessary to ensure the integrity of the original fenced areas shall be provided such that there are no gaps left between the existing fence and the fence being installed. Whether permanent or temporary fencing is used, it shall be at the option of the Contractor.

Full compensation for providing access control shall be considered as included in the contract price paid per meter for remove chain link fence and no additional compensation will be allowed therefor.

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 meter 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 meter for remove metal beam guard railing and no separate payment will be made therefor.

REMOVE CRASH CUSHION

Existing crash cushions (sand filled), where shown on the plans to be removed, shall be removed and disposed of.

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.

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 one meter 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 THERMOPLASTIC AND PAINTED TRAFFIC STRIPE

Thermoplastic and painted traffic stripes to be removed shall be removed at the locations shown on the plans and at the locations designated by the Engineer.

REMOVE YELLOW THERMOPLASTIC AND PAINTED TRAFFIC STRIPE

Yellow thermoplastic and painted traffic stripes to be removed shall be removed at the locations shown on the plans and at the locations designated by the Engineer.

Yellow thermoplastic and yellow painted traffic stripes may contain lead and chromium. Residue produced when yellow thermoplastic and yellow paint are removed may contain heavy metals in concentrations that exceed hazardous waste thresholds established by the California Code of Regulations and may produce toxic fumes when heated.

The removed yellow thermoplastic and yellow paint material shall be disposed of at a Class 1 disposal facility in conformance with the requirements of the disposal facility operator within 90 days after accumulating 100 kg of residue and dust. The Contractor shall make all arrangements with the operator of the disposal facility and perform all testing of the yellow thermoplastic and yellow paint residue required by the operator. The Contractor shall submit the name and location of the facility along with testing requirements to the Engineer not less than 21 days prior to removal of yellow thermoplastic and yellow painted traffic stripes and pavement markings.

The Contractor shall submit the written compliance programs required in Subsection (e)(2), "Compliance Program," of Section 1532.1, "Lead," of the Construction Safety Orders to the Engineer not less than 21 days prior to start of removal operations. The compliance programs shall be prepared by an industrial hygienist certified by the American Board of Industrial Hygiene and shall cover all Contractor or subcontractor employees removing or handling the yellow thermoplastic and yellow paint residue. Inspection reports shall be made in conformance with Section 1532.1, "Lead," and shall be submitted to the Engineer.

Prior to performing any removal, personnel who have no prior lead training, including State personnel, shall complete a safety training class provided by the Contractor, which meets the requirements of Title 8, Section 1532.1. The number of State personnel to be trained shall be 3.

Where grinding or other methods approved by the Engineer are used to remove yellow thermoplastic and yellow painted traffic stripes, the residue, including dust, shall be contained and collected immediately. Sweeping will not be allowed. Collection shall be by High Efficiency Particle Arresting (HEPA) vacuum attachment operated concurrently, or other equally effective method, with removal operations. The Contractor shall submit a removal, storage, and disposal workplan in writing to the Engineer for approval not less than 21 days prior to start of removal operations.

The collected residue shall be stored in properly labeled and covered containers approved by the United States Department of Transportation for transportation and temporary storage. The containers shall be handled in such a manner that no spillage will occur. The containers shall be stored in a secured enclosure at a location within the project limits approved by the Engineer while awaiting test results required by the operators of the disposal facility.

Contractors attention is directed to the Storm Water specifications contained in these special provisions.

Removed yellow thermoplastic and yellow paint material will remain the property of the State.

The removed material shall be transported to the Class 1 disposal facility by a transporter currently registered with the California Department of Toxic Substances Control using current manifesting procedures. The Engineer will obtain the United States Environmental Protection Agency Identification Number and sign all manifests as the generator. The California Board of Equalization Number (State's Generator ID) for this project is HY HQ 36-020676.

The Contractor shall assume that the yellow thermoplastic and yellow paint residue is not regulated under the Federal Resource Conservation and Recovery Act (RCRA). Additional disposal costs for residue regulated under RCRA, as determined by test results, will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

Except as otherwise provided above for possible additional costs to be paid for as extra work, full compensation for submitting the required compliance programs, providing safety training for Contractor and State personnel, making arrangements with the Class 1 disposal facility operator, providing for the temporary storage of the residue within a secured area, testing the residue as required by the disposal facility operator, transportation of the residue to the Class 1 disposal facility, and disposal of the residue, all as specified herein, shall be considered as included in the contract prices paid per meter for remove yellow thermoplastic traffic stripe and remove yellow painted traffic stripe and no additional compensation will be allowed therefor.

Nothing in these special provisions shall relieve the Contractor from the Contractor's responsibilities as provided in Section 7-1.09, "Public Safety," of the Standard Specifications.

REMOVE DRAINAGE FACILITY

Existing culverts, inlets, headwalls, junction box, overside drains and horizontal drain pipe where shown on the plans to be removed, shall be completely removed and disposed of.

Full compensation for plugging holes in existing drainage facilities after removing culvert, as shown on the plans, shall be considered as included in the contract price paid per meter for remove culvert and no separate payment will be made therefor.

REMOVE ROADSIDE SIGN

Existing roadside signs, at those locations shown on the plans to be removed, shall be removed and disposed of.

Sign panels shown on the plans shall be salvaged.

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.

Full compensation for salvaging sign panels shall be considered as included in the contract unit price paid for remove roadside sign of the type shown in the Engineer's Estimate and no separate payment will be made therefor.

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 ASPHALT CONCRETE

Existing bituminous surfacing shown on the plans to be removed, shall be removed to the depth of the existing asphalt concrete surfacing.

The material removed shall be disposed of outside the highway right of way in conformance with the provisions in Section 15-2.03, "Disposal," of the Standard Specifications.

Removing asphalt concrete will be measured by the cubic meter in the same manner specified for roadway excavation in conformance with the provisions in Section 19, "Earthwork," of the Standard Specifications and will be paid for at the contract price per cubic meter for remove asphalt concrete.

PLANE ASPHALT CONCRETE PAVEMENT

Existing asphalt concrete pavement shall be planed at the locations and to the dimensions shown on the plans.

Except as provided herein, planing asphalt concrete pavement shall be performed, at the option of the Contractor, either by the cold planing or heater planing method. The use of the heater planing method shall be subject to approval of the local Air Pollution Control Officer.

Cold planing machines shall be equipped with a cutter head not less than 750 mm in width and shall be operated so that no fumes or smoke will be produced. The cold planing machine shall plane the pavement without requiring the use of a heating device to soften the pavement during or prior to the planing operation.

Heater planing machines shall have, in combination or separately, a means for heating and cutting the asphalt concrete surface and blading the displaced material into windrows in one continuous forward motion. Heat shall be applied uniformly to the area to be planed and shall be accurately controlled according to conditions and the road surfacing being planed. The cutting width of the blade shall be not less than 900 mm.

Heater planing operations shall not be performed at times where there is danger of igniting entrapped gases from sewers or gas mains, if an open flame is used in the heater. The heater planing method shall not be used in areas where the heat generated by the heater planing equipment may damage adjacent shrubs or the foliage on overhanging tree limbs.

The depth, width and shape of the cut shall be as shown on the typical cross sections or as designated by the Engineer. The final cut shall result in a uniform surface conforming to the typical cross sections. The outside lines of the planed area shall be neat and uniform. Planing asphalt concrete pavement operations shall be performed without damage to the surfacing to remain in place.

Planed widths of pavement shall be continuous except for intersections at cross streets where the planing shall be carried around the corners and through the conform lines. Following planing operations, a drop-off of more than 45 mm will not be allowed between adjacent lanes open to public traffic.

Where transverse joints are planed in the pavement at conform lines, no drop-off shall remain between the existing pavement and the planed area when the pavement is opened to public traffic. If asphalt concrete has not been placed to the level of existing pavement before the pavement is to be opened to public traffic, a temporary asphalt concrete taper shall be constructed. Asphalt concrete for temporary tapers shall be placed to the level of the existing pavement and tapered on a slope of 1:30 (vertical: horizontal) or flatter to the level of the planed area.

Asphalt concrete for temporary tapers shall be commercial quality and may be spread and compacted by any method that will produce a smooth riding surface. Temporary asphalt concrete tapers shall be completely removed, including the removal of loose material from the underlying surface, before placing the permanent surfacing. The removed material 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.

Operations shall be scheduled so that not more than 7 days shall elapse between the time when transverse joints are planed in the pavement at the conform lines and the permanent surfacing is placed at the conform lines.

The material planed from the roadway surface, including material deposited in existing gutters or on the adjacent traveled way, shall be removed and 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. Removal operations of planed material shall be concurrent with planing operations and follow within 15 m of the planer, unless otherwise directed by the Engineer.

Plane asphalt concrete pavement will be measured by the square meter for the depth (maximum) designated in the Engineer's Estimate. The quantity to be paid for will be the actual area of surface planed for the depth (maximum) designated in the Engineer's Estimate, irrespective of the number of passes required to obtain the depth shown on the plans.

The contract price paid per square meter for plane asphalt concrete pavement for the depth (maximum) 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 planing asphalt concrete surfacing and disposing of planed material, including furnishing the asphalt concrete for and constructing, maintaining, removing, and disposing of temporary asphalt concrete tapers, as specified in the Standards Specifications and these special provisions, and as directed by the Engineer.

CAP INLET AND CAP RISER

Existing pipe riser and concrete drainage inlets, at the locations and to the details shown on the plans, shall be capped.

Portland cement concrete shall be minor concrete or may be produced from commercial quality aggregates and cement containing not less than 350 kg of cement per cubic meter.

The quantity of capping inlets will be determined as units from actual count.

The contract unit price paid for cap inlet and cap riser shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in capping inlets and riser, including 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 portions of bridges shall conform to the provisions in Section 15-4, "Bridge Removal," of the Standard Specifications and these special provisions.

Park Road Undercrossing, bridge No. 23-128R, Bridge Removal (Portion), Location A.

Portion of the existing wing wall shall be removed to the limits shown on the plans.

West Arsenal Undercrossing, bridge number 23-127L, Bridge Removal (Portion), Location B.

Portion of the existing bridge shall be removed to the limits shown on the plans.

All removed materials that are not to be salvaged or used in the reconstruction shall become the property of the Contractor and shall be disposed 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 following additional requirements apply to the removal of 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 requirements under "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. All 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 which, 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 cover shall extend at least 1.2 m 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 insure the stability of the bridge.
F. 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.
G. Temporary support shoring, temporary bracing, and protective covers shall not encroach closer than 2.4 m horizontally from the edge or 4.6 m vertically above any traffic lane or shoulder that is open to public traffic.
H. 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 0.6-m thick earthen pad or a 25-mm 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.
I. 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.

The following additional requirements apply to the removal of portions of bridges whenever the removal work is to be performed over public traffic and over the existing Exxon pipe lines at West Arsenal Undercrossing, bridge number 23-127R.:

A. A protective cover supported by falsework or members of the existing structure shall be constructed before beginning bridge removal work.
B. The construction and removal of the protective cover and the installation and removal of temporary railings shall conform to the requirements under "Order of Work," "Maintaining Traffic" and "Temporary Railings" of these special provisions.
C. The protective cover shall prevent any materials, equipment, or debris from falling onto the public traffic and onto the existing Exxon pipe lines at West Arsenal Undercrossing, bridge number 23-127R. The protective cover shall have a minimum strength equivalent to that provided by good, sound Douglas fir planking having a nominal thickness of 50 mm. Additional layers of material shall be furnished as necessary to prevent fine materials or debris from sifting down upon the traveled way and shoulders.

D. The protective cover shall conform to the provisions for falsework in Section 51-1.06, "Falsework," of the Standard Specifications.
E. The Contractor shall be responsible for designing and constructing a safe and adequate protective cover, and shoring and falsework needed to support the protective cover, all with sufficient strength and rigidity to support the entire load to be imposed.
F. Bridge removal methods shall be described in the working drawings and calculations in sufficient detail 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.
G. At locations where the bridge railing is to be removed, the protective cover shall extend 2m from the face of the exterior girder.
H. Before removal, the protective cover shall be cleaned of all debris and fine material.
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 4.6 m and a horizontal opening of 9.8 m shall be provided for the passage of public traffic.
J. Falsework or supports for protective cover 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 7-1.12A, "Indemnification," and Section 7-1.12B, "Insurance," of the Standard Specifications.

REMOVE CONCRETE

Concrete, 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 meter, measured before and during 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.

Where no joint exists between concrete to be removed and concrete to remain in place, the concrete shall be cut on a neat line to a minimum depth of 50 mm with a power driven saw before the concrete is removed.

Where concrete has been removed outside the roadway prism, the backfilled areas shall be graded to drain and blend in with the surrounding terrain.

Concrete to be removed which has portions of the same structure both above and below ground will be considered as concrete above ground for compensation.

Remove concrete barrier will be measured and paid for by the meter.

10-1.33 CLEARING AND GRUBBING

Clearing and grubbing shall conform to the provisions in Section 16, "Clearing and Grubbing," of the Standard Specifications and these special provisions.

Vegetation shall be cleared and grubbed only within the excavation and embankment slope lines.

At locations where there is no grading adjacent to a bridge or other structure, clearing and grubbing of vegetation shall be limited to 1.5 m outside the physical limits of the bridge or structure.

Existing vegetation outside the areas to be cleared and grubbed shall be protected from injury or damage resulting from the Contractor's operations.

Activities controlled by the Contractor, except cleanup or other required work, shall be confined within the graded areas of the roadway.

Nothing herein shall be construed as relieving the Contractor of the Contractor's responsibility for final cleanup of the highway as provided in Section 4-1.02, "Final Cleaning Up," of the Standard Specifications.

10-1.34 EARTHWORK

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Surplus excavated material not designated or determined to contain hazardous material shall become the property of the Contractor and 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.

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 50 mm before removing the surfacing. Full compensation for cutting the existing surfacing shall be considered as included in the contract price paid per cubic meter for roadway excavation and no additional compensation will be allowed therefor.

Remove rock (1 to 2 tonne) as shown on the plans will be measured and paid for by the cubic meter as roadway excavation.

It is estimated that 15% of the material volume can not be excavated using conventional excavation equipment. This material is interlayered with material that can be excavated with conventional excavation equipment.

Embankment material placed under Retaining Wall No. 2 to a depth equal to the footing width, from the retaining wall heal to the face of the slope below the wall, shall have a Plasticity Index less than 20 as determined by ASTM Test Method D4318.

"Geocomposite Drain" shall conform to the details shown on the plans and the following:

A. Attention is directed to "Engineering Fabrics" under "Materials" of these special provisions.
B. Geocomposite drain shall consist of a manufactured core not less than 6.35 mm thick nor more than 50 mm 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 25 liters per minute per meter of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 168 kPa.
C. 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.
D. Filter fabric for the geocomposite drain shall conform to the provisions for fabric for underdrains in Section 88, "Engineering Fabrics," of the Standard Specifications.
E. 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.
F. 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.
G. 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 75 mm at all joints and wrap around the exterior edges a minimum of 75 mm 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 150 mm and be attached thereto.
H. 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 150-mm overlap.
I. 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.
J. 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.
K. The treated permeable base shall be enclosed with a high density polyethylene sheet or PVC geomembrane, not less than 250 µm thick, which 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 involved in 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 paid for at the contract price per cubic meter for structure excavation (bridge) or structure backfill (bridge).

Structure excavation designated as (Type D), for footings at the locations shown on the plans, will be measured and paid for by the cubic meter as structure excavation (Type D). Ground water or surface water is expected to be encountered at these locations, but seal course concrete is not shown or specified. Structure excavation for footings at locations not designated on the plans as structure excavation (Type D), and where ground or surface water is encountered, will be measured and paid for by the cubic meter as structure excavation (bridge).

NON-HAZARDOUS AND HAZARDOUS MATERIAL EXCAVATION

Non-hazardous and hazardous material excavation shall consist of excavating non-hazardous, non-RCRA hazardous, and LDR material identified on the plans as within excavation limits shown on the plans, specified in the Standard Specifications, or specified or directed by the Engineer and placing or disposing of the material as specified in this section.

Excavated LDR material, non-RCRA hazardous material, and non-hazardous shall be managed as follows:

A. LDR material – Haul, treat, and dispose of the material at a permitted waste management facility in conformance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications and these special provisions.
B. Non-RCRA hazardous material – Haul and dispose of the material at a permitted hazardous waste management facility in conformance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications and these special provisions.
C. Non-Hazardous material – Haul and place the material within the roadway prism or dispose of the material at a site outside of the highway right of way where ambient environmental conditions will not cause contaminants to be released at concentrations that exceed applicable water quality objectives or could degrade waters of the State in conformance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications and these special provisions. Material with aerially deposited lead from vehicle emissions is considered to be non-hazardous material when placed entirely within the highway prism. These lead deposits are found to a depth of 0.61 meters below original ground. If the Contractor elects to divide this material into smaller quantities for disposal at various locations off highway right of way, material with elevated concentrations of lead, as shown on the plans, may require additional testing prior to disposal. All additional sampling and analysis deemed necessary to confirm this characterization by the owner of the disposal site shall be performed by the Contractor in conformance with the provisions in "Non-Hazardous and Hazardous Material, General," of these special provisions.

Except that when the material is excavated from trenches for irrigation or electrical systems the material shall be used to backfill the trench.

Non-RCRA hazardous materials and LDR materials shall be transferred directly from the excavation to a registered transport vehicle, a storage container approved for transport of hazardous waste by the United States Department of Transportation, or a stockpile location approved by the Engineer. Non-hazardous material shall be transferred directly from the excavation to a transport vehicle, a storage container, or a stockpile location approved by the Engineer. Stockpile locations for non-hazardous material shall be maintained in conformance with the provisions in “Water Pollution Control” of these special provisions. Stockpile locations for non-RCRA hazardous material and LDR materials shall be maintained as follows:

A. The material shall not contain free liquids that separate readily from the material. The presence or absence of free liquids shall be demonstrated by United States Environmental Protection Agency Method 9095 as modified by Section 66264.314 of Title 22 of the California Code of Regulations.
B. The material shall be stored on undamaged 1.5-mm high-density polyethylene or an equivalent impermeable barrier unless the stockpiling location is on a paved surface. If the location is on a paved surface the thickness of the barrier can be reduced to 0.5-mm high-density polyethylene or its equivalent. The dimensions of the barrier shall exceed the dimensions of the stockpile at all times. Any seams in the barrier shall be sealed to prevent leakage.
C. At the end of each day or prior to a storm event the material shall be covered with undamaged 0.3-mm polyethylene or an equivalent impermeable barrier to prevent windblown dispersion and precipitation run-off and run-on. When more than one sheet is required to cover the material, the sheets shall be overlapped a minimum of 0.45-m in a manner that prevents water from flowing onto the material. The cover shall be secured in a manner that keeps it in place at all times. Driven anchors shall not be used except at the perimeter of the stockpile. The cover shall be inspected and maintained in conformance with the provisions in “Water Pollution Control” of these special provisions.

These stockpiling requirements apply to temporary storage outside of an excavation or a transport container including, but not limited to, staging of excavated material next to the excavation prior to pick up by loading equipment, accumulating material for full transport loads, and awaiting test results required by a disposal facility. The removal of stockpiles shall begin within 90 days of accumulating 100 kg of non-RCRA hazardous material or LDR material. After final removal has occurred the Contractor shall be responsible for any cleanup deemed necessary by the Engineer.

Non-RCRA hazardous material, LDR material, and non-hazardous material on exteriors of transport vehicles shall be removed and placed either into the current transport vehicle or the excavation prior to the vehicle leaving the loading area. No non-RCRA hazardous material, or LDR material shall be deposited on public roads. The Contractor shall indemnify the

State from any costs due to spillage during the transport of the non-RCRA hazardous material or LDR material to the disposal facility.

Attention is directed to “Non-Hazardous and Hazardous Material, General” of these special provisions.

Full compensation for excavating, loading, hauling, and placing or disposing of non-hazardous material shall be considered as included in the contract price paid per cubic meter for the various items of work involved and no further compensation will be allowed therefor.

Full compensation for excavating, loading, hauling, treating, and disposing of LDR material shall be considered as included in the contract price paid per cubic meter for structure excavation (Type D-LDR) and no further compensation will be allowed therefor.

Full compensation for excavating, loading, hauling, and disposing of non-RCRA hazardous material shall be considered as included in the contract price paid per cubic meter for structure excavation (Type D)(hazardous) and no further compensation will be allowed therefor.

10-1.35 EARTH RETAINING STRUCTURES

Earth retaining structures shall be constructed at the locations and in conformance with the details shown on the plans and these special provisions.

The earth retaining structure to be constructed shall be Mechanically Stabilized Embankment as shown on the plans.

At the Contractor's option, one of the following acceptable alternative earth retaining systems may be constructed:

Proprietary Earth Retaining System	Address and Phone Number
Reinforced Earth	The Reinforced Earth Company 25651 Atlantic Ocean Drive, Suite A-13 Lake Forest, CA 92630 (949) 587-3060
Retained Earth (1.52-meter square concrete face panels)	Foster Geotechnical 1660 Hotel Circle North - Suite 304 San Diego, CA 92108 (619) 688-2400
MSE Plus	SSL 4740 Scotts Valley Drive, Suite "E" Scotts Valley, CA 95066 (831)430-9300
Evergreen Retaining Wall System	The Quickset Corporation 17791 Fitch Avenue Irvine, CA 92714 (949) 250-8700

Attention is directed to the section, "Engineering Fabrics" of these special provisions.

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 can be obtained from the Office of Structure Design, Mail Station 9, 1801 30th Street, Sacramento, CA 95816.

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 to the Office of Structure Design (OSD) in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. For initial review, 4 sets of drawings shall be submitted. After review, between 6 and 12 sets, as requested by the Engineer, shall be submitted to OSD for final approval and use during construction.

Working drawings shall be 279 mm x 432 mm 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-Kilometer Post. 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 be supplemented as necessary with calculations for the particular installation. 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 4 weeks to review the drawings after a complete set has been received.

One set of the corrected prints on 90-g/m^2 (minimum) bond paper, 279 mm x 432 mm in size, of all working drawings prepared by the Contractor for each earth retaining structure shall be furnished to OSD within 3 weeks after final working drawing approval.

The mechanically stabilized embankment walls shall not be constructed in segments. Each row of the wall panels, including structural backfill and reinforcement elements as well as the roadway embankment fill behind the mechanically stabilized embankment reinforcing zone, should be completed for the entire length of the wall before the next row of panels including structural backfill or embankment lifts can be started.

The top of wall profile of alternative earth retaining systems shall conform to that of the mechanically stabilized embankment (MSE) wall shown on the plans. The bottom of the mechanically stabilized embankment (MSE) wall elevations at face panels 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.

Architectural treatment at the face panels for the alternative earth retaining systems shall conform to that of the mechanically stabilized embankment (MSE) wall where shown on the plans.

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.

Existing metal crib wall at MSE RETAINING WALL NO.1, bridge number 23-0224, shall be removed to the limits shown on the plans. All metal parts of the removed crib wall shall become the property of the Contractor and shall be disposed 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.

Structure backfill for earth retaining structures with metallic soil reinforcement shall consist of material free from organic material and substantially free of shale or other soft, poor durability particles; 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; and shall meet the following requirements:

Gradation Requirements

Sieve Size	Percentage Passing	California Test
159-mm	100	202
75-mm	78 - 100	202
4.75-mm	----	202
600-µm	0 - 60	202
75-µm	0 - 25	202

Property Requirements

Test	Requirement	California Test
Sand Equivalent	12 min.	217
Plasticity Index	10 max.	204
Minimum Resistivity	1500 ohm-cm min.	643
Chlorides	500 ppm max.	422
Sulfates	2000 ppm max.	417
pH	5.5 to 10.0	643

If 12 percent or less passes the No. 75-µm sieve and 50 percent or less passes the No. 4.75-mm sieve, 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 and the following requirements:

Property Requirements

Test	Requirement	California Test
Minimum Resistivity	1500 ohm-cm min.	643
Chlorides	500 ppm max.	422
Sulfates	2000 ppm max.	417
pH	5.5 to 10.0	643

Structure backfill for earth retaining structures with soil reinforcement shall be compacted to a relative compaction of not less than 90 percent except that when the backfill is within 50 meters of a bridge abutment or for a minimum depth of one meter below the grading plane for the width between the outer edges of shoulders, the backfill 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 1:1.5 (vertical:horizontal) out and down from lines 0.3-m outside the bottom limits of structure backfill including permeable material, when required.

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 4 m above the bottom of the lowermost face element.

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 one meter of the facing panels.

At each level of the soil reinforcement, the structure backfill shall be constructed to a plane 45 mm above the elevation of the soil reinforcement connection, and shall start one meter 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.

Water used for earthwork or dust control within 150 meters of any portion of earth retaining structures with metallic soil reinforcement shall conform to the provisions for water in conventionally reinforced concrete work 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 shall conform to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications. 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 where no architectural treatment to be applied shall receive a surface finish conforming to the provisions in Section 51-1.18B, "Class 1 Surface Finish," of the Standard Specifications.

Architectural treatment at the face panels for the mechanically stabilized embankment (MSE) wall, where shown on the plans, shall conform to “Architectural Surface (Textured Concrete) “provisions elsewhere in these special provisions, and to the details shown on the plans.

REINFORCEMENT

Reinforcing steel shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and to the provisions in "Reinforcement" of 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 WIRE

The threaded end may be formed before or after galvanizing. The end 100 mm of the wire shall be coated with 2 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 with a die before painting. There shall be no damage to the unthreaded portion of the galvanized inspection wire.

After placement of an inspection element and placement of backfill to a level at least 0.6-m above the inspection element, the void in the face panel shall be dry packed with portland cement grout 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 cement to sand shall be that required to achieve a 28-day mortar compressive strength of 7 MPa to 10 MPa.

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.

Permeable material shall be Class 1, Type B, conforming to the provisions in Section 68-1.025, "Permeable Material," of the Standard Specifications and these special provisions.

Permeable material and filter fabric shall be placed along with structure backfill as shown on the plans. 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.

Filter fabric shall conform to the provisions for fabric for underdrains in Section 88-1.03, "Filter Fabric," of the Standard Specifications and shall be placed at the locations and in conformance with the details shown on the plans and these special provisions.

Immediately prior to placing, 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.

Filter fabric shall be handled and placed in conformance with the manufacturer's recommendations.

The fabric shall be stretched, aligned, and placed in a wrinkle-free manner.

Adjacent borders of the fabric shall be overlapped from 300 mm to 450 mm or stitched. The preceding roll shall overlap the following roll in the direction the material is being spread or shall be stitched. When the 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 fabric manufacturer. The stitches shall number 2 to 3 per centimeter of seam.

Should the fabric be damaged during placing, the torn or punctured section shall be repaired by placing a piece of fabric that is large enough to cover the damaged area and which meets the overlap requirement.

During spreading of the permeable material a minimum of 150 mm of the material shall be maintained between the fabric and the Contractor's equipment. Where structure backfill material is to be placed on the filter fabric, a minimum of 450 mm of structure backfill material shall be maintained between the fabric and the Contractor's equipment. Equipment or vehicles shall not be operated or driven directly on the filter fabric.

Adhesive for bonding filter fabric to concrete panels shall conform to the requirements in Federal Specification MMM-A-121.

Concrete panel surfaces which are to receive filter fabric shall be dry and thoroughly cleaned of dust and deleterious materials.

STATE-DESIGNED EARTH RETAINING STRUCTURES

If the Contractor elects to construct one of the earth retaining structures shown on the plans, the structure shall be constructed to the lines and grades and the details shown on the plans, in conformance with these special provisions and the following:

MECHANICALLY STABILIZED EMBANKMENT

This work shall consist of constructing earth retaining structures of mechanically stabilized embankments with concrete face panels in conformance with the details shown on the plans and these special provisions.

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 690 kPa.

Pipe for the pipe pin shall conform to the requirements in ASTM Designation: A 53, Standard weight, except the amount of the zinc coating per square meter of actual surface shall average not less than 610 g and no individual specimen shall show less than 550 g.

The button on the button-headed wires shall conform to the provisions in Section 50-1.05, "Prestressing Steel," of the Standard Specifications.

The coupler at the mat connection shall be a seamless steel sleeve. The coupler shall be applied over the button-headed 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 5 mm.

Splicing of the welded wire mat along its length shall be by a mechanical coupler which will develop the minimum tensile strength of the wire. The mechanical coupler shall be approved by the Engineer.

MW70 and MW130 steel wire shall conform to the requirements in ASTM Designation: A 82. The welded wire mat shall conform to the requirements in ASTM Designation: A 185.

MD70 and MD130 deformed steel wire may be substituted for MW70 and MW130 steel wire, respectively. The welded wire mat utilizing deformed steel wire shall conform to the requirements in ASTM Designation: A 497.

The location of the top level of soil reinforcement, assuming no leveling pad settlement, shall be placed parallel to the top of wall and at a distance below the top of wall as shown on the plans within a maximum tolerance of plus 40 mm.

The top of top face panels, assuming no leveling pad settlement, shall be parallel to the top of the wall at the distance below the top of wall as shown on the plans within a maximum tolerance of plus 40 mm.

MEASUREMENT AND PAYMENT

Earth retaining structures will be measured and paid for by the square meter. Regardless of the type of earth retaining structure actually constructed, the square meter area for payment will be based on the vertical height and length of each section of the mechanically stabilized embankment wall shown on the plans which 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 bottom of the lowermost face element top of footing to the top of wall profile.

Full compensation for removing and disposing off the existing metal crib wall to the limits shown on the plans shall be considered as included in the contract price paid per square meter for earth retaining structure and no separate payment will be made therefor.

The contract price paid per square meter for earth retaining structure at each location shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the earth retaining structure and inspection elements, including earthwork, leveling pad, barrier slab, 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 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 meter for earth retaining structure and no separate payment will be made therefor.

10-1.36 CONTROLLED LOW STRENGTH MATERIAL

Controlled low strength material shall consist of a workable mixture of aggregate, cementitious materials, and water and shall conform to the provisions for slurry cement backfill in Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications and these special provisions.

At the option of the Contractor, controlled low strength material may be used as structure backfill for pipe culverts, except that controlled low strength material shall not be used as structure backfill for aluminum and aluminum-coated culverts nor for culverts having a diameter or span greater than 6.1 m.

When controlled low strength material is used for structure backfill, the width of the excavation shown on the plans may be reduced so that the clear distance between the outside of the pipe and the side of the excavation, on each side of the pipe, is a minimum of 300 mm. This minimum may be reduced to 150 mm when the height of cover is less than or equal to 6.1 m or the pipe diameter or span is less than 1050 mm.

Controlled low strength material in new construction shall not be permanently placed higher than the basement soil. For trenches in existing pavements, permanent placement shall be no higher than the bottom of the existing pavement permeable drainage layer. If a drainage layer does not exist, permanent placement in existing pavements shall be no higher than 25 mm below the bottom of the existing asphalt concrete surfacing or no higher than the top of base below the existing portland cement concrete pavement. The minimum height that controlled low strength material shall be placed, relative to the culvert invert, is 0.5 diameter or 0.5 height for rigid culverts and 0.7 diameter or 0.7 height for flexible culverts.

When controlled low strength material is proposed for use, the Contractor shall submit a mix design and test data to the Engineer for approval prior to excavating the trench for which controlled low strength material is proposed for use. The test data and mix design shall provide for the following:

A. A 28-day compressive strength between 345 kPa and 690 kPa for pipe culverts having a height of cover of 6.1 m or less and a minimum 28-day compressive strength of 690 kPa for pipe culverts having a height of cover greater than 6.1 m. Compressive strength shall be determined in conformance with the requirements in ASTM Designation: D 4832.
B. When controlled low strength material is used as structure backfill for pipe culverts, the sections of pipe culvert in contact with the controlled low strength material shall conform to the requirements of Chapter 850 of the Highway Design Manual using the minimum resistivity, pH, chloride content, and sulfate content of the hardened controlled low strength material. Minimum resistivity and pH shall be determined in conformance with the requirements of California Test 643. The chloride content shall be determined in conformance with the requirements of California Test 422 and the sulfate content shall be determined in conformance with the requirements of California Test 417.
C. Cement shall be any type of portland cement conforming to the requirements in ASTM Designation: C 150; or any type of blended hydraulic cement conforming to the requirements in ASTM Designation: C 595M or the physical requirements in ASTM Designation: C 1157M. Testing of cement will not be required.
D. Admixtures may be used in conformance with the provisions in Section 90-4, "Admixtures," of the Standard Specifications. Chemical admixtures containing chlorides as Cl in excess of one percent by mass of admixture, as determined in conformance with the requirements of California Test 415, shall not be used. If an air-entraining admixture is used, the maximum air content shall be limited to 20 percent. Mineral admixtures shall be used at the Contractor's option.

Materials for controlled low strength material shall be thoroughly machine-mixed in a pugmill, rotary drum or other approved mixer. Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Controlled low strength material shall be placed in the work within 3 hours after introduction of the cement to the aggregates.

When controlled low strength material is to be placed within the traveled way or otherwise to be covered by paving or embankment materials, the material shall achieve a maximum indentation diameter of 76 mm prior to covering and opening to public traffic. Penetration resistance shall be measured in conformance with the requirements in ASTM Designation: D 6024.

Controlled low strength material used as structure backfill for pipe culverts will be considered structure backfill for compensation purposes.

10-1.37 GEOSYNTHETIC REINFORCED EMBANKMENT

Geosynthetic reinforced embankment shall consist of placing geosynthetic reinforcement material between layers of compacted soil in accordance with the details shown on the plans, as specified in Section 19 "Earthwork," of the Standard Specifications, these special provisions, and as directed by the Engineer. Only one type of geosynthetic reinforcement material shall be used for an entire embankment.

MATERIAL CONFIGURATION SPECIFICATIONS

The geosynthetic reinforcement material shall be configured as a geosynthetic and shall meet the requirements described under “Material Specifications” found elsewhere in this section. The Engineer shall be furnished a Certificate of Compliance according to the provisions found in Section 6-1.07, “Certificate of Compliance,” of the Standard Specifications for the geosynthetic reinforcement material a minimum of one week prior to beginning placement of geosynthetic reinforcement material. The Certificate of Compliance shall be prepared and signed by a representative of the manufacturer who is a California-registered Civil Engineer.

Geosynthetic reinforcement material shall consist of material designed for use in subsurface geotechnical slope reinforcement applications. Geosynthetic reinforcement material shall be configured as either a geogrid or geotextile material. Geogrid shall have in addition to the requirements for geosynthetic reinforcement, a regular and defined open area. Geogrid shall obtain pullout resistance from the soil by a combination of soils shearing friction on the plane surfaces parallel to the direction of shearing and soils bearing on transverse grid surfaces normal to the direction of grid movement. The percentage of the open area for geogrids shall range from 50 to 90 percent of the total projection of a section of the material. Geotextiles shall have in addition to the requirements for geosynthetic reinforcement material, an irregular or regular open area with the spacing of open areas being less than 6.3 millimeters in any direction.

Geosynthetic reinforcement material shall meet the following requirements in addition to the requirements described under “Materials Specifications” elsewhere in this section:

1. Long Term Design Strength (LTDS) for geosynthetic reinforcement material shall be equal to or greater than values shown on the plans or elsewhere in these specifications as determined by Geosynthetic Research Institute (GRI) Test Methods. LTDS for geogrid reinforcement and geotextile reinforcement shall be determined by Standard Practice GRI G4 (a) and (b) and GRI GT7, respectively. These values are minimum average roll values.

Long Term Design Strength is the strength of the geogrid or the geotextile calculated by applying all partial factors of safety in accordance with GRI Standard Practice GG4 (a) and (b) or GT7. The factor of safety for creep deformation shall be determined for a 75-year design life as determined by GRI G4 (a) and (b) for geogrids or GRI GT7 for geotextiles. The 75-year design life strength is determined from the creep curve which becomes asymptotic to a constant strain line of 10 percent or less.

In the absence of specific test data, the partial factor of safety default values (installation damage, creep deformation, chemical degradation, biological degradation, and joint) as indicated in the Standard Practice GRI G4 (a) and (b) and GRI GT7 shall be applied to the calculations of the LTDS.

2. Geosynthetic reinforcement material shall be resistant to naturally occurring alkaline and acidic soil conditions, and to attack by bacteria.

All test results which contributed to the calculations of the LTDS shall be submitted to the Engineer no less than one week prior to beginning placement of the geosynthetic reinforced embankment. All test results which contribute to the calculations of the LTDS shall be prepared and signed by a California-registered Civil Engineer.

MATERIAL

Geosynthetic reinforcement material shall consist of high density polyethylene, polypropylene, high density polypropylene sheets, high tenacity polyester yarn, or polyaramide and shall meet the applicable material requirements found below. Geosynthetic reinforcement material shall consist of main and secondary reinforcement layers.

High Density Polyethylene.--Geosynthetic reinforcement material consisting of high density polyethylene shall meet or exceed the following material requirements:

1. Be manufactured from high density polyethylene (HDPE) which conforms to ASTM Method D 1248.
2. Shall have a LTDS in the primary strength direction greater than or equal to 20.4 kilo-Newtons per meter.

Polypropylene.--Geosynthetic reinforcement material consisting of polypropylene or high-density polypropylene sheets shall meet or exceed the following material requirements:

1. Shall meet the requirements of ASTM Designation: D 4101, Group 1/Class1/Grade 2.
2. Shall have a LTDS in the primary strength direction greater than or equal to 20.4 kilo-Newtons per meter.

High Tenacity Polyester Encapsulated.--Geosynthetic reinforcement material consisting of high tenacity polyester yarn shall meet or exceed the following material requirements:

1. Be manufactured from high tenacity polyester yarn as determined by ASTM Designation: D 629. In addition to meeting the requirements for geosynthetic, geogrid shall be encapsulated in an acrylic latex coating or similar.
2. Shall have a LTDS in the primary strength direction greater than or equal to 20.4 kilo-Newtons per meter.

Polyaramides.--Geosynthetic reinforcement material consisting of polyaramide shall meet or exceed the following material requirements:

1. Be manufactured from high tenacity polyester yarn as determined by ASTM Designation: D 629.
2. Shall have a LTDS in the primary strength direction greater than or equal to 20.4 kilo-Newtons per meter.

IMPORTED BORROW (GEOSYNTHETIC REINFORCED EMBANKMENT)

All imported borrow used in the geosynthetic reinforced embankment shall be reasonably free from organic or other deleterious materials and shall conform to the following:

Gradation Requirements

Sieve Size	Percentage Passing	California Test No.
75-mm	100	202
19-mm	70 - 100	202
4.75-mm	5 - 70	202
420-µm	0 - 60	202
75-µm	0 - 45	202

Property Requirements

Test	Requirement	California Test No.
Sand Equivalent	10 min.	217
Plasticity Index	20 max.	204
pH	3 to 9	643

The portion of imported borrow (geosynthetic reinforcement embankment) placed shall have a Resistance (R-Value) of not less than 15.

HANDLING AND STORAGE

Geosynthetic reinforcement material shall be handled and stored in accordance with the manufacturer's recommendations and these special provisions. Geosynthetic reinforcement material shall be furnished in an appropriate protective cover which shall protect it from ultraviolet radiation and from abrasion during shipping and handling. Only as much geosynthetic reinforcement material shall be placed as can be placed and covered with backfill in the same work shift.

CONSTRUCTION

The Contractor shall prepare the grade that is to receive the layers of geosynthetic reinforcement material to the compaction and elevation tolerances described in the Standard Specifications under Section 19-2.05, "Slopes," and these special provisions. The grade shall be free of loose or extraneous material and objects that may damage the geosynthetic reinforcement material during installation. Relative compaction of not less than 95 percent shall be obtained in the embankment foundation under the lowest layer of geosynthetic reinforcement material for a minimum depth of 0.15 meter.

The maximum loose thickness of each lift of embankment material shall not exceed 0.3 m and shall be compacted to 90% Relative Compaction.

Geosynthetic reinforcement material shall be handled and placed in accordance with the manufacturer's recommendations and these special provisions. The geosynthetic reinforcement material shall be laid horizontally at the elevation specified on the plans, on compacted backfill from within 150 millimeters of the face of the embankment to the required embedment length. The geosynthetic reinforcement material shall be placed in a wrinkle free manner, pulled taut, aligned, and anchored before backfill placement. Slack in geosynthetic reinforcement material shall be removed in a manner, and to such a degree, as approved by the Engineer. Geosynthetic reinforcement material shall be installed in a horizontal plane at the intervals, elevations, and for the minimum embedment length shown on the plans. Each layer of geosynthetic reinforcement material shall not vary more than 0.15 meter from the theoretical horizontal plane established for that layer for the entire width and length of the reinforced reinforcement.

Geosynthetic reinforcement material shall be placed as shown on the plans and shall extend the full width of the reinforced embankment. Where the full embedment length of geosynthetic reinforcement material as shown on the plans cannot be achieved along the sides or for other limited areas of the reinforcement zone, the geosynthetic reinforcement material shall be trimmed as necessary to avoid the obstruction and to achieve the maximum embedment possible.

Geosynthetic reinforcement material shall be secured in place with staples, pins, sand bags, or backfill as required by construction conditions, weather conditions, or as directed by the Engineer to prevent the displacement of the geosynthetic reinforcement material during compaction and placement of the reinforcement material.

Geosynthetic reinforcement material shall not extend into the pavement structural section.

Each layer of geosynthetic reinforcement material shall be placed (unrolled) into the grade to form a continuous mat. Overlapping and splicing geosynthetic embankment material shall conform to the following:

Uniaxial geogrid and geotextile geotechnical fabric does not need to be overlapped along edges parallel to the direction of working tensile strength. Uniaxial geogrid and woven geotechnical fabric shall not be overlapped or spliced along edges perpendicular to the direction of working tensile strength, or as directed by the Engineer.

Biaxial geogrid shall be overlapped a minimum of 150 millimeters along edges parallel to the direction of working tensile strength, or as directed by the Engineer. Biaxial geogrid shall be overlapped a minimum of 1 meter along edges perpendicular to the direction of working tensile strength of reinforcement, or as directed by the Engineer.

A layer of soil a minimum of 100 millimeters in thickness shall be spread between uniaxial geogrid layers or woven geotechnical fabric layers in the area to be overlapped, or as directed by the Engineer.

The geosynthetic reinforcement material shall be placed in such a manner that the direction of maximum strength is oriented perpendicular to the project centerline. The Contractor shall verify correct orientation of the geosynthetic reinforcement material. Each layer of geosynthetic reinforcement material shall be placed onto the embankment material to form a continuos mat. Adjacent strips of geosynthetic reinforcement material placed in this manner need not be overlapped.

During spreading and compacting of the backfill, at least 150 millimeters, measured vertically, of backfill shall be maintained between the geosynthetic reinforcement material and the Contractor's equipment. Equipment or vehicles shall not be operated or driven directly on the geosynthetic reinforcement material.

At locations where guard rail posts will later be placed at the top crest of the geosynthetic reinforced embankment and the geosynthetic reinforcement material would interfere with placement of such posts, prior to backfilling the Contractor shall be allowed to cleanly precut the reinforcement material of the affected layers into a cross-shaped pattern to aid the later placement of the guard rail posts. The dimensions of the precutting shall not exceed the post dimensions by greater than 750 millimeters.

Splicing of geosynthetic reinforcement material shall not be allowed. For geotextiles, no splicing joints parallel to project centerline shall be allowed for with primary or secondary geotextile reinforcement. Geogrid reinforcement may be joined with mechanical connections. Joints shall not be placed vertically within 2 meters of the slope face, within 2 meters of the slope top, nor horizontally or vertically adjacent (within 1.2 meters) to another joint. Only one joint per length of geogrid shall be allowed. The joint shall be made for the full width of the strip by using a similar material with similar strength, and using a connection devise supplied or recommended by the manufacturer. Joints in geogrid shall be pulled and held taut during backfill placement.

If the geosynthetic reinforcement material is damaged during construction operations, the damaged sections shall be repaired, at the Contractor's expense, by placing sufficient additional geosynthetic reinforcement material to cover the damaged area and to meet the following overlap requirements:

1. Edges of geogrid perpendicular to centerline shall be overlapped for entire lengths by the small of: three aperture openings or 100 millimeters. Edges of geogrid parallel to centerline shall be joined using a mechanical connection described elsewhere in these special provisions.
2. Edges of geotextiles shall be overlapped a minimum of 150 millimeters on all sides.

MEASUREMENT AND PAYMENT

Geosynthetic Reinforced Embankment will be measured and paid for by the square meter for the total area in each level (plan view) as shown on the plans and for any additional area as directed by the Engineer. Payment shall not include additional reinforcement required for overlaps.

Imported Borrow (Geosynthetic Reinforced Embankment) shall be measured and paid for by the cubic meter. The contract price paid per cubic meter for Imported Borrow (Geosynthetic Reinforced Embankment) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in obtaining and placing the imported borrow, 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 price paid per square meter of geosynthetic reinforced embankment shall include full compensation for furnishing all labor and materials, including tools and equipment, and incidentals, for doing all the work involved in placing the geosynthetic reinforcement layers complete and in place, including overlapping and anchoring as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.38 MOVE-IN/MOVE-OUT (EROSION CONTROL)

Move-in/move-out (erosion control) shall include moving onto the project when an area is ready to receive erosion control as determined by the Engineer, setting up all required personnel and equipment for the application of erosion control materials and moving out all personnel and equipment when erosion control in that area is completed.

When areas are ready to receive applications of erosion control (Type D), as determined by the Engineer, the Contractor shall begin erosion control work in that area within 5 working days of the Engineer's notification to perform the erosion control work.

Attention is directed to the requirements of erosion control (Type D) elsewhere in these special provisions.

Quantities of move-in/move-out (erosion control) will be determined as units from actual count as determined by the Engineer. For measurement purposes, a move-in followed by a move-out will be considered as one unit.

The contract unit price paid for move-in/move-out (erosion control) shall include full compensation for furnishing all labor, materials (excluding 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 erosion control (Type D), as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.39 EROSION CONTROL (BLANKET)

Erosion control (blanket) shall conform to the details shown on the plans, the provisions in Section 20-3, "Erosion Control," of the Standard Specifications and these special provisions.

Erosion control (blanket) work shall consist of installing erosion control blanket to unlined ditches, unlined gutters, unlined “V” ditches/gutters, column drain protection locations and other areas designated by the Engineer.

Prior to installing erosion control (blanket), erosion control materials shall be applied as specified in Erosion Control (Type D) of these specifications.

MATERIALS

Materials shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and these special provisions.

Erosion Control Blanket

Erosion control blanket shall consist of wood excelsior or straw and coconut mats secured in place with wire staples and shall conform to one of the following.

A. Excelsior blanket material shall consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 150 mm or longer. The erosion control blanket shall be of consistent thickness and the wood fiber shall be evenly distributed over the entire area of the blanket. The top surface of the blanket shall be covered with a photo-degradable extruded plastic mesh. The blanket shall be smolder resistant without the use of chemical additives and shall be non-toxic and non-injurious to plant and animal life. Erosion control blanket shall be furnished in rolled strips, 1220 mm ± 25 mm in width, and shall have an average mass of 0.5-kg/m^2 ± 10 percent at the time of manufacture.

A. Straw and coconut blanket shall be machine produced mats of straw and a minimum of 30 percent coconut fiber with a light weight biodegradable netting on top. The straw and coconut shall be adhered to the netting with biodegradable organic thread or glue strip. The straw and coconut erosion control blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the blanket. Straw and coconut erosion control blanket shall be furnished in rolled strips with a minimum width of 1.8 meters, minimum length of 20 meters (+/-one meter) and a minimum weight of 0.27-kg/m^2.

C. Staples for erosion control blankets shall be made of 3.05 minimum steel wire and shall be U-shaped with 200-mm legs and 50-mm crown.

APPLICATION

Erosion control (blanket) materials shall be installed as shown on the plans and as follows:

Erosion control blanket strips shall be placed loosely on the gutter or ditch side slope and channel bottom with the longitudinal joints parallel to the slope contour lines and centerline of the ditch or gutter. Longitudinal and transverse joints of blankets shall be overlapped and stapled as shown on the plans and according to the manufacturer's recommendations. Staples shall be driven perpendicular to the slopes, and shall be located and spaced as shown on the plans and in conformance with the manufacturer's instructions. Ends of the blankets shall be secured in place as shown on the plans and in conformance with the manufacturer's instructions.

Erosion control blanket strips at column drain protection locations, shall be placed loosely with the longitudinal joints parallel to the slope contours. Longitudinal and transverse joints of blankets shall be overlapped according to the manufacturer's recommendations and stapled. Staples shall be driven perpendicular to the slope face, and shall be located and spaced in conformance with the manufacturer's instructions. Ends of the blankets shall be secured in place in conformance with the manufacturer's instructions.

MEASUREMENT AND PAYMENT

The quantity of erosion control (blanket) will be determined by the square meter from actual slope measurement of the area covered by the erosion control blanket.

The contract price paid per square meter for erosion control (blanket) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing erosion control blanket, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.40 EROSION CONTROL (NETTING)

Erosion control (netting) shall conform to the details shown on the plans, the provisions in Section 20-3, "Erosion Control," of the Standard Specifications and these special provisions.

Erosion control (netting) work shall consist of installing erosion control netting in conjunction with the installation of geogrids, and on construction slopes as shown on the plans, and other areas designated by the Engineer.

Following the installation of erosion control netting, erosion control materials shall be applied onto the netting face as specified in Erosion Control (Type D) of these specifications.

MATERIALS

Materials shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and these special provisions.

Erosion Control Netting

Erosion control netting shall consist of 100 percent spun coir fiber and shall conform to the following:

Specification	Requirement
Weight, grams per square meter ASTM Designation: D 3776	400
Minimum Tensile Strength, kilonewtons, ASTM Designation: D 4595-86	0.23/0.14 (dry) 0.17/0.11 (wet)
Roll Width, meters, min.	4
Area/Roll, square meters, min.	200
Open Area, percent	63-70

Staples

Staples for erosion control netting shall be made of 3.05-mm minimum steel wire and shall be U-shaped with 200-mm legs and 50-mm crown.

INSTALLATION

Erosion control (netting) materials shall be placed in conjunction with geogrid embankment construction and on construction slopes as shown on the plans and as follows:

Erosion control netting strips shall be placed along with primary geogrid during the construction of the embankment slope. Portions of the netting within the prism of the embankment shall be secured as shown on the plans. Longitudinal and transverse joints of netting shall be overlapped and stapled as shown on the plans. Staples shall be driven perpendicular to the netting such that the top of the staple is flush with the ground surface. Stapling pattern shall be located and spaced as shown on the plans.

On construction slopes, erosion control netting strips shall be placed loosely on the slope with the longitudinal joints perpendicular to the slope contour lines. The netting face shall be anchored longitudinally as shown on the plans. Longitudinal and transverse joints of netting shall be overlapped a minimum of 100 mm and stapled as shown on the plans. Staples shall be driven perpendicular to the netting such that the top of the staple is flush with the ground surface. Slope anchor and stapling pattern shall be located and spaced as shown on the plans.

MEASUREMENT AND PAYMENT

The quantity of erosion control (netting) will be determined by the square meter from actual measurement of the area covered by the erosion control netting.

The contract price paid per square meter for erosion control (netting) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing erosion control netting, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.41 EROSION CONTROL (TYPE D)

Erosion control (Type D) shall conform to the provisions in Section 20-3, "Erosion Control," of the Standard Specifications and these special provisions.

Erosion control (Type D) work shall consist of applying erosion control materials to all embankment and excavation slopes and other areas disturbed by construction activities. Pure live seed (Type 1) shall be applied to all other areas not shown on the plans to receive Pure live seed (Type 2). Erosion control (Type D) shall be applied during the period starting September 1 and ending November 30; or, if the slope on which the erosion control is to be placed is finished during the winter season as specified in "Water Pollution Control" of these special provisions, the erosion control shall be applied immediately; or, if the slope on which the erosion control is to be placed is finished outside both specified periods and the contract work will be completed before September 1, the erosion control shall be applied as a last item of work.

Erosion control (Type D) shall be applied when an area is ready to receive erosion control as determined by the Engineer and in conformance with the provisions in "Move-in/Move-out (Erosion Control)" of these special provisions.

If the slope on which the erosion control is to be placed is finished during the rainy season as specified in "Water Pollution Control" of these special provisions, the erosion control shall be applied immediately to the slope.

Prior to installing erosion control materials, soil surface preparation shall conform to the provisions in Section 19-2.05, "Slopes," of the Standard Specifications, except that rills and gullies exceeding 50 mm in depth or width shall be leveled. Vegetative growth, temporary erosion control materials, and other debris shall be removed from areas to receive erosion control.

Erosion Control (Type D), for erosion control netting areas, shall be applied upon completion of Netting and Fiber Rolls installation as described in these special provisions.

Erosion Control (Type D) for ditches, gutters and column drain protection areas, shall be applied prior to the installation of erosion control (Blanket)

MATERIALS

Materials shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and these special provisions.

Seed

Seed shall conform to the provisions in Section 20-2.10, "Seed," of the Standard Specifications. Individual seed species shall be measured and mixed in the presence of the Engineer.

Seed shall be delivered to the project site in unopened separate containers with the seed tag attached. Containers without a seed tag attached will not be accepted.

A sample of approximately 30 g of seed will be taken from each seed container by the Engineer.

Legume Seed

Legume seed shall be pellet-inoculated or industrial-inoculated and shall conform to the following:

A. Inoculated seed shall be inoculated in conformance with the provisions in Section 20-2.10, "Seed," of the Standard Specifications.
B. Inoculated seed shall have a calcium carbonate coating.
C. Industrial-inoculated seed shall be inoculated with Rhizobia and coated using an industrial process by a manufacturer whose principal business is seed coating and seed inoculation.
D. Industrial-inoculated seed shall be sown within 180 calendar days after inoculation.
E. Legume seed shall consist of the following:

LEGUME SEED

Botanical Name (Common Name)	Percent Germination (Minimum)	Kilograms Pure Live Seed Per Hectare (Slope Measurement)
Lotus pushianus (Purshings Lotus)	60	3.0
Lotus corniculatus (Bird's foot Trefoil)	60	3.0

Non-Legume Seed

Non-legume seed shall consist of the following:

NON-LEGUME SEED (Type 1)

Botanical Name (Common Name)	Percent Germination (Minimum)	Kilograms Pure Live Seed Per Hectare (Slope Measurement)
Eschscholzia californica (California Poppy)	60	0.5
Achillea millefolia (White Yarrow)	50	0.5
Hordeum vulgare 'UC 937' (Cereal Barley)	60	20.0
Festuca rubra 'Molate' (Molate Red Fescue)	60	10.0
Nassella pulchra* (Purple Needle Grass)	60	8.0
Bromus carinatus* (California Brome)	60	10.0
Vulpia microstachys (Six Weeks Fescue)	60	4.0

*Native California seed source.

NON-LEGUME SEED (TYPE 2)

Botanical Name (Common Name)	Percent Germination (Minimum)	Kilograms Pure Live Seed Per Hectare (Slope Measurement)
Eschscholzia californica (California Poppy)	50	1.0
Festuca ovina 'Covar' (Sheep Fescue)	50	20.0
Festuca longifolia 'Duar' (Hard Fescue)	50	30.0

Pure live seed (Type 1) shall consist of legume seed and non-legume seed (Type 1). Pure live seed (Type 2) shall consist of legume seed and non-legume seed (Type 2).

Commercial Fertilizer

Commercial fertilizer shall conform to the provisions in Section 20-2.02, "Commercial Fertilizer," of the Standard Specifications and shall have a guaranteed chemical analysis of 6 percent nitrogen, 20 percent phosphoric acid and 20 percent water soluble potash.

Straw

Straw shall conform to the provisions in Section 20-2.06, "Straw," of the Standard Specifications and these special provisions.

Wheat and barley straw shall be derived from irrigated crops.

Prior to delivery of wheat or barley straw to the project site, the Contractor shall provide the name, address and telephone number of the grower.

Compost

Compost shall be derived from green material consisting of chipped, shredded or ground vegetation or clean processed recycled wood products or a Class A, exceptional quality biosolids composts, as required by the United States Environmental Protection Agency (EPA), 40 CFR, Part 503c regulations or a combination of green material and biosolids compost. The compost shall be processed or completed to reduce weed seeds, pathogens and deleterious material, and shall not contain paint, petroleum products, herbicides, fungicides or other chemical residues that would be harmful to plant or animal life. Other deleterious material, plastic, glass, metal or rocks shall not exceed 0.1 percent by weight or volume. A minimum internal temperature of 57˚C shall be maintained for at least 15 continuous days during the composting process. The compost shall be thoroughly turned a minimum of 5 times during the composting process and shall go through a minimum 90-day curing period after the 15-day thermophilic compost process has been completed. Compost shall be screened through a maximum 9.5-mm screen. The moisture content of the compost shall not exceed 35 percent. Compost products with a higher moisture content may be used provided the weight of the compost is increased to equal the compost with a moisture content of 35 – 40 percent. Moist samples of compost on an as received basis shall be dried in an oven at a temperature between 105°C and 115°C until a constant dry weight of the sample is achieved. The percentage of moisture will be determined by dividing the dry weight of the sample by the moist weight of the sample and then multiplying by 100. Compost will be tested for maturity and stability with a Solvita test kit. The compost shall measure a minimum of 5 on the maturity and stability scale.

Stabilizing Emulsion

Stabilizing emulsion shall conform to the provisions in Section 20-2.11, "Stabilizing Emulsion," of the Standard Specifications and these special provisions.

Stabilizing emulsion shall be in a dry powder form, may be reemulsifiable, and shall be a processed organic adhesive derivative of Plantago ovata used as a soil tackifier.

APPLICATION

Erosion control materials shall be applied in 3 separate applications as specified below. Only application, “A”, of the following applications shall be applied where Erosion Control (Netting) and Erosion control (Blanket) is installed.

A. The following mixtures in the proportions indicated shall be applied with hydro-seeding equipment within 30 minutes after the seed has been added to the mixture:

For areas to receive Pure live seed (Type 1):

Material	Kilograms Per Hectare (Slope Measurement)
Legume Seed	6.0
Non-Legume Seed (Type 1)	53.0
Fiber	310
Compost	940
Commercial Fertilizer	200

Hydroseeding with Pure live seed (Type 1) shall be applied by hose from the ground to all areas with Erosion Control (Netting). Erosion control materials shall be applied at close range onto the netting face such that the materials are well integrated into the netting and in close contact with the ground surface. Application shall be perpendicular to the slope face such that the application does not displace the netting. Any netting displacement shall immediately be repaired by the Contractor.

For areas to receive Pure live seed (Type 2):

Material	Kilograms Per Hectare (Slope Measurement)
Legume Seed	6.0
Non-Legume Seed (Type 2)	51.0
Fiber	310
Compost	940
Commercial Fertilizer	200

B. Straw shall be applied at the rate of 4.0 tonnes per hectare based on slope measurements. Incorporation of straw will not be required. Straw shall be distributed evenly without clumping or piling.
C. The following mixture in the proportions indicated shall be applied with hydro-seeding equipment:

Material	Kilograms Per Hectare (Slope Measurement)
Fiber	310
Compost	940
Stabilizing Emulsion (Solids)	140

The ratio of total water to total stabilizing emulsion in the mixture shall be as recommended by the manufacturer.

Once straw work is started in an area, stabilizing emulsion applications shall be completed in that area on the same working day.

The proportions of erosion control materials may be changed by the Engineer to meet field conditions.

MEASUREMENT AND PAYMENT

Compost (erosion control) will be measured by the kilogram or tonne, whichever unit is designated in the Engineer's Estimate The weight will be as determined by the Engineer from marked mass and sack count or from scale weighings.

The contract price paid per kilogram or tonne for compost (erosion control) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying compost for erosion control, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.42 FIBER ROLLS

Fiber rolls shall conform to the details shown on the plans and these special provisions.

MATERIALS

Fiber rolls shall consist of one of the following:

A. Fiber rolls shall be constructed with manufactured blankets consisting of one material or a combination of materials consisting of wood excelsior, rice or wheat straw, or coconut fibers. Blankets shall measure approximately 2.0 to 2.4 m wide by 20 m to 29 m in length. Wood excelsior material shall have individual fibers, 80 percent of which shall be 150 mm or longer in fiber length. Blankets shall have a biodegradable jute, sisal or coir fiber netting on at least one side. The blanket shall be rolled on the blanket's width and secured with jute twine spaced 2 m apart along the roll for the full length and 150 mm from each end of the individual rolls The finished roll diameter shall be a minimum of 200 mm and a maximum of 250 mm and shall weigh not less than 0.81 kg/m. Overlapping of more than one blanket may be required to achieve the finished roll diameter. When overlapping is required, blankets shall be longitudinally overlapped 150 mm along the length of the fabric.
B. Fiber rolls shall be pre-manufactured rice or wheat straw, wood excelsior or coconut fiber rolls encapsulated within a biodegradable jute, sisal or coir fiber netting. Each roll shall be a minimum of 200 mm and a maximum of 250 mm in diameter, 3 m to 6 m in length and shall weigh not less than 1.6 kg/m. The netting shall have a minimum durability of one year after installation. The netting shall be secured tightly at each end of the individual rolls.
C. Stakes shall be fir or pine and shall be a minimum of 19 mm x 38 mm x 450 mm in length. Metal stakes may be used as an alternative. The Contractor shall submit a sample of the metal stake to the Engineer prior to installation. The tops of the metal stakes shall be bent over at a 90-degree angle. No additional compensation will be allowed for the use of a metal stake.

INSTALLATION

Fiber rolls shall be installed approximately parallel to the slope contour. Fiber rolls shall be installed prior to the application of other erosion control materials.

A. Fiber rolls shall be installed using rope and notched stakes to restrain the fiber roll against the slope face in conformance with these special provisions. Rope shall be sisal or manila, biodegradable, with a diameter of no less than 6.35 mm. Stakes shall be fir or pine and shall be a minimum of 19 mm x 38 mm x 450 mm in length and shall have a 12 mm x 12 mm notch cut 100 mm from the top. Stakes shall be placed on alternate sides of the fiber roll, spaced as shown on the plans. The stakes shall be driven into the slope until the notch is even with the top of the fiber roll. Rope shall be knotted at each stake and laced between the stakes as shown on the plans. After installation of the rope, the stakes shall be driven into the slope such that the rope holds the fiber roll snug to the slope face. Furrows shall not be required. If metal stakes are used instead of wood stakes, the tops shall be bent over so that the rope can be laced and knotted as with the wood stakes.

   Stakes shall be installed 600 mm apart along the total length of the rolls and 300 mm from the end of each individual roll. Stakes shall be driven flush or a maximum of 50 mm above the roll.

MEASUREMENT AND PAYMENT

Fiber rolls will be measured by the meter from end to end along the centerline of the installed rolls deducting the widths of overlaps.

The contract price paid per meter for fiber rolls shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing fiber rolls, complete in place, including stakes, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.43 COLUMN DRAIN PROTECTION

Column drain protection shall be installed and maintained as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

MATERIALS

Materials shall conform to the provisions in Section 20-2, "Materials," of the Standard Specifications and these special provisions.

Erosion Control Blanket

Erosion control blanket shall consist of wood excelsior or straw and coconut mats secured in place with wire staples and shall conform to the following:

A. Erosion control blanket for column drain protection shall conform to the provisions specified for erosion control blanket under "Erosion Control (Blanket)" of these special provisions.
B. Staples for erosion control blankets shall be made of 3.05-mm minimum steel wire and shall be U-shaped with 200-mm legs and 50-mm crown

INSTALLATION

The bedding area shall be excavated and cleared of obstructions including, but not limited to, rocks, clods, and mulch prior to installation of the erosion control blanket. The edges of the erosion control blanket shall be keyed into trenches, stapled, backfilled, and tamped.

MEASUREMENT AND PAYMENT

The quantity of column drain protection to be paid for will be determined from actual measurement of column drain inlets protected conforming to the details shown on the plans

The contract price paid per column drain protection shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing and maintaining column drain protection, complete in place, except furnishing and installing erosion control blanket, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.44 FINISHING SLOPE

Finishing slope shall conform to the provisions in Section 22, "Finishing Roadway," of the Standard Specifications and these special provisions.

Embankment slopes shall be finished in accordance with Section 19-2.05 ‘Slopes’ of the Standard Specifications and shall be finished by running track laying or compaction equipment perpendicular to the slope contours. Several passes may be required to consolidate the slope face to achieve 90 % relative compaction or to the satisfaction of the Engineer. Water shall be used to facilitate compaction, but the application of such shall not result in any runoff being generated that will cause erosion.

Full compensation for finishing slope shall be considered as included in the contract price paid per cubic meter for roadway excavation and no additional compensation will be allowed therefor.

10-1.45 AGGREGATE SUBBASE

Aggregate subbase shall be Class 4 and shall conform to the provisions in Section 25, "Aggregate Subbases," of the Standard Specifications and these special provisions.

The restriction that the amount of reclaimed material included in Class 4 aggregate subbase not exceed 50 percent of the total volume of the aggregate used shall not apply. Aggregate for Class 4 aggregate subbase may include reclaimed glass. Aggregate subbase incorporating reclaimed glass shall not be placed at locations where surfacing will not be placed over the aggregate subbase.

The percentage composition by mass of Class 4 aggregate subbase shall conform to the following grading requirements:

Grading Requirements (Percentage Passing)

Sieve Sizes	Operating Range	Contract Compliance
63 mm	100	100
4.75-mm	30-65	25-70
75-µm	0-15	0-18

Class 4 aggregate subbase shall also conform to the following quality requirements:

Quality Requirements

Test	Operating Range	Contract Compliance
Sand Equivalent	21 Min.	18 Min.
Resistance (R-value)	----	50 Min.

The provisions of the last 4 paragraphs in Section 25-1.02A, "Class 1, Class 2, and Class 3 Aggregate Subbases," of the Standard Specifications shall apply to Class 4 aggregate subbase.

At the option of the Contractor, Class 1 aggregate subbase conforming to the grading and quality requirements in Section 25-1.02A, may be used in place of Class 4 aggregate subbase. The restriction that the amount of reclaimed material included in Class 1 aggregate subbase not exceed 50 percent of the total volume of the aggregate used shall not apply. Aggregate for Class 1 aggregate subbase may include reclaimed glass. Aggregate subbase incorporating reclaimed glass shall not be placed at locations where surfacing will not be placed over the aggregate subbase. Once a class of aggregate subbase is selected, the class shall not be changed without written approval of the Engineer.

Regardless of the class of aggregate subbase supplied under the provisions of this section, payment for all aggregate subbase will be made as Class 4 aggregate subbase.

10-1.46 AGGREGATE BASE

Aggregate base shall be Class 3 and shall conform to the provisions in Section 26, "Aggregate Bases," of the Standard Specifications and these special provisions.

The restriction that the amount of reclaimed material included in Class 3 aggregate base not exceed 50 percent of the total volume of the aggregate used shall not apply. Aggregate for Class 3 aggregate base may include reclaimed glass. Aggregate base incorporating reclaimed glass shall not be placed at locations where surfacing will not be placed over the aggregate base.

Aggregate for Class 3 aggregate base shall conform to the following requirements:

Grading Requirements (Percentage Passing)

Sieve Sizes	19 mm Maximum	
	Operating Range	Contract Compliance
50-mm	-------	-------
37.5-mm	-------	-------
25-mm	100	100
19-mm	90-100	87-100
4.75-mm	35-60	30-65
600-µm	10-30	5-35
75-µm	2-11	0-14

Quality Requirements

Tests	Operating Range	Contract Compliance
Sand Equivalent	25 Min.	22 Min.
Resistance (R-value)	-------	78 Min.

A Durability Index with a minimum of 35 is required.

The aggregate shall not be treated with lime, cement or other chemical material before the Durability Index test is performed. Untreated reclaimed asphalt concrete and portland cement concrete will not be considered to be treated with lime, cement or other chemical material for purposes of performing the Durability Index test.

10-1.47 TREATED PERMEABLE BASE

Treated permeable base shall be asphalt treated and shall conform to the provisions in Section 29, "Treated Permeable Bases," of the Standard Specifications.

10-1.48 ASPHALT CONCRETE

Asphalt concrete shall be Type A and shall conform to the provisions in Section 11-1, "Quality Control / Quality Assurance," of these special provisions and these special provisions.

Surfacing of miscellaneous areas with asphalt concrete shall conform to the provisions in "Asphalt Concrete (Miscellaneous Areas)" of these special provisions.

The aggregate for Type A asphalt concrete shall conform to the 19-mm maximum, coarse grading specified in Section 39-2.02, "Aggregate," in Section 11-1, "Quality Control / Quality Assurance," of these special provisions.

If the finished surface of the asphalt concrete on Route 680 and 780 traffic lanes does not meet the specified surface tolerances, the finished surface shall be brought within tolerance by either (1) abrasive grinding (with fog seal coat applied on the areas which have been ground), (2) removal and replacement, or (3) placing an overlay of asphalt concrete. The method will be selected by the Engineer. The corrective work shall be at the Contractor's expense.

If abrasive grinding is used to bring the finished surface to specified surface tolerances, additional grinding shall be performed as necessary to extend the area ground in each lateral direction so that the lateral limits of grinding are at a constant offset from, and parallel to the nearest lane line or pavement edge, and in each longitudinal direction so that the grinding begins and ends at lines normal to the pavement centerline, within a ground area. Ground areas shall be neat rectangular areas of uniform surface appearance. Abrasive grinding shall conform to the provisions in the first paragraph and the last 4 paragraphs in Section 42-2.02, "Construction," of the Standard Specifications.

The area to which paint binder has been applied shall be closed to public traffic. Care shall be taken to avoid tracking binder material onto existing pavement surfaces beyond the limits of construction.

A drop-off of more than 46 mm will not be allowed at any time between adjacent lanes open to public traffic.

Where the existing pavement is to be widened by constructing a new structural section adjacent to the existing pavement, the new structural section, on both sides of the existing pavement, shall be completed to match the elevation of the edge of the existing pavement at each location prior to spreading and compacting asphalt concrete over the adjacent existing pavement.

Shoulders or median borders adjacent to a lane being paved shall be surfaced prior to opening the lane to public traffic.

10-1.49 ASPHALT CONCRETE (MISCELLANEOUS AREAS)

Surfacing of miscellaneous areas with asphalt concrete shall conform to the provisions for miscellaneous areas in Section 39, "Asphalt Concrete," of the Standard Specifications and these special provisions.

Asphalt concrete placed in miscellaneous areas may be produced in conformance with the requirements for asphalt concrete placed on the traveled way in Section 11-1, "Quality Control / Quality Assurance," of these special provisions.

The amount of asphalt binder used in asphalt concrete placed in dikes, gutters, and guardrail flares shall be increased one percent by mass of the aggregate over the amount of asphalt binder determined for use in asphalt concrete placed on the traveled way.

Aggregate for asphalt concrete dikes shall conform to the 9.5-mm maximum grading specified in Section 39-2.02, "Aggregate," of the Standard Specifications.

The miscellaneous areas to be paid for at the contract price per square meter for place asphalt concrete (miscellaneous area) in addition to the prices paid for the materials involved shall be limited to the areas listed on the plans.

Asphalt concrete placed in miscellaneous areas will be paid for at the contract price per tonne for asphalt concrete in conformance with the provisions in Section 11-1, "Quality Control / Quality Assurance," of these special provisions. Section 39-11.02, "Statistical Evaluation and Determination of Pay Factor," in Section 11-1, "Quality Control / Quality Assurance," of these special provisions, shall not apply to asphalt concrete placed in miscellaneous areas. Payment for placing asphalt concrete in miscellaneous areas and dikes will be in conformance with the provisions in Section 39-8.02, "Payment," of the Standard Specifications.

10-1.50 PILING

GENERAL

Piling shall conform to the provisions in Section 49, "Piling," of the Standard Specifications, and these special provisions.

Attention is directed to "Seismic Monitoring Electrical System" elsewhere in these special provisions for Seismic sensor steel pipes installation.

The Contractor may not substitute a larger diameter or thicker walled permanent steel casing than that shown on the plans.

Section 49-1.05, "Driving Equipment," of the Standard Specifications is amended by adding the following paragraph after the seventh paragraph:

· The use of followers or underwater hammers for driving piles will be permitted if authorized in writing by the Engineer. When a follower or underwater hammer is used, its efficiency shall be verified by furnishing the first pile in each bent or footing sufficiently long and driving the pile without the use of a follower or underwater hammer.

The first and second paragraphs in Section 49-4.01, "Description," of the Standard Specifications are amended to read:

· Cast-in-place concrete piles shall consist of one or combinations of the following:

A. Steel shells driven permanently to the required bearing value and penetration and filled with concrete.
B. Steel casings installed permanently to the required penetration and filled with concrete.
C. Drilled holes filled with concrete.
D. Rock sockets filled with concrete.

· The drilling of holes shall conform to the provisions in these specifications. Concrete filling for cast-in-place concrete piles is designated by compressive strength and shall have a minimum 28-day compressive strength of 25 MPa. At the option of the Contractor, the combined aggregate grading for the concrete shall be either the 25-mm maximum grading, the 12.5-mm maximum grading, or the 9.5-mm maximum grading. Concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," and Section 51, "Concrete Structures." Reinforcement shall conform to the provisions in Section 52, "Reinforcement."

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.

Foundation recommendations are included in the "Information Handout" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

Rock cores are available for viewing at the Transportation Laboratory.

Attention is directed to "Welding " of these special provisions.

At the option of the Contractor, vibratory hammers or oscillators may be used to install permanent casings at the locations listed in the following table:

Bridge Name or Number	Bent Number
NB 680 / WB 780 Connector & OH (23-0212G)	18, 19 and 20
Benicia – Martinez Approach Structure (23-0215R)	18, 19, 20 and 22

Difficult pile installation at the following locations is anticipated due to the reasons listed in the following table:

Location	Reasons
West Arsenal UC (23-0127R)	Proximately to the existing above ground Exxon pipe lines, and requirements of pile embedment into steeply dipping rock.
Park Road Undercrossing (23-0226R)	Presence of claystone, ground water seepage from near by Pine Lake.
EB 780 / NB 680 Connector (23-0211G)	Presence of cobbles and boulders, loose sand, gravel and fill debris, caving soil, requirements of pile embedment into steeply dipping rock, the rock consists of interbeded soft and hard layers, tidal flow fluctuation and high ground water.
NB 680 / WB 780 Connector & OH (23-0212G)	Presence of cobbles and boulders, loose sand, gravel and fill debris, caving and/or sloughing soil, requirements of pile embedment into steeply dipping rock, the rock consists of interbeded soft and hard layers, tidal flow fluctuation and ground water.
NB 680 / WB 780 Connector (23-0214G)	Presence of soft/loose fill deposit overlying dense material, cobbles and boulders, caving soil, requirements of pile embedment into steeply dipping rock, the rock consists of interbeded soft and hard layers, tidal flow fluctuation and high ground water.
Benicia – Martinez Approach Structure (23-0215R)	Presence of cobbles and boulders, loose sand, gravel and fill debris, caving and/or sloughing soil, requirements of pile embedment into steeply dipping rock, tidal flow fluctuation and ground water.
Retaining Wall NB 20	Presence of cobbles and boulders, loose sand, gravel and fill debris, caving and/or sloughing soil, requirements of pile embedment into rock, ground water, and underground and overhead utilities.

Driving System Submittal

Prior to installing driven piling, the Contractor shall provide a driving system submittal, including driveability analysis, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. All proposed driving systems (i.e., each hammer that may be brought onto the site) shall be included in the submittal.

The driving system submittal shall contain an analysis showing that the proposed driving systems will install piling to the specified tip elevation and specified bearing. Driving systems shall generate sufficient energy to drive the piles with stresses not more than 95 percent of the specified yield strength of the steel pile or unfilled steel shell. Submittals shall include the following:

A. Complete description of soil parameters used, including soil quake and damping coefficients, skin friction distribution, ratio of shaft resistance to nominal compression resistance, assumptions made regarding the formation of soil plugs, and assumptions made regarding drilling through the center of open ended steel shells.
B. List of all hammer operation parameters assumed in the analysis, including fuel settings, stroke limitations, and hammer efficiency.
C. Driveability studies that are based on a wave equation analysis using a computer program that has been approved by the Engineer. Driveability studies shall model the Contractor's proposed driving systems, including the hammers, capblocks, and pile cushions, as well as determine driving resistance and pile stresses for assumed site conditions.

Separate analyses shall be completed at elevations above the specified tip elevations where difficult driving is anticipated. Studies shall include plots for a range of pile compression capacities above and below the nominal compression resistance shown on the plans. Plots shall include the following:

1. Pile compressive stress versus blows per 0.30-m.
2. Pile tensile stress versus blows per 0.30-m.
3. Nominal compression resistance versus blows per 0.30-m.

When the driveability analysis hammers indicate that open ended pipe pile and steel shell penetration rates are less than 0.30-m per 200 blows and the driving stresses will exceed 80 percent of the specified yield strength of the pipe and steel shell, the study shall include assumptions for drilling through the center of open ended pipe piles and steel shells.

D. Copies of all test results from any previous pile load tests, dynamic monitoring, and all driving records used in the analyses.
E. Completed "Pile and Driving Data Form," which is shown in these special provisions.

The driving system submittal shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California. Prior to mobilizing equipment to install piling, the Contractor shall allow the Engineer 15 working days to review a driving system submittal after a complete set, as determined by the Engineer, has been received. Should the Engineer fail to complete his review within the 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 the driving system submittal review, 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 Contractor shall use the driving system and installation methods described in the approved driving system submittal for a given control location. Any change in hammers from those submitted and approved by the Engineer shall also meet the requirements for driving system submittals. Revised and new driving system submittals shall be approved by the Engineer prior to using corresponding driving systems on production piling. The Contractor shall allow the Engineer 15 working days to review each revised and each new driving system submittal after a complete set, as determined by the Engineer, has been received.

Approval of pile driving equipment will not relieve the Contractor of his responsibility to drive piling, free of damage, to the specified penetration.

Full compensation for driving system submittals shall be considered as included in the contract unit price paid for drive pile, and no additional compensation will be allowed therefor.

In addition to conforming to the provisions in Section 49-1.05, "Driving Equipment," of the Standard Specifications, should obstructions to driving be encountered, the Contractor shall provide special driving tips or heavier pile sections, or shall subexcavate below the bottom of footing, or take other measures to prevent damage to the pile during driving. Full compensation for providing special tips, heavier sections, or for subexcavating or employing other measures to prevent damage to the piles shall be considered as included in the contract price paid per unit for drive steel pile of the size shown on the plans, and no additional compensation will be allowed therefor.

CAST-IN-DRILLED-HOLE CONCRETE PILES

Cast-in-drilled-hole concrete piling shall conform to the provisions in Section 49-4, "Cast-In-Place Concrete Piles," of the Standard Specifications and these special provisions.

Construction of cast-in-drilled-hole concrete piles shall be a continuous operation at each pile location, as submitted in the placing plan, unless otherwise approved in writing by the Engineer.

Construction of any cast-in-drilled-hole concrete piling shall be brought to completion before proceeding to constructing any adjacent pile of said pile at the following locations:

NB 680/WB 780 Connector & OH, bridge No. 23-0212G, abutment 22 and bents 18, 19, and 21.
Benicia-Martinez Approach Structure, Bridge No. 23-0215R, abutment 23 and bents 18, 19, 20, 21, and 22.
NB 680/ WB 780 Connector, bridge No. 23-0214G, abutments 1 and 4.

Benicia-Martinez RW NB 20, Bridge No. RW NB20, all pile locations.

The fourth paragraph in Section 49-4.03, "Drilled Holes," of the Standard Specifications is amended to read:

· After placing reinforcement and prior to placing concrete in the drilled hole, if caving occurs or deteriorated foundation material accumulates on the bottom of the hole, the bottom of the drilled hole shall be cleaned. The Contractor shall verify that the bottom of the drilled hole is clean.

Cast-in-drilled-hole concrete piling (rock socket) shall consist of drilling or coring sockets in bedrock to the depths or lengths specified and filling with reinforced concrete in conformance with the details shown on the plans and these special provisions. Cored holes, if used, shall conform to the provisions of Section 49-4.03, "Drilled Holes," of the Standard Specifications.

Permanent steel casings are required at the locations shown on the plans. If permanent steel casing is not installed into bedrock at the permanent steel casing tip elevation indicated in the pile data table shown on the plans, the Contractor shall extend the cast-in-drilled-hole concrete piling, including bar reinforcing steel and permanent steel casing to the elevation of achieve the required embedment into bedrock. The Contractor shall extend the specified tip elevation of the cast-in-drilled-hole concrete piling (rock socket) to maintain the length in bedrock as shown on the plans and as determined by the Engineer. The Contractor shall also extend the inspection pipes to the bottom of the drilled or cored hole as shown on the plans. provisions of "Welding " of these special provisions shall not apply to temporary steel casings.

Cast-in-drilled-hole concrete piles 600 mm in diameter or larger may be constructed by excavation and depositing concrete under slurry.

Center relief drilling is allowed to facilitate the installation of the permanent steel casing. Drilled holes shall be under sized holes and shall conformed to the provisions in Section 49-1.06, ‘Predrilled Holes,” of the Standard Specification and the following:

At no time the elevation of the bottom of the drilled hole should be below the bottom elevation of the of permanent steel casing by more than 600 mm.

Materials

Concrete deposited under slurry shall have a nominal penetration equal to or greater than 90 mm. Concrete shall be proportioned to prevent excessive bleed water and segregation.

Concrete deposited under slurry shall contain not less than 400 kg of cement per cubic meter.

The combined aggregate grading used in concrete for cast-in-drilled-hole concrete piling shall be either the 25-mm maximum grading, the 12.5-mm maximum grading, or the 9.5-mm maximum grading and shall conform to the requirements in Section 90-3 "Aggregate Gradings," of the Standard Specifications.

Portions of cast-in-drilled-hole concrete piles 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.

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 midheight and near the bottom of the hole. Slurry shall be recirculated when tests show that the samples taken from midheight and near the bottom of the hole do not have consistent specified properties.

Slurry shall also be sampled and tested prior to final cleaning of the bottom of the hole and again just prior to placing concrete. Samples shall be taken from midheight 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 midheight 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 (kg/m^3) - before placement in the drilled hole - during drilling - prior to final cleaning - immediately prior to placing concrete	1030* to 1110* 1030* to 1200*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/liter) bentonite attapulgite	29 to 53 29 to 42	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) - prior to final cleaning - immediately prior to 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 32 kg/m^3. Slurry temperature shall be at least 4 degrees Celsius 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. Suite 216 735 Broad Street Chattanooga, TN 37402 (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

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 Office of Structure Design, P.O. Box 942874, Sacramento, CA 94274-0001.

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 prior to 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 prior to 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 with steel reinforcement in place and just prior to 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 (kg/m^3) - during drilling - prior to final cleaning - just prior to placing concrete	 less than or equal to 1075* less than or equal to 1025*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/liter) - during drilling -prior to final cleaning - just prior to placing concrete	 53 to 127 less than or equal to 74	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) - prior to final cleaning - just prior to 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 32 kg/m^3. Slurry temperature shall be at least 4 degrees Celsius 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 (kg/m^3) - prior to final cleaning - just prior to placing concrete	less than or equal to 1025*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/liter) - during drilling - prior to final cleaning - just prior to placing concrete	34 to 64 less than or equal to 64	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) - prior to final cleaning -just prior to 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 32 kg/m^3. Slurry temperature shall be at least 4 degrees Celsius 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 (kg/m^3) - prior to final cleaning - just prior to placing concrete	less than or equal to 1025*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/liter) - during drilling - prior to final cleaning - just prior to placing concrete	35 to 78 less than or equal to 60	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) - prior to final cleaning -just prior to 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 32 kg/m^3. Slurry temperature shall be at least 4 degrees Celsius 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 (kg/m^3) - prior to final cleaning - just prior to placing concrete	1017 *	Mud Weight (Density) API 13B-1 Section 1
Sand Content (percent) - prior to final cleaning -just prior to 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 32 kg/m^3.		

Construction

The Contractor shall submit a placing plan to the Engineer for approval prior to producing the test batch for cast-in-drilled-hole concrete piling and at least 10 working days prior to constructing piling. The plan shall include complete description, details, and supporting calculations as listed below:

A. Requirements for all cast-in-drilled hole concrete piling:

1. Concrete mix design, certified test data, and trial batch reports.
2. Drilling or coring methods and equipment.
3. Proposed method for casing installation and removal when necessary.
4. Plan view drawing of pile showing reinforcement and inspection pipes, if required.
5. Methods for placing, positioning, and supporting bar reinforcement.
6. Methods and equipment for accurately determining the depth of concrete and actual and theoretical volume placed, including effects on volume of concrete when any casings are withdrawn.
7. Methods and equipment for verifying that the bottom of the drilled hole is clean prior to placing concrete.
8. Methods and equipment for preventing upward movement of reinforcement, including the Contractor's means of detecting and measuring upward movement during concrete placement operations.

B. Additional requirements when concrete is placed under slurry:

1. Concrete batching, delivery, and placing systems including time schedules and capacities therefor. Time schedules shall include the time required for each concrete placing operation at each pile.
2. 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.
3. Suppliers test reports on the physical and chemical properties of the slurry and any proposed slurry chemical additives including Material Safety Data Sheet.
4. Slurry testing equipment and procedures.
5. Removal and disposal of excavation, slurry, and contaminated concrete, including methods and rates of removal.
6. Slurry agitating, recirculating, and cleaning methods and equipment.

In addition to compressive strength requirements, the consistency of the concrete to be deposited under slurry shall be verified before use by producing a batch to be tested. The test batch shall be produced and delivered to the project under

conditions and in time periods similar to those expected during the placement of concrete in the piles. Concrete for the test batch shall be placed in an excavated hole or suitable container of adequate size to allow testing in conformance with California Test 533. Depositing of test batch concrete under slurry will not be required. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be 2 hours or less, the test batch shall demonstrate that the proposed concrete mix design achieves both the specified nominal penetration and a penetration of at least 50 mm after twice that time has elapsed. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be more than 2 hours, the test batch shall demonstrate that the proposed concrete mix design achieves both the specified nominal penetration and a penetration of at least 50 mm after that time plus 2 hours has elapsed. The time period shall begin at the start of placement. The concrete shall not be vibrated or agitated during the test period. Upon completion of testing, the 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.

Concrete deposited under slurry shall not be vibrated until all temporary casing is removed and concrete contaminated with soil, slurry, or other materials is removed. Concrete deposited under slurry shall be vibrated in the upper 2 m of the pile.

The concrete deposited under slurry shall be carefully placed in a compact, monolithic mass and by a method that will prevent washing of the concrete. 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. The 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 250 mm 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 250-mm tube.

Spillage of concrete into the slurry during concrete placing operations shall not be allowed. Delivery tubes shall be capped with a water tight 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 to prevent reentry of the slurry into the tube. Until at least 3 m of concrete has been placed, the tip of the delivery tube shall be within 150 mm of the bottom of the drilled hole, and then the embedment of the tip shall be maintained at least 3 m 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 3 m 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 within 300 mm of the top of the drilled hole.

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 215 mm x 280 mm 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 1.5 m 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 one working day of completion of placing concrete in the pile.

After placing reinforcement and prior to placing concrete in the drilled hole, if drill cuttings settle out of slurry, the bottom of the drilled hole shall be cleaned. The Contractor shall verify that the bottom of the drilled hole is clean.

If temporary casing is used, concrete placed under slurry shall be maintained at a level at least 1.5 m above the bottom of the casing. The withdrawal of casings shall 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.

Permanent steel casings shall be furnished and placed tight in the hole where shown on the plans. The provisions of Section 49-1.08, "Bearing Value and Penetration," of the Standard Specifications shall not apply to permanent steel casings. Permanent casings shall be watertight and of sufficient strength to withstand the loads from installation procedures, lateral concrete pressures, and earth pressures, and shall conform to the provisions of "Steel Pipe Piling" of these special provisions.

If conditions render it impossible or inadvisable in the opinion of the Engineer to dewater the permanent steel casing prior to drilling or coring the rock socket below, then the bottom of the casing shall be sealed in conformance with the provisions in Section 51-1.10, "Concrete Deposited Under Water," of the Standard Specifications. The sealed casing shall then be dewatered and cleaned out as specified herein.

Any pile which has been increased in diameter as provided above will be paid for at the contract price per meter for the size of cast-in-drilled-hole concrete piling shown on the plans at that location.

Acceptance Testing and Mitigation

Vertical inspection pipes for acceptance testing shall be provided in all cast-in-drilled-hole concrete piles that are 600 mm in diameter or larger, except when the holes are dry or when the holes are dewatered without the use of temporary casing to control the groundwater.

Inspection pipes shall be Schedule 40 polyvinyl chloride pipe with a nominal inside diameter of 50 mm. Each inspection pipe shall be capped top and bottom and shall have watertight couplers to provide a clean, dry and unobstructed 50-mm diameter clear opening from 1.0 m above the pile cutoff down to the bottom of the reinforcing cage.

If the Contractor drills the hole below the specified tip elevation, the reinforcement and the inspection pipes shall be extended to 75 mm clear of the bottom of the drilled hole.

Inspection pipes shall be placed around the pile, inside the outermost spiral or hoop reinforcement, and 75 mm clear of the vertical reinforcement, at a uniform spacing not exceeding 840 mm measured along the circle passing through the centers of inspection pipes. A minimum of 2 inspection pipes per pile shall be used. When the vertical reinforcement is not bundled and each bar is not more than 26 mm in diameter, inspection pipes may be placed 50 mm clear of the vertical reinforcement. The inspection pipes shall be placed to provide the maximum diameter circle that passes through the centers of the inspection pipes while maintaining the clear spacing required herein. The 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 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.

After placing concrete and before requesting acceptance tests, each inspection pipe shall be tested by the Contractor in the presence of the Engineer by passing a 48.3-mm diameter rigid cylinder 610 mm long through the complete length of pipe. If the 48.3-mm diameter rigid cylinder fails to pass any of the inspection pipes, the Contractor shall attempt to pass a 32.0-mm diameter rigid cylinder 1.375 m long through the complete length of those pipes in the presence of the Engineer. If an inspection pipe fails to pass the 32.0-mm diameter cylinder, the Contractor shall immediately fill all inspection pipes in the pile with water.

The Contractor shall replace each inspection pipe that does not pass the 32.0-mm diameter cylinder with a 50.8-mm diameter hole cored 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, no more than 150 mm inside the reinforcement, and 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 concrete. 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 include 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 made available for inspection by the Engineer.

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. Tests may also include crosshole sonic logging and other means of inspection selected by the Engineer. The Contractor shall not conduct operations within 8.0 m 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 piling, the Contractor shall allow 3 weeks for the Engineer to conduct these tests and make determination of acceptance if the 48.3-mm diameter cylinder passed all inspection pipes, and 4 weeks if only the 32.0-mm diameter cylinder passed all inspection pipes. Should the Engineer fail to complete these tests within the 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 inspection, the delay will be considered a right of way delay as specified in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

All inspection pipes and cored holes in a pile shall be dewatered and filled with grout after notification by the Engineer that the pile is acceptable. Placement and removal of water in the inspection pipes shall be at the Contractors expense. Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. The 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 acceptance testing performed by the Engineer determines that a pile does not meet the requirements of the specifications, 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 Contractor shall submit to the Engineer for approval a mitigation plan for repair, supplementation, or replacement for each rejected cast-in-drilled-hole concrete pile, and this plan shall conform to the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. Prior to submitting this mitigation plan, the Engineer will hold a repair feasibility meeting with the Contractor to discuss the feasibility of repairing rejected piling. The Engineer will consider the size of the defect, the location of the defect, and the design information and corrosion protection considerations for the pile. This information will be made available to the Contractor, if appropriate, for the development of the mitigation plan. 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 that a rejected pile does not require mitigation due to structural, geotechnical, or corrosion concerns, the Contractor may elect to 1) repair the pile per the approved mitigation plan, or 2) not repair anomalies found during acceptance testing of that pile. For such unrepaired piles, the Contractor shall pay to the State, $400 per cubic meter for the portion of the pile affected by the anomalies. The volume, in cubic meters, of the portion of the pile affected by the anomalies, shall be calculated as the area of the cross-section of the pile affected by each anomaly, in square meters, as determined by the Engineer, multiplied by the distance, in meters, from the top of each anomaly to the specified tip of the pile. If the volume calculated for one anomaly overlaps the volume calculated for additional anomalies within the pile, the calculated volume for the overlap shall only be counted once. In no case shall the amount of the payment to the State for any such pile be less than $400. The Department may deduct the amount from any moneys due, or that may become due the Contractor under the contract.

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-Kilometer Post, 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.

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 piling.
B. Structural details and calculations for any modification to the structure to accommodate the replacement or supplemental piling.

All provisions for cast-in-drilled-hole concrete piling shall apply to replacement piling.

The Contractor shall allow the Engineer 3 weeks to review the mitigation plan after a complete submittal has been received.

Should the Engineer fail to review the complete pile mitigation submittal within the time specified, 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 pile mitigation plan, an extension of time commensurate with the delay in completion of the work thus caused will be granted in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

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-Kilometer Post, 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

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.

When shown on the plans, shear rings shall be welded to the permanent steel casing to the limits indicated on the plans.

Wherever reference is made to the following American Petroleum Institute (API) specifications in the Standard Specifications, on the project plans, or in these special provisions, the year of adoption for these specifications shall be as follows:

API Codes	Year of Adoption
API 2B	1990
API 5L	1995

All requirements of the codes listed above shall apply unless specified otherwise in the Standard Specifications, on the plans or in these special provisions.

Only steel pipe pile seam welds may be made by the electric resistance welding method. Such welds shall be welded in conformance with the requirements in API 5L and any amendments to API 5L in the Standard Specifications or these special provisions.

Seams in steel pipe piles made by submerged arc welding may be welded in conformance with the requirements in API 5L and any amendments to API 5L in the Standard Specifications or these special provisions.

Handling devices may be attached to steel pipe piling. Welds attaching these devices 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. Prior to making attachments, the Contractor shall submit a plan to the Engineer that includes the locations, handling and fitting device details, and connection details. Attachments shall not be made to the steel pipe piling until the plan is approved in writing by the Engineer. The Engineer shall have 7 days to review the plan. Should the Engineer fail to complete the review within 7 days, 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 plan, 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.

Each length of steel pipe piling shall be marked in conformance with the requirements in ASTM Designation: A 252.

For steel pipe piling, including bar reinforcement in the piling, the Engineer shall be allowed 5 working days to review the "Welding Report," specified in "Welding Quality Control" of these special provisions, 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. Should the Engineer fail to complete the review and provide notification 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 notification, 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.

At the Contractor's option, a steel pipe pile may be re-tapped to prevent pile set-up; however, the field welded splice shall remain at least one meter above the work platform until that splice is approved in writing by the Engineer.

Manufactured Steel Pipe

Manufactured steel pipe is defined as pipe produced at a permanent facility where an automatic welding process, electric resistance welder, or seamless pipe operation is used in conformance with ASTM Designations: A 252, A 53, A 135, A 139, API 5L, or AWWA C200; where this steel pipe can be produced in lengths at least 9 m long without a circumferential splice; and where this manufacturing can be done on a daily basis. Manufactured steel pipe is not a specifically engineered product. (i.e. Manufactured steel pipe is an off-the-shelf item.)

Manufactured steel pipe used for steel pipe piling shall conform to the following requirements:

A. The outside circumference of the steel pipe piling end shall not vary by more than 10 mm from that corresponding to the diameter shown on the plans.
B. The maximum allowable misalignment for adjacent steel pipe pile edges to be welded shall be 0.1875 times the wall thickness, but not more than 1.6 mm.
C. Steel pipe pile straightness shall conform to the requirements in API 5L, Section 7.6, "Straightness."
D. Welds made at a permanent manufacturing facility shall be made by either an automatic welding process or an electric resistance welding process.

Fabricated Steel Pipe

Fabricated steel pipe is defined as pipe produced at a permanent facility where a variety of steel fabrication including roll forming and welding steel plate into pipe is performed, where this pipe is at least 19 mm in wall thickness, where this pipe is produced in conformance with API 2B, and where this fabrication can be done on a daily basis. Fabricated steel pipe is a specifically engineered product. (i.e. Fabricated steel pipe is engineered for a specific project.)

Fabricated steel pipe used for steel pipe piling shall conform to API 2B and the following requirements:

A. An API site license and API monogram are not required.
B. Weld filler metal shall conform to the requirements of AWS D1.5 for the welding of ASTM Designation: A 709, Grade 50 steel, except that the qualification, pretest, and verification test requirements need not be conducted if certified test reports are provided for the consumables to be used.

Field Welding

Field welding of steel piling is defined as welding performed after the certificate of compliance has been furnished by the manufacturer or fabricator and shall conform to the following requirements:

A. Match marking of pipe ends at the manufacturing or fabrication facility is recommended for piling to ensure weld joint fit-up. Prior to positioning any 2 sections of steel pipe to be spliced by field welding, including those that have been match marked at the manufacturing or fabrication facility, the Contractor shall equalize the offsets of the pipe ends to be joined and match mark the pipe ends.
B. Welds made in the flat position or vertical position (where the longitudinal pipe axis is horizontal) shall be single-vee groove welds. Welds made in the horizontal position (where the longitudinal pipe axis is vertical) shall be single-bevel groove welds. Joint fit-ups shall conform to the requirements for tubular sections in AWS D1.1 and these special provisions.
C. The minimum thickness of the backing ring shall be 6 mm, and the ring shall be continuous. Splices in the backing ring shall be made by complete penetration welds. These welds shall be completed and inspected prior to final insertion into a pipe end. 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 prior to subsequent weld passes. The gap between the backing ring and the steel pipe piling wall shall be no greater than 2 mm. One localized portion of the splice, 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 6 mm provided that this localized portion is first seal welded using shielded metal arc E7016 or E7018 electrodes. The Contractor shall mark this localized portion so that it can be referenced during any required nondestructive testing (NDT). Backing rings shall have a minimum width of 1 1/2 times the thickness of the pile to be welded so that they will not interfere with the interpretation of the NDT.
D. For steel pipe with an outside diameter greater than 1.1 m, and with a wall thickness greater than 25.4 mm, the root opening tolerances may be increased to a maximum of 5 mm over the specified tolerances.
E. Weld filler metal shall conform to the requirements shown in AWS D1.5 for the welding of ASTM Designation: A 709, Grade 50 steel, except that the qualification, pretest, and verification test requirements need not be conducted if certified test reports are provided for the consumables to be used.
F. For field welding, including attaching backing rings and making repairs, the preheat and interpass temperature shall be in conformance with AWS D1.1, Section 3.5, "Minimum Preheat and Interpass Temperature Requirements," and with Table 3.2, Category C; and the minimum preheat and interpass temperature shall be 66°C, regardless of the pipe pile wall thickness or steel grade. In the event welding is disrupted, preheating to 66°C must occur before welding is resumed.
G. Welds shall not be water quenched. Welds shall be allowed to cool unassisted.

Radiographic, magnetic particle, or ultrasonic testing shall be used to assure soundness of backing rings in conformance with the requirements in AWS D1.1, Section 6.

NONDESTRUCTIVE TESTING FOR STEEL PIPE PILING

Steel pipe piling and other components shall receive nondestructive testing (NDT) in conformance with these special provisions.

Nondestructive Testing of Welds made at a Manufacturing or Fabrication Facility

Unless otherwise shown on the plans twenty-five percent of each longitudinal, circumferential, or spiral weld made at a permanent manufacturing or fabrication facility shall receive NDT. If repairs are required in a portion of the weld, additional NDT shall be performed. The additional NDT shall be made on both sides of the repair for a length equal to 10 percent of the length of the pipe outside circumference. After the additional NDT is performed, and if more repairs are required that have a cumulative weld length equal to or more than 10 percent of the length of the pipe outside circumference, then the entire weld shall receive NDT.

Circumferential or spiral welds shall receive NDT by either radiographic, radioscopic, real time imaging systems, or ultrasonic methods that are in conformance with the requirements in AWS D1.1. When a radioscopic or real time imaging method is used for inspection of these welds, the fluoroscope shall be evaluated in conformance with the requirements in API 5L, Section 9.7.3.8, "Procedure for Evaluating In-Motion Operation of a Fluoroscope."

At the option of the Contractor, seam welds made by the submerged arc welding process will receive NDT in conformance with the requirements in API 5L or in AWS D1.1.

The acceptance and repair criteria for NDT performed in conformance with the requirements in AWS D1.1 shall conform to the requirements in Section 6 of that code, for cyclically loaded nontubular connections subject to tensile stress.

Welds made by electric resistance welding shall receive ultrasonic testing (UT) in conformance with the requirements in API 5L

When radiological inspection is performed in conformance with the requirements in API 5L, the testing shall also conform to the following additional provisions:

A. Image quality indicators (IQI) shall conform to AWS D1.1, Section 6.17.1.
B. IQI placement shall conform to AWS D1.1, Section 6.35.5.
C. IQIs shall be positioned on the base metal.
D. Procedures shall be qualified in conformance with the requirements in AWS D1.1, Section 6.35.3.
E. Personnel shall be qualified in conformance with the requirements in AWS D1.1, Section 6.35.4.
F. Film radiography shall be performed in conformance with the requirements in AWS D1.1, Section 6, Part E.

When UT is performed in conformance with the requirements in API 5L, the testing shall also conform to the following additional provisions:

A. For electric resistance welds, the acceptance limits of Section 9.7.4.3 shall be based on only a type V10 notch or a type P notch at 10% t or less.
B. For seam welds made by the submerged arc welding process, the acceptance limits of Section 9.7.4.3 shall be based on only a type N5 notch. Reinspection of indicated imperfections by film radiological methods will not be allowed.
C. The ultrasonic instrument shall be suitable for use with transducers oscillating at frequencies between 2.25 and 5 megahertz.

Nondestructive Testing of Field Welds

Personnel performing ultrasonic testing (UT) for field welds will be required to verify their qualifications prior to performing nondestructive testing by both written and practical exams. Information regarding these exams is available at the Transportation Laboratory.

At the option of the Contractor, either ultrasonic testing (UT) or radiographic testing (RT) shall be used as the method of NDT for splices made by field welding steel pipe piling. This NDT shall be used for each field weld, including welds that are made onto a portion of the steel pipe piling that has been installed and any repair made to a splice weld. Testing shall be done at locations selected by the Engineer. The length of a splice weld, not including repairs, where NDT is to be performed, shall have a cumulative weld length that is equal to 25 percent of the pipe outside circumference. The Engineer may select several locations on a given splice for NDT. 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, Section 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. The additional NDT shall be made on both sides of the repair for a length equal to 10 percent of the length of the pipe outside circumference. After the additional NDT is performed, and if more repairs are required that have a cumulative weld length equal to or more than 10 percent of the length of the pipe outside circumference, then the entire splice weld shall receive NDT.

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.

The third paragraph in Section 49-6.02, "Payment," of the Standard Specifications is amended to read:

· The contract price paid per meter for cast-in-drilled-hole concrete piling shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in drilling holes, disposing of material resulting from drilling holes, temporarily casing holes and removing water when necessary, furnishing and placing concrete and reinforcement, and constructing reinforced concrete extensions, complete in place, to the required penetration, as shown on the plans, as specified in these specifications and in the special provisions, and as directed by the Engineer.

Payment for cast-in-place concrete piling shall conform to the provisions in Section 49-6.02, "Payment," of the Standard Specifications except that, when the diameter of cast-in-place concrete piling is shown on the plans as 600 mm or larger, reinforcement in the piling will be paid for by the kilogram as bar reinforcing steel (bridge).

Full compensation for furnishing and placing additional testing reinforcement, for load test anchorages, and for cutting off test piles as specified, shall be considered as included in the contract price paid for piling of the type or class shown in the Engineer's Estimate, and no additional compensation will be allowed.

No additional compensation or extension of time will be made for additional foundation investigation, installation and testing of indicator piling, cutting off piling and restoring the foundation investigation and indicator pile sites, and review of request by the Engineer.

Full compensation for slurry, depositing concrete under slurry, test batches, inspection pipes, filling inspection holes and pipes with grout, drilling oversized cast-in-drilled-hole concrete piling, filling cave-ins and oversized piles with concrete, and redrilling through concrete, shall be considered as included in the contract prices paid per meter for cast-in-drilled-hole concrete piling of the types and sizes listed in the Engineer's Estimate, and no additional compensation will be allowed therefor.

The contract price paid per meter for cast-in-drilled-hole concrete piling (rock socket) of the sizes listed 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 drilling or coring holes, disposing of the material resulting from drilling or coring holes, and furnishing and placing concrete and reinforcement when the diameter of cast-in-place concrete piling (rock socket) is less than 600 mm, complete in place, to the required penetration, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per meter for permanent steel casing of the sizes listed 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 furnishing and installing permanent steel casing, including shear rings, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Additional permanent steel casing and cast-in-drilled-hole concrete piling, including inspection pipes, and bar reinforcing steel, required to extend the permanent steel casing into bedrock and to maintain the length of cast-in-drilled-hole concrete piling (rock socket) into bedrock, as shown on the plans, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Full compensation for cleaning out the permanent steel casing prior to installing reinforcement and filling with concrete, for disposing of materials removed from the inside of the permanent steel casing, and for placing seal course concrete and dewatering the permanent steel casing, 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 per meter for permanent steel casing of the sizes listed in the Engineer's estimate, and no additional compensation will be allowed therefor.

Full compensation for conforming to the provisions in "Steel Pipe Piling" and "Nondestructive Testing" 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.

10-1.51 INSTALL SEISMIC MONITORING CASING

Install seismic monitoring casing shall consist of drilling into soil and rock, sampling soil and rock, providing a log of test borings and a boring report, and furnishing and installing casing for seismic monitoring equipment at the downhole locations shown on the plans. Seismic monitoring casing shall be in accordance with the details shown on the plans and these special provisions.

Install seismic monitoring casing includes the following operations in the following order:

1. Drill 115 mm diameter hole, perform Standard Penetration Tests (SPT) and collect rock cores, and prepare a log of test borings and boring report.

2. Allow State forces to perform P-S suspension logging.
3. Drill 205 mm diameter hole for installation of casing.
4. Furnish and install 105 mm diameter polyvinyl chloride (PVC) pipe casing, including equipment furnished and attached to the bottom of the casing by the State.
5. Grout the annulus between the 205 mm diameter hole and the 105 mm diameter casing, and install pipe cap.

MATERIALS.--The seismic monitoring casing shall consist of 105 mm diameter Schedule 80 screw joint (flush) polyvinyl chloride PVC pipe. Each screw joint shall include an O-ring and shall be sealed with an O-ring lubricant.

The casing will have a specially formed sealed cap (Bishops Hat) at the bottom with instrumentation cables extending up through the casing. The Bishops Hat and instrumentation cables will be furnished and installed by State forces.

Grout for placement in the annular space between the casing and the hole shall be proportioned as follows:

Grout Type	Downhole	Grout Proportion
A	The shallow hole (11 meters).	4 sacks of cement, and 0.5 sack of bentonite per 190 liters of water.
B	The deep hole (30 meters)	5 sacks of cement, and 0.25 sack of bentonite per 190 liters of water.

The Contractor shall furnish sufficient quantities of grout for filling the annular space between the casing and the hole.

BORINGS.--Borings shall consist of drilling holes, taking samples, logging borings and furnishing test boring submittals to the Engineer.

The “Soil and Rock Logging Classification Manual” is included in the "Materials Information" available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

The Contractor shall drill borings at the center of each downhole location as shown on the plans and as directed by the Engineer.

The Contractor shall notify the Engineer in writing not less than 10 working days in advance of drilling borings.

All borings shall be made under the site supervision of the Geologist. The log of test borings stamped by, and the test boring submittal shall be signed by a Geologist or Civil Engineer who is registered in the State of California and has at least five years of geotechnical engineering experience of deep foundations in both soil and rock.

Borings shall be made by rotary drill methods and shall be at least 76 mm in diameter.

Borings shall be drilled to a depth equal to that of the deepest hole at the downhole location.

Standard Penetration Tests (SPT) shall be made in all soil types and performed in accordance with ASTM D1586 in each test boring at 765 mm maximum intervals and terminate when bedrock is encountered. Soil classification and descriptions shall conform to the requirements for visual-manual procedures in ASTM D 2488.

Bedrock shall be continuously cored with at least 90% core recovery. Rock shall not be logged from drill cuttings. Rock quality designation (RQD) shall be made taken at 1.5 meter maximum intervals. Rock shall be cored using an outer and inner core barrel drilling system. The outer core barrel shall be fitted with either a diamond impregnated or polycrystalline drill bit and have an outside diameter of at least 115 mm. The split inner tube core barrel shall have an inside diameter of at least 50 mm.

Prior to removal from the split inner tube barrels and placement into core boxes, rock cores shall be photographed. After core boxes are filled, and prior to removal from the drilling platform, rock cores shall be photographed. All rock core photographs shall be color, 127 mm x 177 mm, and labeled with the bore hole number, sample elevation, scale, and date and time photographed.

The rock cores shall be retained in rock core boxes that are labeled with the job contract number, the pile location, and the sample elevation. Rock core boxes shall become the property of the State and will removed from the job site by the State. Prior to their removal from the job site, the Contractor shall preserve and secure the rock core samples in a weather protected facility until notified by the Engineer.

The log of test borings including the soil and rock classification shall conform to the document “Soil and Rock Logging Classification Manual: Field Manual,” published by the Engineering Service Center, Caltrans, dated August 1995.

After completion of all borings, the Contractor shall furnish to the Engineer a test boring submittal that includes photographs of rock cores, a boring report and the log of test borings.

The log of test borings shall conform with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. All log of test borings shall be 560 mm x 864 mm in size. For initial review, 4 sets of drawings shall be submitted to the Engineer. Within 3 weeks after final approval of the test boring submittal, one set of the corrected

prints on 27 kg (minimum) good quality bond paper, 560 mm x 864 mm in size, prepared by the Contractor shall be furnished to the Office of Structure Design, Documents P.O. Box 942874, MS#9, Sacramento, CA 94274-0001 (1801 30th Street, Sacramento, CA 95816) and 7 sets furnished to the Engineer.

Log of test borings shall show 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 on each sheet. The test boring/geotechnical subcontractor 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 following shall be shown on the log of test borings:

1. Stationing and offset of boring.
2. Northing and easting coordinates.
3. Reference elevation and datum.
4. Boring start and completion date.
5. Geotechnical notes and miscellaneous explanations.
6. Drill bit and sampler types and diameters.
7. Percent of core recovery and RQD.
8. Sample numbers.
9. SPT data.
10. Depth increments of borings.
11. Graphic log.
12. Soil classifications and descriptions.
13. Rock classifications and descriptions.
14. Log symbol legend.
15. Signature and seal of the Geologist or Civil Engineer.

The boring report shall include the following:

1. Summary of drilling methods, drilling equipment, drill platforms, and any drilling difficulties encountered.
2. Location map of the surveyed position of the borings relative to the existing pier (in California Coordinate System and bridge stationing).
3. Bore hole surveying notes.
4. Photographs of rock cores.
5. Copies of original daily drilling notes.

The Engineer will notify the Contractor in writing when a boring submittal is complete and approved.

All materials utilized in making boring shall be disposed of in accordance with the provisions in Section 7-1.13, “Disposal of Material Outside the Highway Right of Way,” of the Standard Specifications, and to the requirements of the non-storm water discharges in the "Caltrans Storm Water Quality Handbook, Construction Contractor's Guide and Specifications" as specified in the Section entitled "Water Pollution Control" elsewhere in these special provisions.

P-S SUSPENSION LOGGING.--P-S suspension logging, consisting of P-wave and S-wave (dilatational wave and shear wave) velocity measurements, will be made by State forces. P-S suspension logging will be made after completion of the Contractor’s boring, sampling, and logging operations. The Contractor shall notify the Engineer in writing not less than 10 working days prior to completing boring, sampling, and logging operations in order for the State forces to be on site to perform P-S suspension logging. The Contractor shall allow 3 working days for the State forces to complete P-S suspension logging.

INSTALL CASING.--The seismic monitoring casing shall be installed into an 205 mm diameter hole. The hole shall be drilled by mud rotary methods and shall be centered over the 115 mm diameter hole described in the section “Borings” in these special provisions.

The 105 mm diameter pipe casing shall be installed from the ground surface to the depth as shown on the plans unless directed by the Engineer (using the P-S suspension logs). The Contractor shall notify the Engineer in writing not less than 15 working days prior to installing the casings in order for personnel from CDMG to attach the Bishops Hat to the casing. CDMG personnel will be on site for the installation and grouting of the casings.

Grout shall be delivered at the low end of the void being filled by methods that prevent the mixing of grout with water during charging of the grout delivery tubes and placement of the grout. Until at least 3 meters of grout has been placed, the tips of grout delivery tubes shall be within 155 mm of the bottom of the void being filled. The grout delivery tubes may be raised during grouting, providing that the embedment of the tips are maintained at least 1.8 meter below the top surface of the grout.

Sufficient grout shall be injected to fill the annular space between the casing and the hole and be expelled at the top of the hole until there is no evidence of entrapped air or water. A minimum grout head of 610 mm shall be maintained above the top of the hole until the grout has set.

All residue from the grouting operation shall be removed after completing the grouting operations and shall be disposed of in accordance with Section 7-1.13, “Disposal of Material Outside the Highway Right of Way,” of the Standard Specifications, and to the requirements of the non-storm water discharges in the "Caltrans Storm Water Quality Handbook, Construction Contractor's Guide and Specifications" as specified in the Section entitled "Water Pollution Control" elsewhere in these special provisions.

MEASUREMENT AND PAYMENT.--Seismic monitoring casing shall be measured and paid for as install seismic monitoring casing. The length of seismic monitoring casing to be paid for shall be the total length in place in the completed work, measured from the bottom tip of the casing to the ground surface.

The contract price paid per linear meter for install seismic monitoring casing shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing the casings, complete in place, including drilling into soil and rock, SPT sampling, collecting soil and rock cores, preparing a log of test borings and boring report, furnishing and installing casing, grouting, and disposing of material resulting from drilling holes and grouting, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.52 ISOLATION CASING

This work shall consist of furnishing and installing isolation casing at locations shown on the plans. isolation casing shall be of the corrugated steel pipe type and shall conform to the provisions in Section 66-3, "Corrugated Steel Pipe," of the Standard Specifications and these special provisions.

MEASUREMENT AND PAYMENT.--Isolation casing will be measured by the linear meter of the types listed in the Engineer’s estimates. The length of isolation casing to be paid for shall be the total length in place in the completed work, measured from the bottom tip of the casing to the ground surface.

The contract price paid per meter for isolation casing of the sizes listed 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 furnishing and installing isolation casing, complete in place, including pea gravel, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.53 STEEL ISOLATION CASING

Steel isolation casings shall consist of furnishing, installing, cleaning, and painting steel isolation casing, steel cover plates, angles and all the hardware needed to mount steel cover plates into columns as shown on the plans and specified in these special provisions.

Minor concrete used in connection with steel isolation casing shall conform to the provisions in Section 90-10, "MINOR CONCRETE," of the Standard Specifications.

Steel isolation casing, steel cover plate, angles and hardware shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications.

Attention is directed to "Welding Quality Control" of these special provisions.

For field welding of steel isolation casings, only visual inspection will be required, and the requirements of the first sentence of paragraph 3.13.2 of AWS D1.5 will not apply.

Structural steel for steel isolation 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.

CLEAN AND PAINT STEEL ISOLATION CASING

Steel isolation casing surfaces including steel cover plate angles and hardware 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.

Whenever the Standard Specifications refer to "Steel Structures Painting Council," the reference shall be replaced with "SSPC: The Society for Protective Coatings."

Section 59-2.01, "General," of the Standard Specifications is amended by adding the following paragraphs after the first paragraph:

- Unless otherwise specified, no painting Contractors or subcontractors will be permitted to commence work without having the following current "SSPC: The Society for Protective Coatings" (formerly the Steel Structures Painting Council) certifications in good standing:

A. For cleaning and painting structural steel in the field, certification in conformance with the requirements in Qualification Procedure No. 1, "Standard Procedure For Evaluating Painting Contractors (Field Application to Complex Industrial Structures)" (SSPC-QP 1).
B. For removing paint from structural steel, certification in conformance with the requirements in Qualification Procedure No. 2, "Standard Procedure For Evaluating Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)" (SSPC-QP 2).
C. For cleaning and painting structural steel in a permanent painting facility, certification in conformance with the requirements in Qualification Procedure No. 3, "Standard Procedure For Evaluating Qualifications of Shop Painting Applicators" (SSPC-QP 3). The AISC's Sophisticated Paint Endorsement (SPE) quality program will be considered equivalent to SSPC-QP 3.

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. Proposed methods and equipment to be used for any paint application.
D. Proof of each of any required certifications, SSPC-QP 1 or 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.
2. In lieu of certification in conformance with the requirements in SSPC-QP 3 for this project, the Contractor may submit written documentation showing conformance with the requirements in Section 3, " General Qualification Requirements," of SSPC-QP 3.

The Contractor shall allow the Engineer 10 working days 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 review of the Contractor's PQWP 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 review shall not 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 review of the PQWP.

Steel isolation casing surfaces including steel cover plate angles and hardware to be painted with waterborne 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 Surface Preparation Specification No. 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 no less than 40 µm nor more than 86 µm as measured in conformance with the requirements of ASTM Designation: D 4417.

Mineral and slag abrasives used for blast cleaning steel shall conform to the requirements of Abrasive Specification No. 1, "Mineral and Slag Abrasives," of the "SSPC: The Society for Protective Coatings," and shall not contain hazardous material. Mineral and slag abrasives shall comply with the requirements for Class A, Grade 2 to 3 as defined therein.

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.

Painting

Blast cleaned surfaces shall receive a single undercoat, and a final coat where specified, consisting of a waterborne inorganic zinc coating conforming to the requirements in AASHTO Designation M 300, Type II, except that: 1) the first 3 sentences of Section 4.7, "Primer Field Performance Requirements," and the entire Section 4.7.1 shall not apply, and 2) zinc dust shall be Type II in conformance with the requirements in ASTM Designation: D 520. The inorganic zinc coating shall be listed on the qualified products list which may be obtained from the Transportation Laboratory.

The color of the final coat of inorganic zinc coating shall match Federal Standard 595B No. 36373.

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.

Inorganic zinc coating shall not be applied when the atmospheric or surface temperature is less than 7°C or more than 29°C, nor when the relative humidity exceeds 85 percent.

The single undercoat of inorganic zinc coating shall be applied to the required dry film thickness in 2 or more applications within 4 hours after blast cleaning.

The total dry film thickness of all applications of the single undercoat of inorganic zinc coating shall be not less than 100 µm nor more than 200 µm.

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.

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 inorganic zinc coating shall be tested for adhesion and cure. The locations of the tests will be determined by the Engineer. The sequence of the rinsing and testing operations shall be determined by the Contractor. The testing for adhesion and cure 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 and to test the inorganic zinc coating cure. The inorganic zinc coating shall pass the following tests:

Adhesion

1. The inorganic zinc coating shall have a minimum adhesion to steel of 4 MPa when measured at no more than 6 locations on each column using a self-aligning adhesion tester in conformance with the requirements in ASTM Designation: D 4541. The Contractor, at the Contractor's expense, shall: (1) verify compliance with the adhesion requirements, (2) furnish test results to the Engineer, and (3) repair the coating after testing.

Cure

1. The inorganic zinc coating, when properly cured, 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.

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 water rinsed.

The final coat of inorganic zinc coating shall be applied after testing for adhesion, testing for cure, 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 non-uniform 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 600 µm mesh. Abrasive blasting shall remove no more than 15 µm 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 25 µm nor more than 75 µm.

The total dry film thickness of all applications of the single undercoat and final coat of inorganic zinc coating shall be not less than 125 µm nor more than 275 µm.

Finish coats will not be required.

MEASUREMENT AND PAYMENT

Steel isolation casing, including steel cover plate, angles and hardware will be measured and paid for in conformance with the provisions in Section 55-4.01, "Measurement," of the Standard Specifications and these special provisions.

The contract price paid per kilogram for steel isolation casing shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in steel isolation casing, complete in place, including, steel cover plates, angles hardware structure backfill, minor concrete, and cleaning and painting of steel isolation casing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.54 PRESTRESSING CONCRETE

Prestressing concrete shall conform to the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications and these special provisions.

The tenth paragraph of Section 50-1.05, "Prestressing Steel," of the Standard Specifications is amended to read:

- Prestressing steel for post-tensioning which is installed in members prior to placing and curing of the concrete, shall be continuously protected against rust or other corrosion, until grouted, by means of a corrosion inhibitor placed in the ducts or applied to the steel in the duct. The corrosion inhibitor shall conform to the provisions in Section 50-1.05, "Prestressing Steel," of the Standard Specifications.

The third paragraph of Section 50-1.08, "Prestressing," of the Standard Specifications is amended to read:

- Working force and working stress will be considered as the force and stress remaining in the prestressing steel after all losses, including creep and shrinkage of concrete, elastic compression of concrete, creep of steel, losses in post-tensioned prestressing steel due to sequence of stressing, friction and take up of anchorages, and all other losses peculiar to the method or system of prestressing have taken place or have been provided for.

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.

10-1.55 CONCRETE STRUCTURES

Portland cement concrete structures shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

The sixth paragraph in Section 51-1.09, "Placing Concrete," of the Standard Specifications is amended to read:

· Vibrators used to consolidate concrete containing epoxy-coated bar reinforcement or epoxy-coated prestressing steel shall have a resilient covering to prevent damage to the epoxy-coating on the reinforcement or prestressing steel.

GENERAL

Lost decks and all form work used in connection with the construction of NB 680/WB 780 Connector & OH, Bridge No. 23-0212G, and Benicia-Martinez Approach Structure, Bridge No. 23-0215R, shall become the property of the Contractor and shall be removed and disposed 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.

Shotcrete shall not be used as an alternative construction method for reinforced concrete members unless otherwise specified.

Neoprene strip shall be furnished and installed 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.

Materials for access ladder and access opening through bents, girders and at 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 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.

Vertical, horizontal, radial, or normal dimensions shown on the Typical Section in the plans, are for zero percent cross-slope. At the Contractor's option, the Typical Section of superelevated concrete box girder structures with (1) sloping exterior girders, (2) a straight uninterrupted cross slope between edges of deck, and (3) a single profile grade line, may be rotated around the profile grade line in superelevation areas. The horizontal distances between the profile grade line and the edges of deck shall remain unchanged. The planned girder widths and slab thicknesses shall remain unchanged and the interior girder stems shall remain vertical at the planned locations.

Drainage gutters located behind retaining walls, where shown on the plans, shall conform to the provisions in Section 51-1.02, "Minor Structures," of the Standard Specifications.

AGGREGATE GRADINGS

The aggregate grading of concrete shall be the 12.5-mm maximum combined aggregate grading and shall conform the requirements in Section 90-3 "Aggregate Gradings," of the Standard Specifications.

All concrete used in the portions of structures where the concrete being placed has a minimum dimension that exceeds 2 m and, at the Contractor's option, other concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these requirements for mass concrete.

A. Aggregate for mass concrete shall conform to the 37.5 mm maximum combined aggregate grading.
B. Cement for mass concrete shall be Type 2 Modified as specified in Section 90-2.01, "Portland Cement," of the Standard Specifications and in addition the sum of the Tricalcium Silicate and Tricalcium Aluminate shall not exceed 58 percent in accordance with the optional chemical requirements of ASTM Designation: C 150.
C. Mass concrete shall contain 375 kg of cement per cubic meter.
D. The amount of free water used in mass concrete shall not exceed 184 kg per cubic meter.
E. Either Type A admixture or a Type D admixture conforming to the requirements of ASTM Designation: C 494 and Section 90-4, "Admixtures," of the Standard Specifications shall be used at such dosage that will produce a workable concrete suitable for its intended use. The admixture at such dosage shall not cause an increase in drying shrinkage of the mass concrete in excess of that permitted in ASTM Designation: C 494.
F. The temperature of the concrete at time of discharge from the mixer shall not exceed 18°C except when ice is substituted for 100 percent of the mixing water the temperature of the concrete shall not exceed 21°C. The minimum temperature requirements of Section 90-6.02, "Machine Mixing," of the Standard Specifications will not apply. When ice is used, all the ice shall be melted before discharging the concrete from the mixer.
G. After the mass concrete pour has been topped out and finished it shall be revibrated and refinished. Revibration shall extend below the top mat of reinforcement and shall be done as late as the concrete will again respond to vibration. For concrete pours without top reinforcement, revibration shall extend to a depth of 150 mm.

SAND LIGHTWEIGHT CONCRETE

Sand lightweight concrete shall be composed of portland cement, lightweight coarse and fine aggregates, admixtures if used, and water, proportioned and mixed as specified in these special provisions.

For sand lightweight concrete only, the 2nd paragraph of Section 90-6.02, “Machine Mixing,” of the Standard Specifications is amended to read:

· The temperature of mixed Sand lightweight concrete, immediately before placing, shall be not less than 10°C nor more than 25°C. 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 65°C. If ice is used to cool the concrete, discharge from the mixer will not be permitted until all ice is melted.

For Sand lightweight concrete only, the first sentence of the 2nd paragraph of Section 90-9.01, “General,” of the Standard Specifications is amended to read:

· The compressive strength of concrete will be determined from test cylinders which have been fabricated from concrete sampled in accordance with California Test 539, except that the cylinders may be 102 x 203 mm. Compressive strength acceptance of Sand lightweight concrete may be based on 102 x 203 mm cylinders.

Concrete for the super structure at NB 680 / WB 780 Connector and Overhead, bridge number 23-0212G, and Benicia Martinez Approach Structure, bridge number 23-0215R, shall be sand lightweight concrete.

The fine aggregate portion of the sand lightweight concrete mix shall consist of natural sand or from natural aggregate, or a combination thereof, as required to comply with the air-dry unit mass requirements of these special provisions.

Sand lightweight concrete shall have not less than the 28-day compressive strength shown on the plans. Compressive strength shall be determined from test cylinders sampled, molded, cured, and tested in conformance with the provisions in Section 90-9, "Compressive Strength," of the Standard Specifications.

Prequalification by the submission of certified test data or and trial batch test reports in conformance with the provisions in Section 90-9, "Compressive Strength," of the Standard Specifications will be required for sand lightweight concrete. In addition to design for strength, the sand lightweight concrete mix shall be designed to achieve the following additional properties:

Modulus of Elasticity--The modulus of elasticity of sand lightweight concrete shall be at least 20700MPaat 28 days when tested in accordance with ASTM C 469. The samples shall be moist cured for seven days, followed by air drying at 23°C and 50% relative humidity until test age. The modulus shall also be reported at 3, 7 and 90 days. Test results shall be based on the average of three test specimens at each age. All specimens in a given sample shall be taken from the same batch of concrete.

Creep--The specific creep coefficient, as determined in accordance with ASTM C 512, after 365 days of loading, shall not exceed 70 millionths/MPa. The test cylinders shall be loaded at 28 days to a stress of 20 to 40% of the 28-day design compressive strength shown on the plans. For submittal of prequalification data, coefficients after 28, 56, 90 and 365 days of loading shall be submitted for approval by the Engineer.

Shrinkage--The shrinkage strain of sand lightweight concrete shall not exceed 0.05% after 180 days of drying in accordance with ASTM C 157. Sample size shall be 100x100x285 mm. The samples shall be moist cured for 7 days followed by air drying at 23°C and 50% relative humidity.

Tensile Strength--The tensile strength of sand lightweight concrete shall be not less than 3.2 MPa at 14 days, 3.4 MPa at 28 days and 3.6 MPa at 90 days when tested in accordance with ASTM C 496. The samples shall be moist cured for 7 days followed by air drying at 23°C and 50% relative humidity until test age.

The prequalification data or reports required herein and the proposed mix design, based on the recommendations of the lightweight aggregate manufacturer, shall be furnished to the Engineer, in writing, not less than 42 days in advance of placing sand lightweight concrete. The mix design shall list the type, brand, mass, and absolute volume of each ingredient for each type and strength of concrete proposed for use. The mass for each aggregate shall be reported in a surface dry condition, including moisture absorbed in the aggregate, or oven-dry condition, or for the condition proposed for use, and shall be adjusted at the time of batching to compensate for surface moisture and for absorbed moisture. The batching equipment shall be subject to approval by the Engineer. The mix design shall be accompanied by written verification that arrangements have been made for the Engineer to obtain samples as required for testing purposes. Samples of lightweight aggregates will not exceed 230 kg for each separate grading.

The absolute volume of coarse aggregate shall be limited to that volume which permits the mixing, transporting, placing, consolidating, and finishing of the concrete without segregation. For site-cast concrete, the absolute volume of coarse aggregate shall not exceed 0.37-cubic meter per cubic meter of concrete.

The air-dry unit mass of sand lightweight concrete furnished for each mix design used shall be a single mass, selected by the Contractor, within the limits of 1922 kg to 2002 kg per cubic meter. The Contractor shall furnish certified copies of the manufacturer's test reports showing the fresh concrete unit mass that is anticipated to result in the air-dry unit mass selected by the Contractor. The unit mass of fresh concrete produced for use in the work shall not vary from the mass shown in the test report by more than 65 kg per cubic meter. The unit mass of fresh concrete shall be determined in conformance with the requirements in California Test 518. The air-dry unit mass shall be determined in conformance with the requirements in ASTM Designation: C 567, except that the drying time shall be 112 days.

Lightweight aggregates shall conform to the requirements in ASTM Designation: C 330, and the following requirements:

A. Lightweight aggregates shall be rotary kiln expanded shale, slate or clay. The final coarse aggregate size shall not exceed 19 mm.
B. The splitting tensile strength and the drying shrinkage requirements of ASTM Designation: C 330 shall not apply.
C. The shrinkage characteristics of lightweight aggregates shall be such that the drying shrinkage of sand lightweight concrete produced therefrom, when tested in conformance with the requirements in California Test 537, shall be not more than 0.040-percent after 14 days of drying.
D. Lightweight aggregates shall have not more than 5 percent loss when tested for soundness in conformance with the requirements in California Test 214.

Proportioning of sand lightweight concrete shall conform to the provisions in Section 90-5, "Proportioning," of the Standard Specifications and to these special provisions.

Sand lightweight concrete shall have good workability and other properties such that proper placement, consolidation, and finishing are obtained.

The aggregates shall be uniformly pre-wetted or presaturated in such a manner that uniform penetration of the concrete will be maintained. Presaturation by thermal, vacuum, or equivalent methods will be required for lightweight aggregate in concrete which is to be pumped.

Portland cement, aggregates, water, and admixtures shall be proportioned to produce sand lightweight concrete containing not less than 350 kg nor more than 600 kg of cement per cubic meter, except that concrete used in roadway deck slabs and slab spans for highway bridges shall contain not less than 400 kg per cubic meter. The penetration requirements in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications shall not apply to lightweight portland cement concrete. Penetration shall in accordance with the Contractor’s approved mix design. The use of admixtures shall conform to the provisions in Section 90-4, "Admixtures," of the Standard Specifications, except that the Contractor may provide for a total air content of freshly mixed concrete of not more than 8.0 percent. The proportions shall be such that the concrete will meet or exceed the strength shown on the plans or specified in these special provisions.

Penetration measurements will be made by a lightweight ball penetrator in conformance with the requirements in California Test 533.

The air content of the freshly mixed sand lightweight concrete will be determined in conformance with the requirements in ASTM Designation: C173.

Fine aggregate and natural sand shall be batched by mass. Lightweight coarse aggregate shall be batched either by mass or by volumetric methods. If volumetric methods are used, the batching equipment shall include provisions whereby the Engineer may check the mass of each size of aggregate in the batch.

When sand lightweight concrete is to be finished in conformance with the provisions in Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications, the mix shall be designed to result in the required deck finish.

After acceptance by the Engineer, materials and batch proportions shall not be altered during the work, except as necessary to maintain the approved cement factor and unit mass. The cement content of individual batches for use in the work shall be not more than 9 kg per cubic meter less than, nor more than 15 kg per cubic meter greater than the approved cement factor.

Mixing and transporting sand lightweight concrete shall conform to the provisions in Section 90-6, "Mixing and Transporting," of the Standard Specifications.

Sand lightweight concrete shall be placed, finished, cured, and protected in conformance with the provisions in Section 51, "Concrete Structures," and Section 90, "Portland Cement Concrete," of the Standard Specifications.

Each trial batch 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 quantities of trial batch sand lightweight concrete will not be included in any contract item of work, and full compensation for furnishing, producing, and disposing of trial batches shall be considered as included in the contract price paid for the item of sand lightweight concrete involved, and no additional compensation will be allowed therefor.

Practice Placement

The Contractor shall demonstrate his capability to deliver and place sand lightweight concrete in accordance with these special provisions prior to placing any permanent sand lightweight concrete into the bridge superstructure. Practice placement of sand lightweight concrete shall utilize the same delivery and placing equipment as shall be used in the actual work and shall use the same mix as approved by the Engineer. As a minimum, two one cubic meter sand lightweight concrete cubes shall be cast. The cubes shall have bar reinforcing in them with a similar density to the most dense reinforcing in the sand lightweight concrete areas with covers matching those shown on the plans for the girder webs and soffit. The cubes shall be located at the top of the first pier table where the first segmental construction is to begin.

If sand lightweight concrete is to be pumped, the air content, penetration, and unit mass shall be measured before and after pumping of the practice sand lightweight concrete placement. Twelve sample cylinders shall be taken for each cube cast: six before pumping and six after pumping. The sand lightweight concrete penetration as sampled after pumping or transporting to the top of the pier shall conform to the Contractor's approved lightweight concrete mix design. The compressive strength at 3 and 7 days, based on an average of 3 breaks, shall be reported to the Engineer for approval. Pumping of sand lightweight concrete for the actual superstructure shall not be allowed until the Engineer approves the pumping procedure, equipment and compressive strength results of the practice placement.

The sample cubes shall be stripped and inspected for rock pockets and lightweight aggregate segregation. If the Engineers reject the practice cubes, placement procedures or strength results, the Contractor shall repeat the practice placement, at the Contractor's expense, until acceptable results are obtained. The sample cubes shall become the property of the Contractor and shall be removed and disposed of as provided in Section 7-1.13, "Disposal of Material Outside the Right of Way," of the Standard Specifications.

Sand lightweight concrete will be measured and paid for in conformance with the provisions in Section 90-11, "Measurement and Payment," of the Standard Specifications.

Sand lightweight concrete testing shall be performed by the Contractor's independent test laboratory. All certified test results shall be furnished to the Engineer within one week from the time of the performance of each test. The laboratory shall be ACI certified and approved by the Engineer. In addition to the requirements of Section 90-9, "Compressive Strength," of the Standard Specifications, the following additional testing shall be performed by the Contractor's independent testing laboratory for every 150 cubic meter of sand lightweight concrete:

A wet unit weight value shall be calculated and reported to the Engineer. Wet unit weight shall be determined in accordance with ASTM C 567.

A unit mass of the sand lightweight concrete shall be calculated and reported to the Engineer. Unit mass value shall be determined in accordance with ASTM C 567, except that the unit mass value shall be reported at 28, 56, 84 and 112 days for each cylinder. In addition to the amount of cylinders required by the above method, two full size 150x300mm cylinders shall be taken for a future use as determined by the Engineer.

An approximate unit mass of the sand lightweight concrete shall be calculated and reported to the Engineer. The approximate unit mass value shall calculated using the oven-dry density in accordance with Section 9.2, "Calculation of Approximate Equilibrium Density," of ASTM C 567.

Modulus of elasticity of the sand lightweight concrete shall be calculated and reported to the Engineer. Modulus of elasticity shall be shall determined in accordance with ASTM C 469-94, "Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression." In addition to the amount of cylinders required by the above method two full size 150x300mm cylinders shall be taken for a future use as determined by the Engineer.

Creep values of the sand lightweight concrete shall be calculated and reported to the Engineer. The creep values shall be determined in accordance with ASTM C 512-87 (Re approved 1997), "Standard Test Method for Creep of Concrete in Compression." Creep data shall be presented both as specific creep (creep strain/applied creep load) and creep coefficient (creep deformation as a ratio to initial elastic deformation). The test cylinders shall be loaded at 28 days to a stress of 20 to 40% of the 28-day design compressive strength shown on the plans. Coefficients after 28, 56 and 90 days of loading shall be submitted and used to predict the coefficient at 365 days based on the procedures of CEB-FIP Model Code for Concrete Structures, by the Comite Euro-International de Beton. In addition to the amount of cylinders required by the above method, two full size 150x300mm cylinders shall be taken for a future use as determined by the Engineer.

Shrinkage values of the sand lightweight concrete taken shall be calculated and reported to the Engineer. Shrinkage values shall be determined in accordance with ASTM C 157. Sample size shall be 100x100x285 mm. The samples shall be moist cured for 7 days followed by air drying at 23°C and 50% relative humidity.

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.

The first and second paragraph in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications are amended to read:

· The Contractor shall submit to the Engineer working drawings and design calculations for falsework proposed for use at bridges. For bridges where the height of any portion of the falsework, as measured from the ground line to the soffit of the superstructure, exceeds 4.25 m; or where any individual falsework clear span length exceeds 4.85 m; or where provision for vehicular, pedestrian, or railroad traffic through the falsework is made; the drawings shall be signed by an engineer who is registered as a Civil Engineer in the State of California. Six sets of the working drawings and 2 copies of the design calculations shall be furnished. Additional working drawings and design calculations shall be submitted to the Engineer when specified in "Railroad Relations and Insurance" of the special provisions.

· The falsework drawings shall include details of the falsework erection and removal operations showing the methods and sequences of erection and removal and the equipment to be used. The details of the falsework erection and removal operations shall demonstrate the stability of all or any portions of the falsework during all stages of the erection and removal operations.

The seventh paragraph in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications is amended to read:

· In the event that several falsework plans are submitted simultaneously, or an additional plan is submitted for review before the review of a previously submitted plan has been completed, the Contractor shall designate the sequence in which the plans are to be reviewed. In such event, the time to be provided for the review of any plan in the sequence shall be not less than the review time specified above for that plan, plus 2 weeks for each plan of higher priority which is still under review. A falsework plan submittal shall consist of plans for a single bridge or portion thereof. For multi-frame bridges, each frame shall require a separate falsework plan submittal.

Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications is amended by adding the following paragraphs:

· If structural composite lumber is proposed for use, the falsework drawings shall clearly identify the structural composite lumber members by grade (E value), species, and type. The Contractor shall provide technical data from the manufacturer showing the tabulated working stress values of the composite lumber. The Contractor shall furnish a certificate of compliance as specified in Section 6-1.07, "Certificates of Compliance," for each delivery of structural composite lumber to the project site.

· For falsework piles with a calculated loading capacity greater than 900 kN, the falsework piles shall be designed by an engineer who is registered as either a Civil Engineer or a Geotechnical Engineer in the State of California, and the calculations shall be submitted to the Engineer.

The first paragraph in Section 51-1.06A(1), "Design Loads," of the Standard Specifications is amended to read:

· The design load for falsework shall consist of the sum of dead and live vertical loads, and an assumed horizontal load. The minimum total design load for any falsework, including members that support walkways, shall be not less than 4800 N/m^2 for the combined live and dead load regardless of slab thickness.

The eighth paragraph in Section 51-1.06A(1), "Design Loads," of the Standard Specifications is amended to read:

· In addition to the minimum requirements specified in this Section 51-1.06A, falsework for box girder structures with internal falsework bracing systems using flexible members capable of withstanding tensile forces only, shall be designed to include the vertical effects caused by the elongation of the flexible member and the design horizontal load combined with the dead and live loads imposed by concrete placement for the girder stems and connected bottom slabs. Falsework comprised of individual steel towers with bracing systems using flexible members capable of withstanding tensile forces only to resist overturning, shall be exempt from these additional requirements.

The third paragraph in Section 51-1.06B, "Falsework Construction," of the Standard Specifications is amended to read:

· When falsework is supported on piles, the piles shall be driven and the actual bearing value assessed in conformance with the provisions in Section 49, "Piling."

Section 51-1.06B, "Falsework Construction," of the Standard Specifications is amended by adding the following paragraphs:

· For falsework piles with a calculated loading capacity greater than 900 kN, the Contractor shall conduct dynamic monitoring of pile driving and conduct penetration and bearing analyses based on a wave equation analysis. These analyses shall be signed by an engineer who is registered as a Civil Engineer in the State of California and submitted to the Engineer prior to completion of falsework erection.

· Prior to the placement of falsework members above the stringers, the final bracing system for the falsework shall be installed.

Section 51-1.06C, "Removing Falsework," of the Standard Specifications is amended by adding the following paragraph:

· The falsework removal operation shall be conducted in such a manner that any portion of the falsework not yet removed remains in a stable condition at all times.

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
EB 780 / NB 680 CONNECTOR bridge number 23-211G	11
NB 680 / WB 780 Connector and Overhead, bridge number 23-0212G	11
Benicia Martinez Approach Structure, bridge number 23-0215R	11

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 4.6 m 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 1.8 m from the edge of a traffic lane.

Welding and Nondestructive Testing

Welding of steel members, except for when fillet welds are used where load demands are less than or equal to 175 N/mm for each 3 mm 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.

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, Section 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 and previously 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. The 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.

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.

No cost reduction incentive proposals for the sand lightweight concrete used in the superstructure work will be allowed at the following locations:

NB 680 / WB 780 Connector and Overhead, Bridge number 23-0212G.
Benicia Martinez Approach Structure, Bridge number 23-215R.

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 Office 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 Office 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 279 mm x 432 mm, or 559 mm x 864 mm 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-Kilometer Post. 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 75-g/m^2 (minimum) bond paper, 559 mm x 864 mm in size, of all CRIP plan sheets prepared by the Contractor for each CRIP shall be furnished to the Office 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 6 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 42 MPa.

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.

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.

ELASTOMERIC BEARING PADS

Elastomeric bearing pads shall conform to the provisions in Section 51-1.12H, "Elastomeric Bearing Pads," of the Standard Specifications and these special provisions.

The table in the ninth paragraph of Section 51-1.12H(1), "Plain and Fabric Reinforced Elastomeric Bearing Pads," of the Standard Specifications is amended to read:

Tensile strength, percent	-15
Elongation at break, percent	-40; but not less than 300% total elongation of the material
Hardness, points	+10

10-1.56 PRECAST CONCRETE GIRDERS

Precast reinforced concrete girders shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications.

PRECAST PRESTRESSED CONCRETE BRIDGE MEMBERS

The top surface of the member shall be given a coarse texture by brooming with a stiff bristled broom or by other suitable devices that will result in uniform transverse scoring, in advance of curing operations.

The anticipated deflection and method of accommodation of deflection of precast prestressed concrete girders, prior to the time the deck concrete is placed, shall be shown on the working drawings in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The deflection shall include the following:

A. Anticipated upward deflection caused by the prestressing forces.
B. Downward deflection caused by the dead load of the girder.
C. Deflection caused by the creep and shrinkage of the concrete for the time interval between the stressing of the girders and the planned placement of the deck.

Such deflection shall be substantiated by calculations that consider the ages of the girder concrete at the time of stressing and the Contractor's planned placement of the deck. All deflection calculations shall be based on the concrete producer's estimate of the modulus of elasticity at the applicable concrete age.

Adjustments to accommodate girder deflections, which occur prior to the time the deck concrete is placed, may include revisions in bearing seat elevations, but any such adjustments shall be limited by the following conditions:

A. The minimum permanent vertical clearance under the structure as shown on the plans shall not be reduced.
B. The profile grade and cross slope of the deck shall not be changed.
C. A minimum of 25 mm of deck slab concrete between the top of the precast girders and the deck slab reinforcement shall be maintained.

Girders with unanticipated girder deflection and which cannot comply with conditions A, B, and C will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials," of the Standard Specifications.

Adjustments to accommodate girder deflections will not be considered a change in dimensions. Full compensation for increases in the cost of construction, including increases in the quantity of deck or bearing seat concrete, resulting from adjustments to accommodate girder deflections shall be considered as included in the contract price paid for the various items of work involved and no additional compensation will be allowed therefor.

Temporary lateral bracing shall be provided for girders located over the Exxon pipe lines at the West Arsenal Undercrossing bridge. The bracing shall be installed at each end of each girder, except notched ends, prior to the release of the erection equipment from the girder and shall remain in place until 48 hours after the concrete diaphragms have been placed. The bracing shall be adequate to prevent overturning of the girders prior to completion of the work and as a minimum shall be capable of resisting a lateral force of 720 Pa of girder side area applied laterally in either direction to the top of the girder. Girder erection shall not be started until the temporary lateral bracing proposed for use by the Contractor has been approved by the Engineer.

10-1.57 PTFE SPHERICAL BEARING

PTFE spherical bearings, consisting of polytetrafluoro-ethylene (PTFE) and stainless steel bearing surfaces, structural steel plates and anchors shall conform to the details shown on the plans and these special provisions.

A. Fixed type with spherical bearing surfaces.
B. Expansion type with spherical and sliding bearing surfaces.

The manufacturer of the PTFE spherical bearings shall show evidence that PTFE spherical bearings furnished by the same manufacturer and used in conditions similar to this application have had at least 3 years of satisfactory service at each of 2 projects.

A qualified representative of the manufacturer shall be present during installation of the first bearing and shall be available for advice during any remaining installations.

The working drawings for PTFE spherical bearings shall include a description of the method of mechanical interlocking of the PTFE fabric to the metallic substrate for the PTFE bearing sole plate during concrete placement.

Working drawings shall be 279 mm x 432 mm or 559 mm x 864 mm in size and each drawing and calculation sheet shall include the name of the structure as shown on the contract plans, District-County-Route, bridge number, and contract number.

At the completion of each structure on the contract, one set of reduced prints on 75-g/m^2 (minimum) bond paper, 279 mm x 432 mm in size, of the corrected original tracings of all working drawings for each structure shall be furnished to the Engineer. Reduced prints of drawings which are common to more than one structure shall be submitted for each structure. An index prepared specifically for the drawings for each structure containing sheet numbers and titles shall be included on the first reduced print in the set for each structure. Reduced prints for each structure shall be arranged in the order of drawing numbers shown in the index.

The edge of the corrected original tracing image shall be clearly visible and visually parallel with the edges of the page. A clear, legible symbol shall be provided as near to the upper left side of each page as is feasible within the original print to show the amount of reduction and a horizontal and vertical scale shall be provided on each reduced print to facilitate enlargement to original scale.

PTFE spherical bearings shall be installed on surfaces prepared in conformance with the provisions in Section 55-3.19, "Bearings and Anchorages," of the Standard Specifications.

The manufacturer shall furnish certificates of compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for all material used in the PTFE spherical bearings. The certification shall be supported by a copy of the results of all proof tests performed on the bearings.

PTFE surfaces of PTFE spherical bearings shall be unfilled PTFE fabric made from virgin PTFE oriented multifilament and other fibers. The resin in the filaments shall be virgin PTFE material (not reprocessed) in conformance with the requirements of ASTM Designation: D 1457.

At the highest point of substrate and after compression, the PTFE fabric shall have a minimum thickness of 1.6 mm and a maximum thickness of 3.2 mm.

Flat stainless steel surfaces shall be a weld overlay on structural steel plate, or solid or sheet stainless steel conforming to the requirements of ASTM Designation: A 240, Type 304 with a minimum thickness of 1.5 mm.

Curved stainless steel surfaces shall be solid stainless steel conforming to the requirements of ASTM Designation: A 240, Type 304.

Curved stainless steel surfaces with dimensions shown on the plans exceeding 101.6 mm in thickness shall be either a weld overlay on structural steel plate or solid stainless steel conforming to the requirements of ASTM Designation: A 240, Type 304. Stainless steel sheet will not be allowed.

When a weld overlay is used for stainless steel surfacing, the overlay shall be placed by submerged arc welding using Type 309L electrodes. The finished overlay shall have a 2.38 mm minimum thickness after welding, grinding and polishing. Prior to welding, the manufacturer must submit a complete weld procedure to the Engineer for approval.

When stainless steel sheets are used for stainless steel surfacing, the sheets shall be attached by perimeter arc welding using Type 309L electrodes. After completion of the weld operation, the stainless steel surface shall be smooth and free from waves.

Structural steel plates, except stainless steel, shall conform to the requirements of ASTM Designation: A 709/A 709, Grade 36 [250], 50 [345], or 50W [345W].

Welding shall conform to the requirements of ANSI/AASHTO/AWS D1.5.

Convex plate radius dimension tolerances shall be 0.000 to -250 µm. Concave plate radius dimensions shall be +250 to 0.000 µm.

The bearing manufacturer shall have full size convex and concave metal templates for the 2 spherical surfaces of each bearing radius. The templates shall be available to the inspector during all bearing inspections.

The PTFE fabric on spherical or sliding bearing surfaces shall be epoxy bonded and mechanically interlocked to the steel substrate. All bonding shall be done under controlled factory conditions. The mechanical interlock on the spherical concave surface must be integrally machined into the steel substrate. Welded retention grids will not be allowed on the concave surface. Any edges, other than the selvage shall be oversown or recessed so that no cut fabric edges are exposed.

After completion of the bonding operation the PTFE surface shall be smooth and free from bubbles.

The surface of the bearing elements shall be controlled such that upon completion of the bearing assembly the PTFE to stainless steel interface shall be in full bearing.

The mating surface of the stainless steel with the PTFE surfacing shall have a polished surface finish of less than 0.5 µm root-mean-square (rms), determined in conformance with the requirements in ANSI Standard B46.1.

Metal surfaces of bearings exposed to the atmosphere in the completed work, except stainless steel surfaces 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 "Clean and Paint Structural Steel" of these special provisions.

Certification in conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for PTFE spherical bearings.

Finish coats will not be required on the bearings.

PTFE spherical bearing assemblies shall be assembled at the factory. Each assembly shall have a minimum of 4 temporary steel straps which are bolted to threaded holes in the masonry and sole plates so that the entire assembly is shipped as a unit and remains intact when uncrated and installed. Welding of the steel straps will not be allowed. Straps must be adequate for vertical lifting purposes. Bearing dismantling will only be allowed under the direction and in the presence of the Engineer.

During fabrication, the maximum temperature of bonded PTFE surfaces shall be 150°C.

Damaged bearings and bearings with scratched mating surfaces shall be replaced or resurfaced.

PTFE spherical bearing sole plates shall be temporarily supported during concrete placement. Temporary supports shall prevent the rotation or displacement of the bearing during concrete placing operations. Temporary supports shall not inhibit the functioning of the PTFE spherical bearing after concrete is placed. Temporary supports shall not restrict the movement at bridge joints due to temperature changes and shortening from prestress forces. Materials for temporary supports within the limits for placing concrete shall conform to the requirements for form fasteners.

PTFE spherical bearings shall have a first movement static coefficient of friction not exceeding 0.06

Prior to proof testing, all bearings shall be permanently die-stamped on 2 of 4 sides with markings consisting of bearing number and contract number. Each bearing shall have a unique bearing number and match marks on plate edges to insure correct assembly at the job site.

Full sized PTFE spherical bearings shall be proof tested and evaluated for compression and coefficient of friction in the presence of the Engineer, unless otherwise directed. The proof tests shall be performed on samples randomly selected by the Engineer from the production bearings to be used in the work. Proof testing shall be performed by the Contractor at the manufacturer's plant or at an approved laboratory. If proof tests are not performed at the specified load, the Contractor shall perform additional physical tests in the presence of the Engineer, unless otherwise directed, to demonstrate that the requirements for proof testing at the specified load are satisfied. The Contractor shall give the Engineer at least 7 days notice before beginning proof testing. Proof testing of PTFE spherical bearings shall conform to the following requirements:

A. One bearing per lot of production bearings shall be proof tested. A lot is defined as 25 bearings or fraction thereof of the same type, within a load category.

B. The bearing types and proof tests required for each type shall be as follows:

Expansion type bearings shall be proof tested for compression and coefficient of friction.

C. A load category shall consist of bearings of differing vertical load capacity within a range defined as follows:

1. Bearings with less than or equal to 2225 kN maximum vertical load capacity.
2. Bearings with greater than 2225 kN but less than or equal to 8900 kN maximum vertical load capacity.
3. Bearings with more than 8900 kN maximum vertical load capacity.

D. Proof tests for compression: The bearing shall be held at the design rotation or 0.02 radians whichever is greater for one hour at 1.5 times the maximum vertical load shown on the plans for the bearing. The device shall be in a rotated position during the test. The rotation may be imposed on the bearing by inserting a beveled plate between the bearing and the restraining surface prior to loading.

E. Proof tests for coefficient of friction: The tests shall be performed at the maximum vertical load shown on the plans for the bearing with the test load applied for 12 hours prior to friction measurement and the following:

1. The tests shall be arranged to allow measurement of the static coefficient of friction on the first movement of the bearing.
2. The first movement static and dynamic coefficients of friction shall be measured at a sliding speed not exceeding 25 millimeter per minute and shall not exceed the specified coefficient of initial static friction.
3. The test bearings shall be subjected to a minimum of 100 movements of at least 25 mm of relative movement at a sliding speed not exceeding 300 millimeter per minute. After cycling, the first movement static and dynamic coefficients of friction shall be measured again at a sliding speed not exceeding 25 millimeter per minute and shall not exceed the specified coefficient of initial static friction.

F. The bearing surfaces shall be cleaned prior to proof testing.

G. Proof testing of bearings shall be done after conditioning specimens for 12 hours at 21°±8°C.

H. The proof tested bearings shall show no visible sign of: (1) bond failure of bearing surfaces, (2) separation or lift-off of plates from each other or from PTFE surfaces, or (3) other defects. When a proof tested bearing fails to comply with these specifications, all bearings in that lot shall be individually tested for acceptance.

I. Proof test results shall be certified correct and signed by the testing laboratory personnel who conducted the test and interpreted the test results. Proof test results shall include the bearing numbers of the bearings tested.

Quantities of PTFE spherical bearings will be determined as units from actual count in the completed work. A PTFE spherical bearing with more than one PTFE surface shall be considered a single PTFE spherical bearing.

The contract unit price paid for PTFE spherical bearing shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the bearing, complete in place, including masonry and sole plates, anchor bolts and sleeves, mortaring of bolts, temporary supports, proof testing, and cleaning and painting of PTFE spherical bearings, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

If a portion or all of PTFE spherical bearings are either fabricated or tested at a site more than 480 air line kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Payment to the Contractor for furnishing PTFE spherical bearings will be reduced $5,000 for any fabrication and testing site located more than 480 air line kilometers from both Sacramento and Los Angeles, or in the case where a fabrication or testing site is located more than 4800 air line kilometers from both Sacramento and Los Angeles, payment will be reduced $15,000.

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 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 meter 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 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 meter for the various items of concrete work involved and no separate payment will be made therefor.

Full compensation for furnishing and installing steel plates and for forming blockouts for joint seal assemblies shall be considered as included in the contract price paid per cubic meter for structural concrete, bridge and no separate payment will be made therefor.

10-1.58 STRUCTURE APPROACH SLABS (Type N)

This work shall consist of constructing reinforced concrete approach slabs, structure approach drainage system, and treated permeable base at structure approaches in conformance with the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

GENERAL

Attention is directed to the section "Engineering Fabrics" of these special provisions.

STRUCTURE APPROACH DRAINAGE SYSTEM

Geocomposite Drain

Geocomposite drain shall consist of a manufactured core not less than 6.35 mm thick nor more than 50 mm 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 25 liters per minute per meter of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 168 kPa. 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 and the externally applied pressures and hydraulic gradients. The flow capability graph shall be stamped with the verification of an independent testing laboratory.

Filter fabric for the geocomposite drain shall conform to the provisions for fabric for underdrains in Section 88, "Engineering Fabrics," of the Standard Specifications.

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.

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.

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 75 mm at all joints and wrap around the exterior edges a minimum of 75 mm 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 150 mm and be attached thereto.

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 150-mm overlap.

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.

Drainage Pads

Concrete for use in drainage pads shall be minor concrete, except the concrete shall contain not less than 300 kilograms of cement per cubic meter.

Treated Permeable Base At Bottom Of Geocomposite Drains

Treated permeable base to be placed around the slotted plastic pipe at the bottom of geocomposite drains shall conform to the provisions in "Treated Permeable Base Under Approach Slabs." If asphalt treated permeable base is used, it shall be placed at a temperature of not less than 82°C nor more than 110°C.

The filter fabric to be placed over the treated permeable base at the bottom of geocomposite drains shall conform to the provisions for filter fabric for edge drains in Section 88, "Engineering Fabrics," of the Standard Specifications.

ENGINEERING FABRICS

Filter fabric to be placed between the structure approach embankment material and the treated permeable base shall conform to the provisions for filter fabric for edge drains in Section 88, "Engineering Fabrics," of the Standard Specifications and these special provisions.

The subgrade to receive the filter fabric, immediately prior to placing, shall conform to the compaction and elevation tolerance specified for the material involved.

Filter fabric shall be aligned, handled, and placed in a wrinkle-free manner in conformance with the manufacturer's recommendations.

Adjacent borders of the filter fabric shall be overlapped from 300 to 450 mm or stitched. The preceding roll shall overlap the following roll in the direction the material is being spread or shall be stitched. When the 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 fabric manufacturer. The stitches shall number 5 to 7 per 25 mm of seam.

Equipment or vehicles shall not be operated or driven directly on the filter fabric.

Woven tape fabric to be placed between the treated permeable base and the approach slab shall be a fabric made of woven strips or tapes and shall conform to the following:

Specification	ASTM Designation	Requirement
Weight, grams per square meter, min.	D 3776	100
Grab Tensile Strength, kilonewtons, min.	D 4632	0.22
Elongation, percent, max.	D 4632	35
Toughness, kilonewtons, min. (Percent elongation times grab tensile strength)	----	5

Woven tape fabric shall be treated to provide a minimum of 70 percent breaking strength retention after 500 hours exposure when tested in conformance with the requirements in ASTM Designation: D 4355. The Contractor shall notify the Engineer, in writing, of the source of woven tape fabric at least 45 days prior to use.

TREATED PERMEABLE BASE UNDER APPROACH SLAB

Treated permeable base under structure approach slabs shall consist of constructing either an asphalt treated permeable base or a cement treated permeable base in accordance with Section 29, "Treated Permeable Bases," of the Standard Specifications and these special provisions.

The type of treatment, asphalt or cement, to be used shall be at the option of the Contractor.

Not less than 30 days prior to the start of placing the treated permeable base, the Contractor shall notify the Engineer, in writing, which type of treated permeable base will be furnished. Once the Contractor has notified the Engineer of the selection, the type to be furnished shall not be changed without a prior written request to do so and approval thereof in writing by the Engineer.

Asphalt treated permeable base shall be placed at a temperature of not less than 93°C nor more than 121°C. Material stored in excess of 2 hours shall not be used in the work.

Asphalt treated permeable base material may be spread in one layer. The base material shall be compacted with a vibrating shoe type compactor or rolled with a roller weighing not less than 1.3 tonnes nor more than 4.5 tonnes. Rolling shall begin as soon as the mixture has cooled sufficiently to support the weight of the rolling equipment without undue displacement.

Cement treated permeable base material may be spread in one layer. The base material shall be compacted with either a vibrating shoe type compactor or with a steel-drum roller weighing not less than 1.3 tonnes nor more than 4.5 tonnes. Compaction shall follow within one-half hour after the spreading operation and shall consist of 2-complete coverages of the treated material.

APPROACH SLABS

Concrete for use in approach slabs shall contain not less than 400 kilograms of cement per cubic meter.

Miscellaneous steel parts shall conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications

Structure approach slabs shall be cured for not less than 5 days prior to opening to public traffic, unless, at the option of the Contractor, the structure approach slabs are constructed using concrete with a non-chloride Type C chemical admixture conforming to these special provisions.

Portland cement for use in concrete using a non-chloride Type C chemical admixture shall be Type II Modified, Type II Prestress, or Type III. Type II Modified and Type III cement shall conform to the provisions in Section 90-2.01, "Portland Cement," of the Standard Specifications. Type II Prestress cement shall conform to the requirements of Type II Modified

cement, except the mortar containing the portland cement to be used and Ottawa sand, when tested in conformance with California Test 527, shall not contract in air more than 0.053-percent.

The non-chloride Type C chemical admixture, approved by the Engineer, shall conform to the requirements in ASTM Designation: C 494 and Section 90-4, "Admixtures," of the Standard Specifications.

The concrete with non-chloride Type C chemical admixture shall be prequalified prior to placement in conformance with the provisions for prequalification of concrete specified by compressive strength in Section 90-9.01, "General," of the Standard Specifications and the following:

A. Immediately after fabrication of the 5 test cylinders, the cylinders shall be stored in a temperature medium of 21 ± 1.5°C until the cylinders are tested.
B. The 6-hour average strength of the 5 test cylinders shall not be less than 5.85 MPa. No more than 2 test cylinders shall have a strength of less than 5.5 MPa.

Building paper shall be commercial quality No. 30 asphalt felt.

Polyvinyl chloride (PVC) conduit used to encase the abutment tie rod shall be of commercial quality.

The top surface of approach slabs shall be finished in conformance with the provisions in Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications. Edges of slabs shall be edger finished.

Approach slabs shall be cured with pigmented curing compound (1) in conformance with the provisions for curing structures in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications.

Structure approach slabs constructed using concrete with a non-chloride Type C chemical admixture shall be cured for not less than 6 hours prior to opening to public traffic. The curing period shall be considered to begin at the start of discharge of the last truck load of concrete to be used in the slab.

If the ambient temperature is below 18°C during the curing period for approach slabs using concrete with a non-chloride Type C chemical admixture, an insulating layer or blanket shall cover the surface. The insulation layer or blanket shall have an R-value rating given in the table below. At the Contractor's option, a heating tent may be used in lieu of or in combination with the insulating layer or blanket.

Temperature range during curing period	R-value, minimum
13°C to 18°C	1
7°C to 13°C	2
4°C to 7°C	3

JOINTS

Hardboard and expanded polystyrene shall conform to the provisions in Section 51-1.12D, "Sheet Packing, Preformed Pads and Board Fillers," of the Standard Specifications.

Type AL joint seals shall conform to the provisions in 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 shall conform to 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 prior to placing the seal, the joint shall be thoroughly cleaned, including abrasive blast cleaning of the concrete surfaces, so that all foreign material and concrete spillage are removed from all joint surfaces. Joint surfaces shall be dry at the time the seal is placed.

MEASUREMENT AND PAYMENT

Structural concrete, approach slab (Type N)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, drainage pads, treated permeable base, filter fabric, woven tape fabric, miscellaneous metal, pourable seals shall be considered as included in the contract price paid per cubic meter for structural concrete, approach slab of the type shown in the Engineer's Estimate and no additional compensation will be allowed therefor.

10-1.59 STRUCTURE APPROACH SLABS (TYPE R)

Structure approach slabs (Type R) shall consist of removing portions of existing structures,—asphalt concrete surfacing,, subsealing material, and cement treated base and constructing new reinforced concrete approach slabs at structure approaches as shown on the plans and in conformance with these special provisions.

GENERAL

The thickness shown on the plans for structure approach slabs is the minimum thickness. The thickness will vary depending on the thickness of the pavement and base materials removed.

Where pavement subsealing has been performed under existing approach slabs, the subsealing material shall be removed for its full depth. Where removal of cement treated base is required to construct the approach slab, the entire thickness of the cement treated base shall be removed.

Voids between the new reinforced structure approach slab and the base material remaining in place that are caused by removal of subsealing material or cement treated base shall be filled, at the option of the Contractor, with aggregate base (approach slab) or structure approach slab concrete.

The Contractor shall establish a grade line for new approach slabs by setting stringlines on each side of the proposed approach slab. The stringlines shall start approximately 30 m from the structure and extend approximately 15 m onto the structure. The stringlines shall be adjusted as necessary to provide a smooth profile grade for the new approach slab. The profile grade will be subject to the approval of the Engineer.

The Contractor shall schedule his operations so that the pavement and base materials removed during a work period shall be replaced, in that same work period, with approach slab concrete that shall be cured for at least 6 hours prior to the time the lane is to be opened to public traffic as designated in "Maintaining Traffic" of these special provisions. In the event the existing pavement and base materials are removed and the Contractor is unable, as determined by the Engineer, to construct, finish and cure the new approach slab by the time the lane is to be opened to public traffic, the excavation shall be filled with a temporary roadway structural section as specified in this section, "Structure Approach Slabs (Type R)."

TEMPORARY ROADWAY STRUCTURAL SECTION

A sufficient standby quantity, as determined by the Engineer, of asphalt concrete and aggregate base shall be provided at the project site for construction of a temporary roadway structural section where existing approaches to structures are being replaced. The temporary structural section shall be maintained and later removed as a first order of work when the Contractor is able to construct and cure the approach slab within the prescribed time limit. The temporary structural section shall consist of 90-mm thick layer of asphalt concrete over aggregate base.

The aggregate base for the temporary structural section shall conform to the requirements specified under "Aggregate Base (Approach Slab)" of these special provisions.

The asphalt concrete for the temporary structural section shall be produced from commercial quality aggregates and asphalt binder. The grading of the aggregate shall conform to the 19-mm maximum medium grading in Section 39-2.02, "Aggregate," of the Standard Specifications and the asphalt binder shall conform to the requirements of liquid asphalt SC-800 in Section 93, "Liquid Asphalts," of the Standard Specifications. The amount of asphalt binder to be mixed with the aggregate shall be approximately 0.3-percent less than the optimum bitumen content as determined by California Test 367.

Aggregate base and asphalt concrete for the temporary structural section shall be spread and compacted 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 asphalt concrete may each be spread and compacted in one layer. The finished surface of the asphalt concrete shall not vary more than 15 mm from the lower edge of a 3.6-m straightedge placed parallel with the centerline and shall match the elevation of the existing concrete pavement and structure along the joints between the existing pavement and structure and the temporary surfacing.

The material from the removed temporary structural section shall be disposed of outside the highway right of way in conformance with Section 7-1.13 of the Standard Specifications except that removed aggregate base may be stockpiled at the project site and reused for construction of another temporary structural section. When no longer required, standby material or stockpiled material for construction of temporary structural sections shall be removed and disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13.

REMOVING PORTIONS OF EXISTING STRUCTURES

Attention is directed to "Existing Highway Facilities" of these special provisions.

REMOVING EXISTING PAVEMENT AND BASE MATERIALS

The outlines of excavations in asphalt concrete shall be cut on a neat line to a minimum depth of 75 mm with a power-driven concrete saw or wheel-type rock cutting excavator before any asphalt concrete material is removed. These excavations shall be permanently or temporarily backfilled to conform to the grade of the adjacent pavement prior to 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, the surface of the concrete to be removed shall not be impacted within 0.5-m of the pavement to remain in place. Removing existing pavement and base materials shall be performed without damage to the adjacent structure or pavement that is to remain in place. Damage to the structure or to pavement that is to remain in place shall be repaired to a condition satisfactory to the Engineer. Damaged

pavement shall be removed and replaced with new concrete pavement if ordered by the Engineer. Repairing damage to structures or repairing or removing and replacing damaged pavement outside the limits of structure approach slabs shall be at the Contractor's expense.

Materials removed shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

The base material remaining in-place, after removing the existing pavement and base materials to the required depth, shall be graded uniformly, watered, and compacted. The finished surface of the base material at any point shall not extend above the grade approved by the Engineer.

Areas of the base material that are low as a result of over excavation shall be filled, at the Contractor's expense, with structure approach slab concrete at the time and in the same operation that the new concrete is placed.

AGGREGATE BASE (APPROACH SLAB)

The aggregate base (approach slab) for filling voids below the reinforced structure approach slab concrete shall 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 shall conform to the 19-mm maximum grading specified in Section 26-1.02A, "Class 2 Aggregate Base," of the Standard Specifications.

Aggregate base (approach slab) for filling voids below the reinforced structure approach slab concrete shall be spread and compacted by methods that will produce a well-compacted, uniform base, free from pockets of coarse or fine material. The aggregate base shall be watered and compacted to the grade approved by the Engineer. Where the required thickness of aggregate base is 200 mm or less, the base may be spread and compacted in one layer. Where the required thickness of aggregate base is more than 200 mm, the base shall be spread and compacted in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 200 mm. The finished surface of the base material at any point shall not extend above the grade approved by the Engineer. Areas of the base material that are lower than the grade approved by the Engineer, shall be filled with structure approach slab concrete at the time and in the same operation that the new concrete is placed.

STRUCTURE APPROACH SLAB

Reinforced concrete approach slabs shall conform to the provisions for approach slabs in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

Concrete for use in approach slabs shall contain not less than 400 kg of cement per cubic meter.

Miscellaneous steel parts shall conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Approach slab concrete that requires a minimum curing period of 6 hours shall be constructed using a non-chloride Type C chemical admixture. Mineral admixture will not be required in this concrete.

Portland cement for use in concrete using a non-chloride Type C chemical admixture shall be Type II Modified, Type II Prestress, or Type III. Type II Modified and Type III cement shall conform to the provisions in Section 90-2.01, "Portland Cement," of the Standard Specifications. Type II Prestress cement shall conform to the requirements of Type II Modified cement, except the mortar containing the portland cement to be used and Ottawa sand, when tested in conformance with California Test 527, shall not contract in air more than 0.053-percent.

The non-chloride Type C chemical admixture shall be approved by the Engineer and shall conform to the requirements in ASTM Designation: C 494 and Section 90-4, "Admixtures," of the Standard Specifications.

The concrete with non-chloride Type C chemical admixture shall be prequalified prior to placement in conformance with the provisions for prequalification of concrete specified by compressive strength in Section 90-9.01, "General," of the Standard Specifications and the following:

A. Immediately after fabrication of the 5 test cylinders, the cylinders shall be stored in a temperature medium of 21 ± 1.5°C until the cylinders are tested.
B. The 6-hour average strength of the 5 test cylinders shall not be less than 5.85 MPa. No more than 2 test cylinders shall have a strength of less than 5.5 MPa.

Bar reinforcement in drilled holes shall be bonded in conformance with the provisions for drilling and bonding dowels in Section 83-2.02D(1), "General," of the Standard Specifications.

The top surface of approach slabs shall be finished in conformance with the provisions in Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications. The finished top surface shall not vary more than 6 mm from the lower edge of a 3.6-m straightedge placed parallel with the centerline. Edges of slabs shall be edger finished.

The surface of the approach slab will not be profiled and the Profile Index requirements shall not apply.

Approach slabs shall be cured with pigmented curing compound (1) in conformance with the provisions for curing structures in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications. The minimum curing period as

specified in this section "Structure Approach Slabs (Type R)" shall be considered to begin at the start of discharge of the last truck load of concrete to be used in the slab. Fogging of the surface with water after the curing compound has been applied will not be required. Should the film of curing compound be damaged from any cause before the approach slab is opened to public traffic, the damaged portion shall be repaired immediately with additional compound, at the Contractor's expense. Damage to the curing compound after the approach slab is opened to public traffic shall not be repaired.

If the ambient temperature is below 18°C during the curing period, an insulating layer or blanket shall cover the surface. The insulation layer or blanket shall have an R-value rating given in the table below. At the Contractor's option, a heating tent may be used in lieu of or in combination with the insulating layer or blanket:

Temperature range during curing period	R-value, minimum
13°C to 18°C	1
7°C to 13°C	2
4°C to 7°C	3

Tests to determine the coefficient of friction of the final textured surface will be made only if the Engineer determines by visual inspection that the final texturing may not have produced a surface having the specified coefficient of friction. Tests to determine the coefficient of friction will be made after the approach slab is opened to public traffic, but not later than 5 days after concrete placement. The coefficient of friction will be measured by California Test 342. Portions of completed concrete surfaces that are found to have a coefficient of friction less than 0.35 shall be ground or grooved parallel to the center line in conformance with the provisions for bridge decks in Section 42, "Groove and Grind Pavement," of the Standard Specifications.

JOINTS

Type AL joint seals shall conform to the provisions in 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 shall conform to 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 prior to placing the seal, the joint shall be thoroughly cleaned, including abrasive blast cleaning of the concrete surfaces, so that all foreign material and concrete spillage are removed from all joint surfaces. Joint surfaces shall 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 miscellaneous metal, Type AL joint seals, and pourable seals shall be considered as included in the contract price paid per cubic meter 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 by the Contractor, will be measured and paid for by the cubic meter as aggregate base (approach slab).

No adjustment of compensation will be made for any increase or decrease in the quantity of aggregate base (approach slab) required, regardless of the reason for such increase or decrease. The provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications shall not apply to the item of aggregate base (approach slab).

The contract price paid per cubic meter 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 meter for structural concrete, approach slab (Type R) and no separate payment will be made therefor.

Full compensation for drilling and bonding of bar reinforcement shall be considered as included in the contract price paid per cubic meter for structural concrete, approach slab (Type R) and no separate payment will be made therefor.

10-1.60 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 meter 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 meter 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.

10-1.61 SEALING JOINTS

Joints in concrete bridge decks and joints between concrete structures and concrete approach slabs shall 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.

Where polyurethane seals are shown on the plans, a silicone sealant conforming to the provisions in Section 51–1.12F, "Sealed Joints," of the Standard Specifications may be used.

When ordered by the Engineer, a joint seal larger than called for by the Movement Rating shown on the plans shall 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.

10-1.62 JOINT SEAL ASSEMBLIES (MOVEMENT RATING EXCEEDING 100 mm)

Joint seal assemblies with movement ratings greater than 100 mm shall consist of a metal frame system, supporting rails and support bars with intervening neoprene glands and shall conform to the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications and to these special provisions.

Joint seal assemblies will not be considered for approval without satisfactory evidence that the assemblies have had at least one year of satisfactory service under conditions similar to this application.

A qualified representative of the manufacturer shall be present during installation of the first assembly and shall be available for advice during any remaining installations.

The Contractor shall submit complete working drawings for each joint seal assembly to the Division of Structure Design (DSD) in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The working drawings shall show complete details of the joint seal assembly and anchorage components and the method of installation to be followed, including concrete blockout details and any additions or rearrangements of the reinforcing steel from that shown on the plans. 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 DSD for final approval and use during construction.

The working drawings shall be supplemented with complete calculations for the particular joint seal assembly, when requested by the Engineer. Working drawings shall be either 279 mm x 432 mm or 559 mm x 864 mm 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-Kilometer Post. 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.

Calculations, when requested, and working drawings shall be stamped and signed by an engineer who is registered as a Civil Engineer. The Contractor shall allow the Engineer 4 weeks to review the drawings after a complete set has been received.

Within 3 weeks after final working drawing approval, one set of the corrected good quality prints on 75-g/m^2 (minimum) bond paper (559 mm x 864 mm in size) of all working drawings prepared by the Contractor for each joint seal assembly shall be furnished to OSD.

Each shipment of joint seal assembly materials shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-l.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.

The neoprene glands shall conform to the requirements in Table 1 of ASTM Designation: D 2628 and the following, except that no recovery tests or compression-deflection tests will be required:

Property	Requirement	ASTM Test Method
Hardness, Type A Durometer, points	55-70	D 2240 (Modified)
Compression set, 70 hours at 100°C, maximum, percent	40	D 395 Method B (Modified)

The number of neoprene glands in the joint seal assembly at the following locations NB 680/WB 780 Connector and OH, Bridge No. 23-0212G, and Benicia Martinez Approach Structure, Bridge No. 23-0215R, shall be determine by dividing the movement rating shown on the plans by 130 mm.

All metal parts of the joint seal assembly shall conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications. Bolts, nuts and washers shall conform to the requirements of ASTM Designation: A 325 or A 325M. At the Contractor's option, metal parts may conform to the requirements of ASTM Designation: A 572/A 572M.

At the Contractor's option, cleaning and painting of all new metal surfaces of the joint seal assembly, except stainless steel and anchorages embedded in concrete, may be substituted for galvanizing. Cleaning and painting shall be in conformance with the provisions in Sections 59-2, "Painting Structural Steel," and 91, "Paint," of the Standard Specifications, and "Clean and Paint Structural Steel" of these special provisions.

Certification in conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for cleaning and painting joint seal assemblies.

Finish coats will not be required on joint seal assemblies.

If the assembly consists of more than one component, the design of the assembly shall be such that the external components can be removed and reinstalled at any position, within the larger one-half of the movement rating shown on the plans, to permit the inspection of the internal components of the assembly.

Except for components in contact with the tires, the assembly and its components shall be designed to support the AASHTO HS20-44 loading with 100 percent impact. Each component in contact with the tires shall support a minimum of 80 percent of the AASHTO HS20-44 loading with 100 percent impact. The tire contact area used to distribute the tire loads shall be 244 mm, measured normal to the longitudinal axis of the assembly, by 508 mm wide. The assembly shall provide a smooth riding joint without slapping of components or wheel tire rumble.

The movement rating of the assembly shall be measured normal to the longitudinal axis of the assembly. The dimensions for positioning the assembly within the movement rating during installation shall be measured normal to the longitudinal axis, disregarding any skew of the deck expansion joint. The assembly shall be capable of adjustment to the "a" dimension shown on the plans.

The maximum width of unsupported or yielding components or grooves in the roadway surface of the assembly, measured in the direction of vehicular traffic, shall be 75 mm.

The assembly shall have cast-in-place anchorage components forming a mechanical connection between the joint components and the concrete deck.

The bridge deck surface shall conform to the provisions in Section 51-1.17 "Finishing Bridge Deck," of the Standard Specifications prior to placing joint seal assemblies and anchorage.

The assembly shall be completely shop-assembled and placed in a blocked out recess in the concrete deck surface. The depth and width of the recess shall permit the installation of the assembly anchorage components or anchorage bearing surface to the planned line and grade.

The maximum depth and width of the recess shall be such that the primary reinforcement to provide the necessary strength of the structural members is outside the recess. The maximum depth of the recess at abutments and at hinges shall be as shown on the plans. The maximum width of recess on each side of the expansion joint shall be as shown on the plans.

All reinforcement other than primary reinforcement shall continue through the recess construction joint into the recess and engage the anchorage components of the assembly.

The vertical expansion joint in barrier shall be available for inspection after placement of the recess concrete around the anchorage components of the assembly.

The assembly shall make a watertight, continuous return 150 mm up into the barrier at the low side of the deck joint. Neoprene glands shall be continuous without field splices or joints, including the return up into barrier.

Full compensation for any additional materials or work required because of the application of the optional cleaning and painting shall be considered as included in the contract price paid per linear meter for the joint seal assembly involved, and no additional compensation will be allowed therefor.

10-1.63 ARCHITECTURAL SURFACE (TEXTURED CONCRETE)

Architectural texture for concrete surfaces shall conform to the details shown on the plans and the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

Architectural textures listed below are required at concrete surfaces shown on the plans:

A. Running bond sandstone texture
B. Split face block texture

The architectural texture shall simulate a running bond sandstone texture and split face block texture constructed to the dimensions and shapes shown on the plans. Corners at the intersection of plane surfaces shall be sharp and crisp without easing or rounding. A Class 1 surface finish shall be applied to the architectural texture.

PREPARE AND STAIN CONCRETE

This work shall consist of preparing and staining concrete surfaces with brown/tan color, where shown on the plans, and in conformance with these special provisions.

MATERIALS

The stain shall be a water base solution of metallic salts that penetrate and react with the concrete surface to produce insoluble, abrasion-resistant color deposits in the pores of the concrete. The stain shall contain dilute acid to etch the concrete surface so that the staining ingredients can penetrate the concrete.

The Contractor shall submit to the Engineer, not less than one week prior to applying the concrete stain to the test panels, a copy of the manufacturer’s recommendations and written application instructions.

REFEREE SAMPLE

The architectural texture shall match the color of the referee sample available for inspection by bidders which is located at:

California Department of Transportation
Office of Landscape Architecture
9th Floor
111 Grand Avenue
MR. ROBERT RYERSON
Oakland, CA 94623
Tel: 510-286-4205

TEST PANEL

A test panel at least 1.25 m x 1.25 m in size shall be successfully completed at a location approved by the Engineer before beginning work on architectural textures. The test panel shall 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 shall 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 shall be used as the standard of comparison in determining acceptability of architectural texture for concrete surfaces.

FORM LINERS

Form liners shall be used for textured concrete surfaces and shall be installed in conformance with the manufacturer's recommendations, unless other methods of forming textured concrete surfaces are approved by the Engineer. Form liners shall be manufactured from an elastomeric material or a semi-elastomeric polyurethane material by a manufacturer of commercially available concrete form liners. No substitution of other types of formliner material will be allowed. Form liners shall leave crisp, sharp definition of the architectural surface. Recurring textural configurations exhibited by repeating, recognizable shadow patterns shall be prevented by proper casting of form liner patterns. Textured concrete surfaces with

such recurring textural configurations shall be reworked to remove such patterns as approved by the Engineer or the concrete shall be replaced.

Form liners shall have the following properties:

Description	ASTM Designation:	Range
Elastomeric material		
Shore A hardness	D 2240	20 to 65
Tensile strength (MPa)	D 412	0.9 to 6.2
Semi-elastomeric polyurethane		
Shore D hardness	D 2240	55 to 65
Tensile strength (MPa)	D 2370	18 minimum

Cuts and tears in form liners shall be sealed and repaired in conformance with the manufacturer's recommendations. Form liners that are delaminated from the form shall not be used. Form liners with deformations to the manufactured surface caused by improper storage practices or any other reason shall not be used.

Form liners shall extend the full length of texturing with transverse joints at 2.5 m minimum spacing. Small pieces of form liners shall not be used. Grooves shall be aligned straight and true. Grooves shall match at joints between form liners. Joints in the direction of grooves in grooved patterns shall be located only in the depressed portion of the textured concrete. Adjoining liners shall be butted together without distortion, open cracks or offsets at the joints. Joints between liners shall be cleaned before each use to remove any mortar in the joint.

Adhesives shall be compatible with the form liner material and with concrete. Adhesives shall be approved by the liner manufacturer. Adhesives shall not cause swelling of the liner material.

RELEASING FORM LINERS

Products and application procedures for form release agents shall be approved by the form liner manufacturer. Release agents shall not cause swelling of the liner material or delamination from the forms. Release agents shall not stain the concrete or react with the liner material. For reliefs simulating fractured concrete or wood grain surfaces the application method shall include the scrubbing method using a natural bristle scrub brush in the direction of grooves or grain The release agent shall coat the liner with a thin film. Following application of form release agent, the liner surfaces shall be cleaned of excess amounts of agent using compressed air. Buildup of form release agent caused by the reuse of a liner shall be removed at least every 5 uses.

Form liners shall 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 shall be protected from damage.

CURING

Concrete surfaces with architectural texture shall be cured only by the forms-in-place or water methods. Seals and curing compounds shall not be used.

MEASUREMENT AND PAYMENT

Architectural texture will be measured and paid for by the square meter.

The contract price paid per square meter for architectural texture of the types listed 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 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.

10-1.64 MINOR CONCRETE (PIPE COVER)

Concrete for Minor Concrete (Pipe Cover) shall conform to the provisions in Section 90-10 "Minor Concrete" of the Standard Specifications and these special provisions.

Minor concrete shall contain not less than 400 Kg of cement per cubic meter.

Calcium chloride conforming to the provisions of Section 90-4.04 of the Standard Specifications shall be added to the minor concrete (pipe cover).

The concrete shall be placed in the trench against undisturbed material at the sides of the trench. Foreign material which falls into the trench, prior to or during placing of the concrete, shall be immediately removed. Where necessary, earth plugs shall be constructed and compacted at the ends of the planned concrete to contain the concrete within the trench.

The surface of the minor concrete (pipe cover) shall be broomed with a heavy broom to produce a uniform rough surface.

Minor concrete (pipe cover) shall be placed and compacted without segregation and the finished surface shall not vary more than 15-mm above or below the grade established by the Engineer.

Minor concrete (pipe cover) shall be cured by applying SS1 type asphaltic emulsion applied in conformance with the provisions in Section 94, "Asphaltic Emulsions", of the Standard Specifications. The curing seal shall be applied at a rate between 0.70 and 1.15 L per square meter of surface. The exact rate of application will be determined by the Engineer. Any areas of the curing seal that are damaged shall be covered immediately with additional seal by the Contractor at his expense. The curing seal shall be allowed to remain on the minor concrete (pipe cover) to serve as a paint binder when surfacing is placed thereon.

Minor concrete (pipe cover) will be measured and paid for by the cubic meter in the same manner specified for minor concrete (backfill) in Section 65-1.10 "Payment" of the Standard Specifications.

Full compensation for curing seal and calcium chloride shall be considered as included in the contract price paid per cubic meter for minor concrete (pipe cover) and no separate payment will be made therefor.

10-1.65 REINFORCEMENT

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

The third paragraph in Section 52-1.04, "Inspection," of the Standard Specifications is amended to read:

· A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall also be furnished for each shipment of epoxy-coated bar reinforcement or wire reinforcement certifying that the coated reinforcement conforms to the requirements in ASTM Designation: A 775/A 775M or A 884/A 884M, respectively, and the provisions in Section 52-1.02B, "Epoxy-coated Reinforcement." The Certificate of Compliance shall include all of the certifications specified in ASTM Designation: A 775/A 775M or A 884/A 884M respectively, and a statement that the coating material has been prequalified by acceptance testing performed by the Valley Forge Laboratories, Inc., Devon, Pennsylvania.

The third paragraph in Section 52-1.08C, "Mechanical Butt Splices," of the Standard Specifications is amended to read:

· The total slip of the reinforcing bars within the splice sleeve after loading in tension to 200 MPa and relaxing to 20 MPa shall not exceed the values listed in the following table. The slip shall be measured between gage points that are clear of the splice sleeve.

Reinforcing Bar Number	Total Slip (µm)
13	250
16	250
19	250
22	350
25	350
29	350
32	450
36	450
43	600
57	750

The first paragraph in Section 52-1.08C(5), "Sleeve-Lockshear Bolt Mechanical Butt Splices," of the Standard Specifications is amended to read:

· The sleeve-lockshear bolt type of mechanical butt splices shall consist of a seamless steel sleeve, center hole with centering pin, and bolts that are tightened until the bolt heads shear off with the bolt ends left embedded in the reinforcing bars. The seamless steel sleeve shall be either formed into a V configuration or shall have 2 serrated steel strips welded to the inside of the sleeve.

Section 52-1.08F, "Nondestructive Splice Tests," of the Standard Specifications is amended by deleting the seventh paragraph.

Individual hoops, made continuous with butt welded splices, which are substituted for spiral reinforcement, shall conform to the requirements for "Ultimate Butt Splices" of these special provisions.

ULTIMATE BUTT SPLICES

Ultimate butt splices shall be either welded or mechanical splices, shall be used at the locations shown on the plans, and shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

General Requirements

The Contractor shall designate in writing an ultimate butt splicing Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for 1) the quality of all ultimate butt splicing including the inspection of materials and workmanship performed by the Contractor and all subcontractors; and 2) submitting, receiving, and approving all correspondence, required submittals, and reports regarding ultimate butt splicing to and from the Engineer.

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 length of any type of ultimate mechanical butt splice shall not exceed 10 times the bar diameter of the larger bar to be spliced.

All ultimate prejob, production, and job control sample splices shall be 1) a minimum length of 1.5 meters for reinforcing bars No. 25 or smaller and 2 meters for reinforcing bars No. 29 or larger, with the splice located at mid-point, and 2) suitably identified prior to shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals. Any splice that shows signs of tampering will be rejected.

A minimum of one control bar shall be removed from the same bar as, and adjacent to, all ultimate prejob, production, and job control sample splices. Control bars shall be 1) a minimum length of one meter for reinforcing bars No. 25 or smaller and 1.5 meters for reinforcing bars No. 29 or larger, and 2) suitably identified prior to shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals. The portion of adjacent bar remaining in the work shall also be identified with weatherproof markings that correspond to its adjacent control bar.

Shorter length sample splice and control bars may be furnished if approved in writing by the Engineer.

Each sample splice and its associated control bar shall be identified and marked as a set. Each set shall be identified as representing a prejob, production, or job control sample splice.

The portion of hoop reinforcing bar, removed to obtain a sample splice and control bar, 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 "Prejob Test Requirements for Ultimate Butt Splices" specified herein, or the bars shall be replaced in kind. These bars shall be repaired or replaced such that no splices are located in the "No Splice Zone" shown on the plans.

Section 52-1.08E, "Job Control Tests," of the Standard Specifications shall not apply.

The provisions for total slip shall not apply to any ultimate splices that are welded or that are used on hoops.

The independent qualified testing laboratory used to perform the testing of all ultimate butt sample splices and control bars 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, and shall have the following:

A. Proper facilities, including a tensile testing machine capable of breaking the largest size of reinforcing bar to be tested.
B. A device for measuring the total slip of the reinforcing bars across the splice to the nearest 25 µm, that, when placed parallel to the longitudinal axis of the bar is able to simultaneously measure movement across the splice, at 2 locations, 180 degrees apart.
C. Operators who have received formal training for performing the testing requirements of ASTM Designation: A 370/A 370M and California Test 670.

D. A record of annual calibration of testing equipment performed by an independent third party that has 1) standards that are traceable to the National Institute of Standards and Technology, and 2) a formal reporting procedure, including published test forms.

Ultimate Butt Splice Test Criteria

Ultimate prejob, production, and job control sample splices shall be tensile tested in conformance with the requirements described in ASTM Designation: A 370/A 370M and California Test 670.

Ultimate prejob and production sample splices shall rupture in the reinforcing bar either: 1) outside of the affected zone or 2) within the affected zone, provided that the sample has achieved at least 95 percent of the ultimate tensile strength of the control bar associated with the sample. In addition, necking of the bar shall be visibly evident at rupture regardless of whether the bar breaks inside or outside the affected zone.

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 ultimate tensile strength of each control bar shall be determined by tensile testing the bar to rupture and shall be determined for all control bars, regardless of where each sample splice ruptures. If 2 control bars are tested for one sample splice, the bar with the lower ultimate tensile strength shall be considered the control bar.

Testing to determine the minimum tensile strength, in conformance with the provisions in the ninth paragraph of Section 52-1.08, "Splicing," of the Standard Specifications, will not be required.

Prejob Test Requirements for Ultimate Butt Splices

Prior to use in the work, all ultimate butt splices shall conform to the following prejob test requirements:

A. Eight prejob sample splices for each bar size of each splice type including ultimate mechanical butt splices, ultimate complete joint penetration butt welded splices, and ultimate resistance butt welded splices, that will be used in the work, shall be fabricated by the Contractor. For deformation-dependent types of couplers, 8 sample prejob splices shall also be fabricated for each reinforcing bar size and deformation pattern that will be used in the work.
B. The sample splices shall be fabricated using the same splice materials, position, operators, location, and equipment, and following the same procedures as will be used to make the splices in the work.
C. At the option of the Contractor, operator qualification tests may be performed simultaneously with the preparation of prejob sample splices.
D. If different diameters of hoops are shown on the plans, prejob sample splices, as described above, will only be required for the smallest hoop diameter. In addition, these splices shall be fabricated using the same radius as shown on the plans for these hoops.
E. Unless otherwise directed in writing by the Engineer, 4 prejob sample splices and control bar sets shall be shipped to the Transportation Laboratory and the remaining 4 sets shall be tested by the Contractor's independent qualified testing laboratory.
F. Each group of 4 sets from a prejob test shall be securely bundled together and identified by location and contract number with weatherproof markings prior to shipment. Bundles containing fewer than 4 sets will not be tested by the Transportation Laboratory, nor shall they be tested by the independent laboratory.
G. All 8 sample splices from each prejob test shall conform to the provisions in "Ultimate Butt Splice Test Criteria" specified herein.
H. Prior to performing any tensile tests on prejob test sample splices, one of the 4 samples shall be tested for, and shall conform to, the provisions for total slip. Should this sample not meet these requirements, one retest, in which the 3 remaining samples are tested for total slip, will be allowed. All 3 of these remaining samples tested shall conform to the aforementioned slip requirements.
I. For each bundle of 4 sets, a Prejob Test Report shall be prepared by the independent testing laboratory performing the testing. The report shall 1) be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California; 2) include, as a minimum, the following information for each set: contract number, bridge number, bar size, type of splice, length of mechanical splice, physical condition of test sample splice and control bar, any notable defects, limits of affected zone, total measured slip, location of visible necking area, ultimate strength of each splice, ultimate strength and 95 percent of this ultimate strength for each control bar, and a comparison between 95 percent of the ultimate strength of each control bar and the ultimate strength of its associated splice; and 3) be submitted to the QCM for review and approval, and then to the Engineer.
J. Test results for each bundle of 4 sets will be reported in writing to the Contractor within 10 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.

K. Should the Engineer fail to provide the test results 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 providing the test results, 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.

Production Test Requirements for Ultimate Butt Splices

Production tests shall be performed for all ultimate butt splices used in the work. A production test shall consist of 4 sets of sample splices and control bars removed from each lot of completed splices, except when quality assurance tests are performed.

A lot of ultimate butt splices is defined as 1) 150, or fraction thereof, of the same type of ultimate mechanical butt splices used for each bar size and each bar deformation pattern that is used in the work or 2) 150, or fraction thereof, of ultimate complete joint penetration butt welded splices, or ultimate resistance butt welded splices for each bar size used in the work. If different diameters of hoop reinforcement are shown on the plans, separate lots shall be used for each different hoop diameter.

After all splices in a lot have been completed, the QCM shall notify the Engineer in writing that all couplers in this lot conform to the specifications and are ready for testing. The sample splices will either be selected by the Engineer at the job site or a fabrication facility, provided the facility is located within an 80-km radius of the jobsite.

At the option of the Contractor, sample splices for spiral reinforcement may be either 1) removed from the completed lot, or 2) prepared in the same manner as specified herein for ultimate prejob sample splices and control bars.

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. The Contractor or QCM shall select the adjacent control bar for each sample splice bar, and the Engineer will place tamper-proof markings or seals on them. These ultimate production sample splices and control bars shall be removed by the Contractor, and tested by an independent qualified testing laboratory, in the presence of either the Engineer or the Engineer's authorized representative.

The Engineer or the Engineer's authorized representative will be at the independent qualified testing laboratory within a maximum of 5 working days after receiving written notification that the samples are at the laboratory and ready for testing. Should the Engineer or the Engineer's authorized representative fail to be at the laboratory 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 this action, 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.

A sample splice or control bar from any set will be rejected if any tamper-proof marking or seal is disturbed prior to testing.

The 4 sets from each production test shall be securely bundled together and identified with a completed sample identification card prior to shipment to the independent laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 sets of splices shall not be tested.

A Production Test Report for all testing performed on each lot shall be prepared by the 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 set: contract number, bridge number, lot number and location, bar size, type of splice, length of mechanical splice, physical condition of test sample splice and control bar, any notable defects, limits of affected zone, total measured slip, location of visible necking area, ultimate strength of each splice, ultimate strength and 95 percent of this ultimate strength for each control bar, and a comparison between 95 percent of the ultimate strength of each control bar and the ultimate strength of its associated splice.

The QCM must review, approve, and forward each Production Test Report to the Engineer for review before any splices represented by the report are encased in concrete. The Engineer shall 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 prior to receiving notification from the Engineer, 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. Any material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase any splices pending notification by the Engineer, and should the Engineer fail to complete the review and provide notification 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 notification, 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.

Prior to performing any tensile tests on production test sample splices, one of the 4 samples shall be tested for, and shall conform to, the provisions for total slip. Should this sample not meet these 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 these requirements, all splices in the lot represented by this production test will be rejected.

If 3 or more sample splices from any production test conform to the provisions in "Ultimate Butt Splice Test Criteria" specified herein, all splices in the lot represented by this production test will be considered acceptable.

Should only 2 sample splices from any production test conform to the provisions in "Ultimate Butt Splice Test Criteria" specified herein, one additional production test shall be performed on the same lot of splices. Should any of the 4 sample splices from this additional test fail to conform to these provisions, all splices in the lot represented by these production tests will be rejected.

If only one sample splice from any production test conforms to the provisions in "Ultimate Butt Splice Test Criteria" specified herein, all splices in the lot represented by this production test will be rejected.

If a production test for any lot fails, the Contractor will be required to repair or replace all reinforcing bars from which sample splices were removed, complete in place, before the Engineer selects any additional splices from this lot for further testing.

Whenever any lot of ultimate butt splices is rejected, additional ultimate butt splices shall not be used in the work until 1) the QCM performs a complete review of the Contractor's quality control process for these splices, 2) a written report is submitted to the Engineer describing the cause of failure for the splices in this lot and provisions for correcting these failures in future lots, and 3) the Engineer has provided the Contractor with written notification that the report is acceptable. The Engineer shall have 3 working days after receipt of the report to provide notification to the Contractor. Should the Engineer not provide notification 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 this action, 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.

Production tests will not be required on any repaired splice from a lot, regardless of the type of prequalified ultimate mechanical butt splice used to make the repair.

Should an additional production test be required, the Engineer may select any repaired splice for use in the additional production test.

Quality Assurance Test Requirements for Ultimate Butt Splices

For the first production test performed, and for at least one, randomly selected by the Engineer, of every 5 additional production tests, or portion thereof, performed thereafter, the Contractor shall concurrently prepare 4 additional ultimate job control sample splices along with associated control bars. These ultimate job control samples shall be prepared in the same manner as specified herein for ultimate prejob sample splices and control bars.

Each time 4 additional ultimate job control sample splices are prepared, 2 of these job control sample splice and associated control bar sets and 2 of the production sample splice and associated control bar sets, together, shall conform to the requirements for ultimate production sample splices in "Production Test Requirements for Ultimate Butt Splices" specified herein.

The 2 remaining job control sample splice and associated control bar sets, along with the 2 remaining production sample splice and associated control bar sets shall be shipped, unless otherwise directed in writing by the Engineer, to the Transportation Laboratory for quality assurance testing. The 4 sets shall be securely bundled together and identified by location and contract number with weatherproof markings prior to shipment. Bundles containing fewer than 4 sets will not be tested.

Quality assurance testing will be performed in conformance with the requirements for ultimate production sample splices in "Production Test Requirements for Ultimate Butt Splices" specified herein.

Test results for each bundle of 4 sets will be reported in writing to the Contractor within 3 working days after receipt of the bundle by 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 any splices prior to receiving notification from the Engineer, 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. Any material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase any splices pending notification by the Engineer, and should the Engineer fail to complete the review and provide notification 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 notification, 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.

10-1.66 WELDED HEADED BAR REINFORCEMENT

Welded headed bar reinforcement, consisting of furnishing and friction welding heads onto one or both ends of bar reinforcement, shall conform to the details shown on the plans, the provisions of Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

GENERAL

Prior to performing any manufacturing, the Contractor shall submit to the Engineer the manufacturer's Quality Control Manual (QCM) for the fabrication of welded headed bar reinforcement. As a minimum, the manual shall include the following:

A. The pre-production procedures for the qualification of materials and equipment;
B. The methods and frequencies for performing all quality control procedures during production;
C. The calibration procedures and calibration frequency for all equipment;
D. A system for the identification and tracking of all welds. The system shall have provisions for permanently identifying each weld and the parameters used to perform it;
E. The welding procedure specification (WPS); and
F. A system for marking welded headed bar reinforcement.

A daily production log for the manufacture of welded headed bar reinforcement shall be kept by the manufacturer for each day of production. The log shall clearly indicate the production lot numbers, the heats of bar material and head material used in the manufacture of each production lot, the number of bars in each production lot, welding records, including tracking and production parameters for all welds, and results of all tests performed. A test report shall be furnished by the manufacturer containing, on a per heat basis, the chemical analysis of the bar and of the head material, including all elements represented in the carbon equivalent formula in ASTM Designation: A 706/A 706M, in addition to phosphorus and sulfur.

A production lot of welded headed bar reinforcement is defined as 150 reinforcing bars, or fraction thereof, of the same bar size, with welded heads of the same size and type, produced from bar material of a single heat number and head material of a single heat number. A new production lot shall be started if the heat number of either the bar material or the head material changes before the maximum production lot size of 150 is reached.

The daily production log shall be submitted in writing to the Engineer within 7 calendar days following the manufacture of any welded headed bar reinforcement.

The manufacturer shall furnish certificates of compliance to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," for all material used in the manufacture of welded headed bar reinforcement.

MATERIALS AND MANUFACTURE

All bar reinforcement to be used in the fabrication of welded headed bar reinforcement shall conform to the provisions of "Reinforcement" of these special provisions.

Heads to be used in the fabrication of welded headed bar reinforcement shall be forge formed or cut from properly identified heats of mold cast or strand cast steel using the open-hearth, basic oxygen or electric-furnace process. The chemical composition of the heads shall conform to the requirements in ASTM Designation: A 29/A 29M, A 36/A 36M, A 108 Grade 1018, A 304, A 572/A 572M, or A 706/A 706M. Forging of heads shall conform to the requirements in ASTM Designation: A 788. Heads cut from plate shall conform to the provisions of Section 55, "Steel Structures," of the Standard Specifications.

Welding, welder qualifications, and inspection of welding shall conform to the requirements for friction welding in ANSI/AWS C6.1.

All welding shall be performed at an established and permanent fabrication facility.

All equipment used to perform friction welding shall be fitted with an effective in-process monitoring system to record essential production parameters that describe the process of welding the head onto the bar reinforcement. As a minimum, the parameters to be recorded shall include friction welding force, forge force, rotational speed, friction upset distance and time, forge upset distance and time, and other elements of the production process. The data from this in-process monitoring shall be recorded and preserved by the manufacturer and shall be provided to the Engineer upon request.

Heads shall be forge formed or cut from plate into a round, elliptical, or rectangular shape. Nominal head dimensions to be used for standard bar sizes shall conform to the following:

Nominal Head Dimensions			
Standard Bar Designation No.	Min. thickness mm	Min. cross-sectional area mm^2	Min. width mm
10	10	710	19
13	11	1 290	22
16	12	2 000	25
19	14	2 840	35
22	16	3 870	37
25	16	5 100	40
29	18	6 450	43
32	20	8 200	51
36	22	9 700	55
43	32	14 500	65
57	40	25 800	80
Notes: (1) These head dimensions are based on concrete compressive strength of 30 MPa. (2) The head thickness shall be measured parallel to the reinforcing bar longitudinal axis, and the head width shall be measured perpendicular to the reinforcing bar axis. (3) The cross-sectional area of the head shall be the projected area measured perpendicular to the axis of the bar.			

The Contractor may request, in writing, to use alternative head dimensions to those specified herein. The alternative head dimensions shall be designed using the concrete compressive strength shown on the plans. Alternative head dimensions will not be considered for approval unless it can be proven by the Contractor that the alternative heads have been successfully produced and have had at least 2 years of satisfactory service in conditions similar to this application. The Contractor shall furnish, at the Contractor's expense, documentation satisfactory to the Engineer that the alternative head dimensions are suitable for the intended application. The documentation shall include, but not be limited to, calculations and test reports showing the following:

A. The alternative head is capable of resisting the nominal tensile strength of the reinforcing bar when the bar reinforcement with welded head is embedded in concrete; and
B. Shear or bending forces do not cause premature failure of the alternative head or crushing failure of the concrete under the alternative head.

Quality Control (QC) is the responsibility of the Contractor. As a minimum, the Contractor shall perform inspection and testing prior to welding, during welding and after welding and as necessary to ensure that materials and workmanship conform to the requirements of the specifications.

All equipment and materials for performing all pre-production and production testing shall be furnished by the Contractor at the Contractor's expense. All testing shall be performed 1) at the manufacturer's plant or at an approved laboratory, 2) in the presence of the Engineer, unless otherwise directed in writing, and 3) at the Contractor's expense.

TENSILE TEST CRITERIA

Tensile testing of the welded headed bar reinforcement shall be performed in conformance with the requirements described in ASTM Designation: A 370.

Tensile test specimens shall be the full cross-section of the bar as rolled with a head attached to one end of the reinforcing bar. A specimen with a head welded to one end shall be placed in the testing machine with the head supported by a steel plate or other fixture to prevent movement and bending of the head. The fixture shall be placed concentrically with the longitudinal axis of the reinforcing bar directly against the flat inner surface of the head. The fixture shall provide clearance between the head support and the head-to-bar connection. Provisions shall be made for clearance between the support and any weld or forming material on the reinforcing bar-to-head connection. The free end of the bar, without a head attached, shall be gripped by the test machine.

All tensile test specimens for welded headed bar reinforcement shall conform to the following requirements:

A. The tensile strength, yield strength and elongation shall conform to the requirements in Table 2, "Tensile Requirements," in ASTM Designation: A 706/A 706M;
B. At rupture, there shall be no observed partial or total fracture of the head, the head-to-bar connection or the reinforcing bar within one bar diameter of the head-to-bar connection; and
C. At rupture, there shall be visible signs of necking in the reinforcing bar, at a minimum distance of one bar diameter away from the head-to-bar connection.

PRE-PRODUCTION TESTING

Prior to production, successful test results from 3 tensile tests and 3 bend tests shall be furnished by the Contractor for each combination of 1) reinforcing bar size, 2) head size, 3) head type and, 4) head material specification to be used in the work. Bend tests will not be required for reinforcing bars Nos. 43 and 57.

Tensile tests shall conform to the requirements of "Tensile Test Criteria" of this section.

The bend tests shall be performed in conformance with the requirements described in ASTM Designation: A 706/A 706M, except that the test specimen shall be bent around a test mandrel to an angle of at least 90-degrees.

The mandrel shall be placed so as to directly bend the welded region. The mandrel dimensions for bend testing shall conform to the requirements for mandrel (pin) diameters in ASTM Designation: A 706/A 706M. The centerline of the bend test mandrel shall be placed at the intersection of the reinforcing bar and the weld.

Bend test specimens shall be the full cross-section of the bar as rolled with a head attached to one end of the reinforcing bar. For welded heads directly attached to the end of the reinforcing bar where the head interferes with placement of the bend test mandrel, sufficient head material and any excess material associated with the welding process shall be removed along one edge of the reinforcing bar to provide a flat surface on the specimen for the bend mandrel. For welded headed bar reinforcement where the head does not interfere with the positioning of the bend test mandrel, no specimen preparation shall be performed.

All welded headed bar reinforcement bend test specimens shall conform to the following requirements:

A. There shall be no observed partial or total fracture of the head, the head-to-bar connection or the bar within one bar diameter of the head-to-bar connection; and
B. There shall be no cracking on the outside of the bent portion.

PRODUCTION TESTING

Production testing shall be performed using samples that have been randomly selected by the Engineer from each production lot of welded headed bar reinforcement which is ready for shipment to the job site. The Engineer shall be notified in writing at least 7 days prior to conducting any tests.

A minimum of 3 samples of welded headed bar reinforcement from each production lot shall be tested. One tensile test shall be conducted on each sample.

All tensile test specimens shall conform to the requirements of "Tensile Test Criteria" of this section, except that if one of the test specimens fails to meet said requirements, one retest may be performed on one additional sample, selected by the Engineer, from the same production lot. Should this additional test specimen, or should more than one of the original test specimens, fail to meet said requirements, all welded headed bar reinforcement represented by the tests will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials," of the Standard Specifications.

All welded headed bar reinforcement of each bar size from each production lot to be shipped to the site shall be tagged in such a manner that each such production lot can be accurately identified at the job site. All unidentified welded headed bar reinforcement received at the job site will be rejected.

Marking

All welded headed bar reinforcement shall be identified by a distinguishing set of marks legibly stamped onto the flat outer side of the head, away from the bar, to denote the following:

A. Point of Origin--Letter or symbol established as the manufacturer's designation.
B. Type of Welded Headed Reinforcing Bar--Letter T indicating that the welded headed bar reinforcement was produced to this specification.

MEASUREMENT AND PAYMENT

Quantities of welded headed bar reinforcement will be measured as units determined from the number of welded heads shown on the plans or as directed by the Engineer.

The contract unit price paid for welded headed bar reinforcement shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing heads and friction welding heads to bar reinforcement, including conforming to all testing requirements, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Bar reinforcement to be used in the manufacture of welded headed bar reinforcement will be measured and paid for as specified in Section 52, "Reinforcement," of the Standard Specifications, except that the lengths to be used in the computation of calculated weights of the bar reinforcement shall be the entire length of the welded headed bar, including heads.

Full compensation for placing the completed welded headed bar reinforcement into the work shall be considered as included in the contract price paid per kilogram for the bar reinforcement involved and no additional compensation will be allowed therefor.

10-1.67 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 galvanized steel link plate and portions of the permanent steel casing to the limits shown on the plans in the same manner provided for waterproofing concrete surfaces.

The exposed surfaces of the membrane waterproofing applied to steel link plate and portions of the permanent steel casing to the limits shown on the plans 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 (Minimum)(1)	ASTM D 882 (2)	3.5N/mm (3)	3.5N/mm (3)
Percent Elongation at break (Minimum) (4)	ASTM D 882 (2)	150 percent (3)	25 percent (3)
Pliability	ASTM D 146 (5)	No cracks	No cracks
Thickness (Minimum) (6)	------	1.5 mm	1.5 mm
Rubberized Asphalt Softening Point (Minimum)	AASHTO T 53	74°C	74°C
Polymer Modified Bitumen Softening Point (Minimum)	AASHTO T 53	99°C	99°C

Notes:
(1) Breaking factor in machine direction.
(2) Method A, average 5 samples.
(3) At 23°C ± 2°C
(4) Machine direction.
(5) 180-degree bend over a 25-mm mandrel at -120°C
(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 3-mm 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 4°C.

Preformed membrane material shall be placed starting at the bottom and lapped by a minimum of 150 mm 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 meter as asphalt membrane waterproofing.

10-1.68 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 and these special provisions.

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 and in the special provisions.

Working drawings shall be 559 mm x 864 mm or 279 mm x 432 mm in size and each drawing and calculation sheet shall include the State assigned designations for the contract number, sign structure type and reference as shown on the contract plans, District-County-Route-Kilometer Post, and contract number.

The Engineer shall have 20 working 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.

Should the Engineer fail to complete the review within the 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 sign structure working drawings, 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 third paragraph of Section 56-1.01, "Description," of the Standard Specifications shall not apply.

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.

Surfaces of base plates which are to come in contact with concrete, grout, or washers and leveling nuts shall be flat to within 3 mm tolerance in 305 mm, and to within 5 mm tolerance overall. Faying surfaces of plates in high-strength bolted connections including flange surfaces of field splices, chord joints, and frame junctures, and contact surfaces of plates used for breakaway slip base assemblies shall be flat to within 2 mm tolerance in 305 mm, and within 3 mm tolerance overall.

The sixth through the thirteenth paragraphs in Section 56-1.03, "Fabrication," of the Standard Specifications are amended to read:

· High-strength bolted connections, where shown on the plans, shall conform to the provisions in Section 55-3.14, "Bolted Connections," except that only fastener assemblies consisting of a high-strength bolt, nut, hardened washer, and direct tension indicator shall be used.

· High-strength fastener assemblies, and any other bolts, nuts, and washers attached to sign structures shall be zinc-coated by the mechanical deposition process.

· An alternating snugging and tensioning pattern for anchor bolts and high-strength bolted splices shall be used. Once tensioned, high-strength fastener components and direct tension indicators shall not be reused.

· For bolt diameters less than 10 mm, the diameter of the bolt hole shall be not more than 0.80-mm larger than the nominal bolt diameter. For bolt diameters greater than or equal to 10 mm, the diameter of the bolt hole shall be not more than 1.6 mm larger than the nominal bolt diameter.

· Sign structures shall be fabricated into the largest practical sections prior to galvanizing.

· Ribbed sheet metal panels for box beam closed truss sign structures shall be fastened to the truss members by cap screws or bolts as shown on the plans, or by 4.76 mm stainless steel blind rivets conforming to Industrial Fasteners Institute, Standard IFI-114, Grade 51. The outside diameter of the large flange rivet head shall be not less than 15.88 mm in diameter. Web splices in ribbed sheet metal panels may be made with similar type blind rivets of a size suitable for the thickness of material being connected.

· Spalling or chipping of concrete structures shall be repaired by the Contractor at the Contractor's expense.

· Overhead sign supports shall have an aluminum identification plate permanently attached near the base, adjacent to the traffic side on one of the vertical posts, using either stainless steel rivets or stainless steel screws. As a minimum, the information on the plate shall include the name of the manufacturer, the date of manufacture and the contract number.

Steel members used for overhead sign structures shall receive nondestructive testing (NDT) in conformance with AWS D1.1 and the following:

A.

Weld Location	Weld Type	Minimum Required NDT
Welds for butt joint welds in tubular sections, nontubular sections, and posts	CJP groove weld with backing ring	100% UT or RT
Longitudinal seam welds*	PJP groove weld	25% MT
	CJP groove weld	100% UT or RT
Welds for base plate, flange plate, or end cap to post or mast arm	CJP groove weld	25% UT or RT
	Fillet weld	25% MT
* Longitudinal seam welds shall have 60% minimum penetration, except that within 150 mm of any circumferential weld, longitudinal seam welds shall be CJP groove welds.		

B. A written procedure approved by the engineer shall be used when performing UT on material less than 8 mm thick.

C. When less than 100 percent of a weld is specified for NDT, and if defects are found during this inspection, additional NDT shall be performed. This additional NDT shall be performed on 25 percent of the total weld for all similar welds, as determined by the Engineer, produced for sign structures in the project. If any portion of the additional weld inspected is found defective, 100 percent of all similar welds produced for sign structures in the project, as determined by the Engineer, shall be tested.

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 kilogram for furnish sign structure and no additional compensation will be allowed therefor.

10-1.69 ROADSIDE SIGNS

Roadside signs shall be 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.

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 with creosote, creosote coal tar solution, creosote petroleum solution (50-50), pentachlorophenol in hydrocarbon solvent, copper naphthenate, ammoniacal copper arsenate, or ammoniacal copper zinc arsenate. In addition to the preservatives listed above, Southern yellow pine may also be pressure treated with chromated copper arsenate. When other than one of the creosote processes is used, blocks shall have a minimum retention of 6.4 kg/m^3, and need not be incised.

10-1.70 INSTALL SIGN PANEL ON EXISTING FRAME

Sign panels shall be installed on existing frames at the locations shown on the plans or where designated by the Engineer and in conformance with the provisions in Section 56-1.06, "Sign Panels and Fastening Hardware," of the Standard Specifications and these special provisions.

Existing sign panels, as shown on the plans, shall be removed and disposed of as provided in Section 15, "Existing Highway Facilities," of the Standard Specifications.

Installing sign panels on existing frames will be measured by the square meter and the quantity to be paid for will be the total area, in square meters, of sign panels installed in place.

The contract price paid per square meter for install sign panel on existing frame shall include full compensation for furnishing all labor, materials (except State-furnished sign panels and mounting bolts), tools, equipment, and incidentals, and for doing all the work involved in installing sign panels on existing frames, complete in place (including removing and disposing of existing sign panels), as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.71 CLEAN AND PAINT STRUCTURAL STEEL

Exposed new metal surfaces, except where galvanized, shall be cleaned and painted in conformance with the provisions in Section 59-2, "Painting Structural Steel," and Section 91, "Paint," of the Standard Specifications and these special provisions.

Whenever the Standard Specifications refer to "Steel Structures Painting Council," the reference shall be replaced with "SSPC: The Society for Protective Coatings."

Section 59-2.01, "General," of the Standard Specifications is amended by adding the following paragraphs after the first paragraph:

- Unless otherwise specified, no painting Contractors or subcontractors will be permitted to commence work without having the following current "SSPC: The Society for Protective Coatings" (formerly the Steel Structures Painting Council) certifications in good standing:

A. For cleaning and painting structural steel in the field, certification in conformance with the requirements in Qualification Procedure No. 1, "Standard Procedure For Evaluating Painting Contractors (Field Application to Complex Industrial Structures)" (SSPC-QP 1).
B. For removing paint from structural steel, certification in conformance with the requirements in Qualification Procedure No. 2, "Standard Procedure For Evaluating Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)" (SSPC-QP 2).
C. For cleaning and painting structural steel in a permanent painting facility, certification in conformance with the requirements in Qualification Procedure No. 3, "Standard Procedure For Evaluating Qualifications of Shop Painting Applicators" (SSPC-QP 3). The AISC's Sophisticated Paint Endorsement (SPE) quality program will be considered equivalent to SSPC-QP 3.

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. Proposed methods and equipment to be used for any paint application.

D. Proof of each of any required certifications, SSPC-QP 1, SSPC-QP 2, 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.
2. In lieu of certification in conformance with the requirements in SSPC-QP 3 for this project, the Contractor may submit written documentation showing conformance with the requirements in Section 3, " General Qualification Requirements," of SSPC-QP 3.

The Engineer shall have 10 working days 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.

It is expressly understood that the Engineer's review 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 Engineer's review shall not 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 review of the PQWP.

CLEANING

Exposed new metal surfaces shall be dry blast cleaned in conformance with the requirements in Surface Preparation Specification No. 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 40 µm nor more than 86 µm as measured in conformance with the requirements in ASTM Designation: D 4417.

Mineral and slag abrasives used for blast cleaning steel shall conform to the requirements in Abrasive Specification No. 1, "Mineral and Slag Abrasives," of the "SSPC: The Society for Protective Coatings" and shall not contain hazardous material. Mineral and slag abrasives shall comply with the requirements for Class A, Grade 2 to 3 as defined therein.

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.

The inside surfaces of bolt holes shall be cleaned in conformance with the requirements in Surface Preparation Specification No. 1, "Solvent Cleaning," of the "SSPC: The Society for Protective Coatings," and visible rust shall be removed.

PAINTING

Blast cleaned surfaces shall receive a single undercoat, where specified, consisting of a waterborne inorganic zinc coating conforming to the requirements in AASHTO Designation M 300, Type II, except that: 1) the first 3 sentences of Section 4.7, "Primer Field Performance Requirements," and the entire Section 4.7.1 shall not apply, and 2) zinc dust shall be Type II in conformance with the requirements in ASTM Designation: D 520. The inorganic zinc coating shall be listed on the qualified products list which may be obtained from the Transportation Laboratory.

The inside surfaces of bolt holes shall be painted with one application of a zinc rich primer (organic vehicle type) after the application of the undercoat of inorganic zinc on adjacent steel. The steel surfaces adjacent to the bolt holes shall be kept clean and protected from drippings during the application of the primer.

The color of the final application of inorganic zinc coating shall match Federal Standard 595B No. 36373.

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.

Inorganic zinc coating shall not be applied when the atmospheric or surface temperature is less than 7°C or more than 29°C, nor when the relative humidity exceeds 85 percent.

The single undercoat of inorganic zinc coating shall be applied to the required dry film thickness in 2 or more applications within 4 hours after blast cleaning.

The total dry film thickness of all applications of the inorganic zinc undercoat, including the surfaces of outside existing members within the grip under bolt heads, nuts and washers, shall be not less than 100 µm nor more than 200 µm, except that the total dry film thickness on each faying (contact) surface of high strength bolted connections shall be between 25 µm and the maximum allowable dry film thickness for Class B coatings as determined by certified testing in conformance with Appendix A of the "Specification for Structural Joints Using ASTM A325 or A490 Bolts" of the Research Council on Structural Connections (RCSC Specification). Unless otherwise stated, all inorganic zinc coatings used on faying surfaces

shall meet the slip coefficient requirements for a Class B coating on blast-cleaned steel, as specified in the RCSC Specification. The Contractor shall provide results of certified testing showing the maximum allowable dry film thickness for the Class B coating from the qualifying tests for the coating he has chosen, and shall maintain the coating thickness on actual faying surfaces of the structure at or below this maximum allowable coating thickness.

Areas where mudcracking occurs in the inorganic zinc coating shall be blast cleaned and repainted 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 inorganic zinc coating shall be tested for adhesion and cure. The locations of the tests will be determined by the Engineer. The sequence of the testing operations shall be determined by the Contractor. The testing for adhesion and cure 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 and to test the inorganic zinc coating cure. The inorganic zinc coating shall pass the following tests:

Adhesion

The inorganic zinc coating shall have a minimum adhesion to steel of 4 MPa when measured at no more than 6 locations per span on each girder using a self-aligning adhesion tester in conformance with the requirements in ASTM Designation: D 4541. The Contractor, at the Contractor's expense, shall: (1) verify compliance with the adhesion requirements, (2) furnish test results to the Engineer, and (3) repair the coating after testing.

Cure

The inorganic zinc coating, when properly cured, 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.

Except at bolted connections, the total dry film thickness of all applications of the single undercoat and final coat of inorganic zinc coating shall be not less than 125 µm nor more than 275 µm.

Finish coats will not be required.

10-1.72 ALTERNATIVE PIPE

Alternative pipe culverts shall conform to the provisions in Section 62, "Alternative Culverts," of the Standard Specifications and these special provisions.

SPIRAL RIB PIPE

Spiral rib pipe shall conform to the provisions in "Corrugated Metal Pipe" of these special provisions, except for profile and fabrication requirements.

Spiral rib pipe shall, at the option of the Contractor, consist of either (1) three rectangular ribs spaced midway between seams with ribs 19 m wide by 19 mm high at a maximum rib pitch of 191 mm, (2) two rectangular ribs and one half-circle rib equally spaced between seams with ribs 19 m wide by 25 mm high at a maximum rib pitch of 292 mm. The half-circle rib diameter shall be spaced midway between the rectangular ribs or (3) two rectangular ribs equally spaced between seams with ribs 19 mm wide by 25 mm high at a maximum rib pitch of 213 mm. Rib pitch measured at right angles to the direction of the ribs may vary ±13 mm.

Corrugated steel spiral rib pipe shall be fabricated by a continuous helical lock seam fabricated in conformance with the provisions in Section 66-3.03C(1), "Fabrication by Continuous Lock Seam," of the Standard Specifications.

Coupling bands for spiral rib pipe shall conform to the provisions in Section 66-1.07, "Coupling Bands," of the Standard Specifications. A coupling band shown on the plans or approved by the Engineer in conformance with the provisions in Section 61-1.02, "Performance Requirements for Culvert and Drainage Pipe Joints," of the Standard Specifications, for use on a pipe corrugation of 68 mm x 13 mm for corrugated metal pipe may be used on spiral rib pipe having 68 mm x 13 mm rerolled annular ends. The width of band (W) for hat bands for pipe sizes larger than 1200 mm in diameter shall be 95 mm.

Alternative pipe culverts specified with watertight joints shall be wrapped in filter fabric as shown on the plans. Filter fabric shall conform to the provisions for underdrains in Section 88-1.03, "Filter Fabric", of the Standard Specifications except, the ASTM Designation of D3776 for weight in the table in the first paragraph is amended to read ASTM Designation D5261.

Full compensation for furnishing and placing filter fabric around watertight joints shall be considered as included in the contract price paid per meter for alternative pipe culvert of the size shown in the Engineer's Estimate and no additional compensation will be allowed therefor.

Concrete backfill for alternative culverts shall be constructed in conformance with the provisions in Section 66-1.045, "Concrete Backfill," of the Standard Specifications and will be measured and paid for in conformance with the provisions in Section 66-4, "Measurement and Payment," of the Standard Specifications and the following:

A. The quantity of concrete backfill to be paid for, regardless of the kind of culvert and wall thickness of the culvert installed, will be based on the dimensions shown on the plans and the installation of corrugated steel pipe, except that when reinforced concrete pipe is designated as the only kind of culvert allowed for the installation of an alternative culvert, the quantity of concrete backfill to be paid for at that installation, regardless of the kind of culvert and wall thickness of the culvert installed, will be based on the dimensions shown on the plans and the installation of reinforced concrete pipe with the least wall thickness shown in AASHTO Designation: M 170M for the Class of pipe designated.

10-1.73 PLASTIC PIPE-INSERT

Plastic Pipe-insert shall be furnished and installed in existing culverts and at the locations shown on the plans and in accordance with the details shown on the plans and these special provisions.

Plastic pipe-insert shall be smooth interior wall type conforming to the provisions of Section 64, "Plastic Pipe," of the Standard Specifications.

In accordance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications, a Certificate of Compliance shall be furnished to the Engineer.

Plastic pipe-insert joints shall have watertight joints in conformance with Section 61, "Culvert and Drainage Pipe Joints," of the Standard Specifications.

The existing culvert shall be cleaned thoroughly prior to inserting the plastic pipe-insert. Earthy material, trash, cuttings and other waste materials removed from existing culverts shall be disposed of in accordance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications. During installation of the plastic pipe-insert, the Contractor shall provide all necessary protection to prevent damage to the plastic pipe-insert and the existing culvert.

The annular space between the plastic pipe-insert and the existing culvert shall be filled with grout for the entire length of the culvert. The grouting operation shall be initiated from the upstream end of the existing culvert once the plastic pipe-insert is in place.

The grout (low density foam concrete) shall be composed of water, Portland cement, sand, and a foaming agent. The foaming agent shall conform to the requirements of ASTM Designations: C 869 and C 796. Portland cement shall conform to the requirements of Section 90-2.01, "Portland Cement," of the Standard Specifications. Sand shall be clean and free from deleterious coatings, clay balls, roots and other extraneous material and be of such size that all will pass a 2.36-mm sieve.

The grout shall have a cast density, at the point of placement, of between 675 and 950 kg/m^3 and shall have a minimum compressive strength of 1400 kPa at 28 days. Compressive strength will be determined from test cylinders sampled, molded, cured, and tested in accordance with the provisions in Section 90-9, "Compressive Strength," of the Standard Specifications.

The water, cement, and sand shall be mixed prior to adding the foaming agent. The foaming agent shall not be added until the material is at the jobsite.

The Contractor shall determine the mix proportions of the grout.

Before using grout for which the mix proportions have been determined by the Contractor, the Contractor shall submit in writing to the Engineer a copy of the mix design for approval. Certified test data or trial batch reports, verifying the mix design and compressive strength requirements of these special provisions, shall be submitted with the mix design.

The Contractor shall develop and submit to the Engineer a grouting plan. The grouting plan shall address all aspects of the grouting procedure, including plans for diverting any existing stream flow. Grouting shall not begin until the grouting plan has been approved by the Engineer. The Contractor shall allow 2 days for review of the grouting plan.

Grouting pressure shall not exceed 35 kPa for plastic pipe-inserts.

Prior to grouting, the existing culvert shall be free from water and debris. Grouting shall not begin until the existing stream flow has been temporarily diverted. Grout shall be placed in a continuous manner. The Contractor's placement method shall prevent floating or shifting of the plastic pipe-insert and shall also prevent segregation or voids from occurring in the grout mix.

Where plastic pipe-insert is to be placed in embankment it shall be installed and conform to Section 64, "Plastic Pipe," of the Standard Specifications.

Plastic pipe-inserts shall be provided in 3 m section lengths. The length of plastic pipe-insert to be paid for will be the slope length designated by the Engineer. Pipe placed in excess of the length designated will not be paid for.

The contract price paid per meter for plastic pipe-insert of the size shown in the Engineers Estimate shall include full compensation for furnishing all labor, materials (including grout), tools, equipment, and incidentals, and for doing all the

work involved in installing plastic pipe-insert, complete in place, including grouting and submitting the grout mix design and grouting plan, diverting existing stream flow, cleaning of existing culverts and disposal of residue form cleaning, shoring, excavation and backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.74 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.

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 1.2 m 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.

When reinforced concrete pipe is installed in conformance with the details shown on Revised Standard Plan A62DA, the fifth paragraph of Section 19-3.04, "Water Control and Foundation Treatment," of the Standard Specifications shall not apply.

When solid rock or other unyielding material is encountered at the planned elevation of the bottom of the bedding, the material below the bottom of the bedding shall be removed to a depth of 1/50 of the height of the embankment over the top of the culvert, but not less than 150 mm nor more than 300 mm. The resulting trench below the bottom of the bedding shall be backfilled with structure backfill material in conformance with the provisions in Section 19-3.06, "Structure Backfill," of the Standard Specifications.

The excavation and backfill below the planned elevation of the bottom of the bedding will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

The Outer Bedding shown on Revised Standard Plan A62DA shall not be compacted prior to placement of the pipe.

10-1.75 CORRUGATED METAL PIPE

Corrugated steel pipe culverts shall conform to the provisions in Section 66, "Corrugated Metal Pipe," of the Standard Specifications.

10-1.76 ALTERNATIVE PIPE UNDERDRAIN

Alternative pipe underdrains shall conform to the provisions in Section 68-1, "Underdrains," of the Standard Specifications for the kind of alternative pipe underdrain installed.

Permeable material for alternative pipe underdrains shall be class 3 and shall conform to the provisions in "Permeable Material (Blanket)," elsewhere in these special provisions.

10-1.77 EDGE DRAIN

Edge drains shall conform to the provisions in Section 68-3, "Edge Drains," of the Standard Specifications and these special provisions.

Outlet and vent covers will not be required.

10-1.78 PERMEABLE MATERIAL (BLANKET)

Permeable material blanket shall be constructed in conformance with the details shown on the plans and these special provisions.

Permeable material for permeable material blanket shall be Class 3 and shall conform to the provisions in Section 68-1, "Underdrains," of the Standard Specifications, except for payment.

Class 3 permeable material shall conform to the following grading requirements:

Grading Requirements

Sieve Sizes	Percentage Passing
37.5-mm	100
25-mm	88-100
19-mm	52-85
9.5-mm	15-38
4.75-mm	0-16
2.36-mm	0-6

Class 3 permeable material shall have a Durability Index of not less than 40.

At least 90 percent by mass of Class 3 permeable material shall be crushed particles as determined by California Test 205.

Filter fabric for use with permeable material blanket shall conform to the provisions for filter fabric for underdrain trenches in Section 88, "Engineering Fabrics," of the Standard Specifications and the following:

A. The subgrade to receive the filter fabric, immediately prior to placing, shall conform to the compaction and elevation tolerance specified for the material involved.
B. Filter fabric shall be handled and placed in conformance with the manufacturer's recommendations.
C. The fabric shall be aligned and placed in a wrinkle-free manner.
D. Adjacent borders of the fabric shall be overlapped from 300 mm to 450 mm or stitched. The preceding roll shall overlap the following roll in the direction the material is being spread or shall be stitched. When the fabric is joined by stitching, the fabric shall be stitched with yarn of a contrasting color. The size and composition of the yarn shall be as recommended by the fabric manufacturer. The stitches shall number 5 to 7 per 25 mm of seam.
E. Within 24 hours after the filter fabric has been placed, the fabric shall be covered with the planned thickness of permeable material or aggregate subbase material as shown on the plans.
F. During spreading and compaction of the permeable material and aggregate subbase material, a minimum of 150 mm of the material shall be maintained between the fabric and the Contractor's equipment. Where embankment material is to be placed on the filter fabric, a minimum of 450 mm of embankment material shall be maintained between the fabric and the Contractor's equipment. Equipment or vehicles shall not be operated or driven directly on the filter fabric.

Permeable material (blanket) will be measured by the cubic meter. Quantities of permeable material to be paid for as permeable material (blanket) will be determined from the dimensions shown on the plans or such other dimensions as may be ordered in writing by the Engineer. Permeable material blanket constructed in excess of these dimensions will not be paid for.

The contract price paid per cubic meter for permeable material (blanket) shall include full compensation for furnishing all labor, materials (including filter fabric), tools, equipment, and incidentals, and for doing all the work involved in constructing a permeable material (blanket) 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.

10-1.79 HORIZONTAL DRAIN

Horizontal drains shall conform to the provisions in Section 68-2, "Horizontal Drains," of the Standard Specifications.

The horizontal drain collector system, as shown on the plans, shall be plastic pipe and shall conform to Section 64, "Plastic Pipe" of the Standard Specifications.

The contract price paid per meter for 150-mm plastic pipe (horizontal drain collector 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 the horizontal drain collector 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.

10-1.80 OVERSIDE DRAIN

Metal pipe downdrain anchor assemblies shall conform to the provisions in Section 69, "Overside Drains," of the Standard Specifications.

10-1.81 MISCELLANEOUS FACILITIES

Alternative flared end sections and bituminous coated corrugated steel pipe inlet shall conform to the provisions in Section 70, "Miscellaneous Facilities," of the Standard Specifications.

10-1.82 WELDED STEEL PIPE

Welded steel pipe shall conform to the provisions in Section 70, "Miscellaneous Facilities," of the Standard Specifications and these special provisions.

Coating and wrapping will not be required.

10-1.83 SLOPE PROTECTION

Slope protection shall be placed or constructed in conformance with the provisions in Section 72, "Slope Protection," of the Standard Specifications and these special provisions.

Rock slope protection fabric shall be woven or nonwoven type fabric, Type A or Type B, at the option of the Contractor.

10-1.84 MISCELLANEOUS CONCRETE CONSTRUCTION

Aprons and gutter depressions shall conform to the provisions in Section 73, "Concrete Curbs and Sidewalks," of the Standard Specifications.

10-1.85 MISCELLANEOUS IRON AND STEEL

Miscellaneous iron and steel shall conform to the provisions in Section 75, "Miscellaneous Metal," of the Standard Specifications.

10-1.86 MISCELLANEOUS METAL (BRIDGE)

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.

Attention is directed to "Welding Quality Control" of 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. Ladders and hardware.
B. Liners and hardware used for access opening thought bents, girders, hinges.
C. Steel plates and hardware used in connection concrete barriers.
D. Access doors, column vents and all associated hardware at bents.
E. Link beam plates.
F. Shear pins and welded studs, steel cap and extra strong pipe and hardware used in connection with bar restrainer (shear pins).
G. Aluminum plates and hardware used for the sensors blockouts, except no galvanization is required.
H. Jacking plates, welded studs and hardware.
I. Ramps and all associated metal and hardware at bridge hinges.
J. Steel plates at soffit access used in connection with high strength rods at bridge hinges.
K. Sleeve assembly and hardware at bridge hinges.
L. Anchorage assembles for the signs structures and light poles.
M. Bearing plaque.

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 207 MPa. 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 2500 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 (UV) exposure at 60°C, and then 4 hour of condensate exposure at 50°C. 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 38 mm.

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, which is: (1) enclosed in a box girder cell and exposed for a length not greater than 6 m within the cell, or (2) encased in concrete, 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.

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 2 m.

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.

Cast-in-place inserts shall be the ferrule loop type.

Metal parts of concrete anchorage devices shall be fabricated from stainless steel conforming to the requirements of ASTM Designation: A 276, Type 316.

10-1.87 MISCELLANEOUS METAL (RESTRAINER-PIPE TYPE)

Miscellaneous metal (restrainer-pipe type) shall consist of bridge joint pipe restrainers with double extra strong steel pipe and associated hardware as shown on the plans and in conformance with the provisions in Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications and in these special provisions.

The Contractor shall submit working drawings with the method of grouting the pipe restrainers in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

Double extra strong steel pipe shall conform to the requirements of ASTM Designation: A53, Grade B.

Pipe restrainers shall be bonded to the existing concrete by completely filling the entire void between the pipe restrainer and the cored hole with grout within the limits shown on the plans. Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. Filler material and seals shall be provided along the sides of the pipe to be grouted, to prevent grout from entering the bridge hinge joints. The filler material and seals shall not restrict joint movement.

Miscellaneous metal (restrainer-pipe type) will be measured and paid for by the kilogram in the same manner specified for miscellaneous metal (restrainer) in Sections 75-1.06, "Measurement," and 75-1.07, "Payment," of the Standard Specifications.

Full compensation for bonding pipe restrainers to existing concrete shall be considered as included in the contract price paid per kilogram for miscellaneous metal (restrainer-pipe type) and no additional compensation will be allowed therefor.

10-1.88 MISCELLANEOUS METAL (RESTRAINER-ROD TYPE)

Miscellaneous metal (restrainer-rod type) units consisting of high strength rods, bearing plates, couplers, anchorage devices, and incidentals shall conform to the details shown on the plans and the provisions in Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications and in these special provisions.

Rod assemblies shall conform to the materials and sampling provisions for prestressing steel in Section 50, "Prestressing Concrete," of the Standard Specifications and the following:

A. The high strength rods shall conform to the requirements of ASTM Designation: A 722, including all supplementary requirements.
B. All new metal surfaces of restrainer-rod type units 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 "Clean and Paint Structural Steel" of these special provisions.
C. Anchorage devices and couplers, conforming to the requirements specified herein, shall be of a type selected by the Contractor and shall include locking devices to prevent turning or loosening.
D. The anchorage device and coupler shall develop the specified minimum ultimate tensile strength of the steel rod.
E. The Contractor shall be responsible for determining the required lengths of the rod assemblies.
F. The rod assemblies shall be shipped as a complete unit including anchorage device and coupler.

Bearing plates shall conform to the requirements of ASTM Designation: A 36/A 36M.

New concrete adjacent to restrainers shall be placed prior to installing restrainers.

Miscellaneous metal (restrainer- rod type) will be measured and paid for by the kilogram in the same manner specified for miscellaneous metal (restrainer) in Sections 75-1.06, "Measurement," and 75-1.07, "Payment," of the Standard Specifications.

Certification in conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for restrainer- rod type units.

Full compensation for cleaning and painting of rod type restrainer units shall be considered as included in the contract price paid per kilogram for miscellaneous metal (restrainer- rod type) and no additional compensation will be allowed therefor.

10-1.89 CHAIN LINK FENCE

Chain link fence shall be Type CL-0.9, vinyl-clad and CL-1.8 and shall conform to the provisions in Section 80, "Fences," of the Standard Specifications and these special provisions.

Vinyl-clad chain link fence shall conform to the following:

1. Chain link fabric shall be vinyl coated in accordance with the provisions in Section 83-1.02I, "Chain Link Railing," of the Standard Specifications. The color shall be black.
2. Tension wires, tie wires, and post clips shall be vinyl coated as specified for fabric. The color shall be black.
3. Posts, braces, fittings and appurtenances shall be vinyl coated. The color shall be black.
4. Where necessary to conform to curvature, either horizontal or vertical, the fabric shall be reworked and fitted so as to present a smooth, neat, and workmanlike appearance.

10-1.90 MARKERS AND DELINEATORS

Delineators shall conform to the provisions in Section 82, "Markers and Delineators," of the Standard Specifications and these special provisions.

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.

10-1.91 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 and blocks shall be wood.

Delete the ninth and eleventh paragraphs in Section 83-1.02B, "Metal Beam Guard Railing," of the Standard Specifications.

The grades and species of wood posts and blocks shall be No. 1 timbers (also known as No. 1 structural) Douglas fir or No. 1 timbers Southern yellow pine. Wood posts and blocks shall be graded in conformance with the provisions in Section 57-2, "Structural Timber," of the Standard Specifications, except allowances for shrinkage after mill cutting shall in no case exceed 5 percent of the American Lumber Standards minimum sizes, at the time of installation.

Wood posts and blocks 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 with creosote, creosote coal tar solution, creosote petroleum solution (50-50), pentachlorophenol in hydrocarbon solvent, copper naphthenate, ammoniacal copper arsenate, or ammoniacal copper zinc arsenate. In addition to the preservatives listed above, Southern yellow pine may also be pressure treated with chromated copper arsenate. When other than one of the creosote processes is used, blocks shall have a minimum retention of 6.4 Kg/m^3, and need not be incised.

Metal beam guard railing elements and required backup plates, terminal sections, end sections, and return sections shall conform to the requirements of Type 2 W-Beam as shown in AASHTO Designation: M 180.

Guard railing delineators shall be as specified in "Prequalified and Tested Signing and Delineation Materials," elsewhere in these special provisions. They shall be installed on the guard railing in accordance with the manufacturer's recommendations.

Quantities of guard railing delineator to be paid for will be determined as units from actual count in place.

The contract unit price paid for guard railing delineator shall include full compensation for furnishing all labor, materials (including the materials for attaching the guard railing delineator), tools, equipment, and incidentals, and for doing all the

work involved in furnishing and installing the guard railing delineator complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

TERMINAL SYSTEM (TYPE SRT)

Terminal system (Type SRT) shall be furnished and installed as shown on the plans and in conformance with these special provisions.

Terminal system (Type SRT) shall be a SRT-350 Slotted Rail Terminal (8 post system) as manufactured by Trinity Industries, Inc., and shall include all the items detailed for terminal system (Type SRT) shown on the plans.

The 5 mm x 44 mm x 75 mm plate washer shown on the elevation view and in Section D-D at Wood Post No. 1 shall be omitted.

Arrangements have been made to insure that any successful bidder can obtain the SRT-350 Slotted Rail Terminal (8 post system) from the manufacturer, Trinity Industries, Inc., P.O. Box 99, 950 West 400S, Centerville, UT 84014, Telephone 1-800-772-7976. The price quoted by the manufacturer for the SRT-350 Slotted Rail Terminal (8 post system), FOB Centerville, Utah is $845.00, not including sales tax.

The above price will be firm for orders placed on or before July 31,2002, provided delivery is accepted within 90 days after the order is placed.

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 terminal systems (Type SRT) 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.

The terminal system (Type SRT) shall be installed in conformance with the manufacturer's installation instructions and these requirements. 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 100 mm thick and each layer shall be moistened and thoroughly compacted. Wood terminal 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 65°C or less. The edges of the wood terminal posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

Surplus excavated material remaining after the terminal system (Type SRT) has been constructed shall be disposed of in a uniform manner along the adjacent roadway where designated by the Engineer.

10-1.92 CHAIN LINK RAILING

Chain link railing shall conform to the provisions in Section 83-l, "Railings," of the Standard Specifications and these special provisions.

The chain link fabric shall be 9-gage (3.76 mm), 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.

10-1.93 CABLE RAILING

Cable railing shall conform to the provisions in Section 83-1, "Railings," of the Standard Specifications.

10-1.94 CONCRETE BARRIER

Concrete barriers shall conform to the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

The provisions of the third paragraph in Section 83-2.02D(4), "Finishing," of the Standard Specifications shall not apply.

Concrete barrier markers shall conform to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. At those locations shown on the plans, concrete barrier markers shall be cemented to the barrier in conformance with the manufacturer's recommendations.

Quantities of concrete barrier marker to be paid for will be determined as units from actual count in place.

The contract unit price paid for concrete barrier marker shall include full compensation for furnishing all labor, materials (including the materials for cementing the concrete barrier marker), tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing the concrete barrier marker complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

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.

Type 25A concrete barriers will be measured and paid for as concrete barrier (Type 25).

10-1.95 CONCRETE BARRIER (TYPE K)

Concrete barrier (Type K) shall conform to the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

Concrete barrier (Type K) shall consist of precast units conforming to the provisions for temporary railing (Type K) in Section 12-3.08, "Temporary Railing (Type K)," of the Standard Specifications, except that removable panels shall not be used and the concrete barrier (Type K) shall remain in place at the completion of the contract.

Temporary railing (Type K) reflectors on concrete barrier (Type K) shall conform to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Full compensation for furnishing and installing temporary railing (Type K) reflectors on concrete barrier (Type K) shall be considered as included in the contract price paid per meter for concrete barrier (Type K) and no additional compensation will be allowed therefor.

10-1.96 THRIE BEAM BARRIER

Thrie beam barrier shall conform to the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

Attention is directed to "Order of Work" of these special provisions.

Rail elements and required backup plates, terminal sections, terminal connectors, and return sections shall conform to the requirements of Type 2 Thrie Beam in AASHTO Designation: M 180.

10-1.97 CRASH CUSHION, SAND FILLED

Sand filled crash cushions shall be furnished and installed as shown on the plans and in conformance with these special provisions.

A sand filled crash cushion shall consist of a grouping of sand filled modules.

Crash cushions shall be installed at the following locations:

TNB 16+70.
SB 20+18.
TNB 20+40.
ES 7+88.5.
ES 8+11.
TNW 16+40.
NW 15+34

At the Contractor's option, modules for use in sand filled crash cushions shall be either Energite III Inertial Modules, Fitch Inertial Modules or TrafFix Sand Barrels manufactured after March 31, 1997, or equal:

A. Energite III and Fitch Inertial Modules, manufactured by Energy Absorption Systems, Inc., One East Wacker Drive, Chicago, IL 60601-2076. Telephone 1-312-467-6750, FAX 1-800-770-6755

   1. Distributor (North): Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828. Telephone 1-800-884-8274, FAX 1-916-387-9734
   2. Distributor (South): Traffic Control Service, Inc., 1881 Betmor Lane, Anaheim, CA 92805. Telephone 1-800-222-8274, FAX 1-714-937-1070

B. TrafFix Sand Barrels, manufactured by TrafFix Devices, Inc., 220 Calle Pintoresco, San Clemente, CA 92672. Telephone 1-949 361-5663, FAX 1-949 361-9205

   1. Distributor (North): United Rentals, Inc., 1533 Berger Drive, San Jose, CA 95112. Telephone 1-408 287-4303, FAX 1-408 287-1929
   2. Distributor (North): Statewide Safety & Sign, Inc., P.O. Box 1440, Pismo Beach, CA 93448. Telephone 1-800-559-7080, FAX 1-805 929-5786

Modules contained in the 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 exterior components of the modules shall be formulated or processed to resist deterioration from ambient ultraviolet rays. The modules shall exhibit good workmanship free from structural flaws and objectionable surface defects.

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 crash cushions comply with the contract plans and specifications, conform to the prequalified design and material requirements, and were manufactured in conformance with the approved quality control program.

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 placed on bridge decks shall be provided with positioning blocks fastened to the deck surface. Positioning blocks shall be shaped as segments of a ring and placed along the inner or outer periphery of the module wall. A minimum of 2 blocks, a minimum of one-sixth of a ring in length shall be provided for each module. Positioning blocks and fasteners shall be of a material that is corrosion and water resistant.

Module cylinders shall be filled with sand in conformance with the manufacturer's directions and to the sand capacity in kilograms for each module shown on the plans.

Lids shall be securely attached as recommended by the manufacturer.

A Type R or Type 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 3.6 m 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 approved by the Engineer.

Sand filled crash cushions, regardless of the number of modules required in each sand filled crash cushion, will be measured and paid for by the unit as crash cushion, sand filled. The quantity to be paid for will be determined from actual count of the units in place in the completed work.

The contract unit price paid for crash cushion, sand filled shall include full compensation for furnishing all labor, materials (including sand and marker panels), tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing crash cushions, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.98 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.

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 material shall conform to the requirements in State Specification 8010-19A.

Thermoplastic material for traffic stripes shall be applied at a minimum thickness of 2.0 mm.

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 meter as thermoplastic traffic stripe and by the square meter as thermoplastic pavement marking.

10-1.99 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.

Retroreflective pavement markers shall comply with the specific intensity provisions for reflectance after abrading the lens surface in conformance with the "Steel Wool Abrasion Procedure" specified for pavement markers placed in pavement recesses in Section 85-1.05, "Retroreflective Pavement Markers," of the Standard Specifications.

SECTION 10-2. (BLANK)

SECTION 10-3. SIGNALS, LIGHTING AND ELECTRICAL SYSTEMS

10-3.01 DESCRIPTION

Traffic operations system, call box system, lighting, sign illumination, traffic operations system hub, communication conduit, electrical facilities, pier stairway lighting, marine navagational aids system, cable tray layout, substations (at Pier 3, toll plaza and north approach), interconnection between Pier 3 and new toll plaza and supervisory control and data acquisition (SCADA) system shall conform to the provisions in Section 86, "Signals, Lighting and Electrical Systems," of the Standard Specifications and these special provisions.

Lighting equipment is included in the following structures:

A. Benicia-Martinez Bridge No. 28-153R.
B. Benicia-Martinez Approach Structure Bridge No. 28-215R.
C. NB 680 / WB 780 Connector and Overhead No. 23-212G.
D. EB 780 / NB 680 Connector Bridge No. 23-211G.

Communication conduit is included in the following structures:

A. NB 680 / WB 780 Connector & OH, bridge number 23-0212G.
B. Benicia – Martinez Approach Structure, bridge number 23-0215R.

Work to be done in traffic operations system, as a minimum, shall consist of:

1. Camera stations
2. Traffic monitoring stations
3. Ramp metering system
4. Extinguishable message sign (EMS) system
5. Microwave vehicle detection sensor (MVDS) system
6. Fiber optic system

Work to be done in call box system, as a minimum, shall consist of:

1. Installation of Metropolitan Transportation Commission call boxes.
2. Associated pull boxes, conduits and conductors.

Work to be done in Traffic Operations System Hub, as a minimum, shall consist of:

1. Hub communication system.
2. Fiber communication cable system.

Work to be done in electrical facilities, as a minimum, shall consist of:

1. Insert (concrete anchor) and associated hardware.
2. Conduits, junction boxes, and associated fittings and hardware.

Work to be done in pier stairway lighting, as a minimum, shall consist of:

1. Conduits, conductors, lighting fixtures, transformer, GFCI receptacles, and associated hardware.

Work to be done in marine navigational aids system, as a minimum, shall consist of:

1. Marine navigational aids system, conduits, conductors and associated hardware.
2. Fog horn, fog detection system, conduits, conductors and associated hardware.
3. Radar beacon system, conduits, conductors, and associated hardware.

Work to be done in substations (at Pier 3, new toll plaza and north approach), as a minimum, shall consist of:

1. 15 kV switchgear, transformer, low voltage, circuit breakers.
2. Conduits, cable tray, conductors, and associated hardware.

Work to be done in cable tray layout, as a minimum, shall consist of:

1. Conductors and associated hardware.

Work to be done in interconnection between pier 3 and new toll plaza, as a minimum, shall consist of:

1. Conduits, cable tray, conductors, and associated hardware.

Work to be done in supervisory control and data acquisition (SCADA) system, as a minimum, shall consist of:

1. Programmable logic control (PLC)
2. Communication cabinets, conduits and conductors
3. PLC Cabinets
4. SCADA Cabinet
5. Computers and monitors associated hardware
6. Software

10-3.02 ABBREVIATIONS AND GLOSSARY

The following abbreviations are added to those listed in Section 1-1.02, "Abbreviations," of the Standard Specifications:

BNC	Bayonet Nut Connector
CCD	Charge Coupled Device
CCITT	International Telegraph and Telephone Consultative Committee
CE Mark	European proof of conformity to standards, "CE" is French for "Conformite Europeenne"
CPU	Central Processing Unit
CSA	Canadian Standards Association
C-UL	Canadian Underwriters Laboratories
DLCI	Data Link Control Identifier
DMA	Direct Memory Access
EEMAC	Electrical Equipment Manufactures Advisory Council
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMI/RFI	Electromagnetic Interference/Radio Frequency Interference
ESO	Electrical Safety Orders of the Division of Industrial Relations, State of California
FCC	Federal Communications Commission
GFCI	Ground Fault Current Interrupter
THD	Total Harmonic Distortion
I/O	Input / Output
IACK	Interrupt Acknowledge
ICEA	Insulated Cable Engineering Association
IDC	Insulation Displacement Connector
IEC	International Electrotechnical Commission
I/O	Input and Output
IP-##	Ingress Protection (IP) Rating
IPCEA	Insulated Power Cable Engineering Association
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
JEDEC	Joint Electron Device Engineering Council
JIC	Joint Industry Conference
JIS	Japanses Industrial Standard
kV	kilovolt
NC	Normally Closed
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association Inc.
NFPA	National Fire Protection Association
NO	Normally Open
NTSC	National Television System Committee
OSHA	Occupational Safety and Health Administration
OSI	Open Systems Interconnect
PVC	Polyvinyl Chloride
REA	Rural Electrification Administration
RTD	Resistance Temperature Detector
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition
SCSI	Small Computer Systems Interface
SDLC	Serial Data Link Control
TELCO	Telephone company
TIA	Telecommunications Industry Association
TELCO	Telephone company
VME	Versa Module Eurocard

10-3.03 CODES AND STANDARDS

All work performed and material installed or furnished on this contract shall conform to Section 86-1.02 "Regulations and Code" and the following codes and standards subject to the modifications and additional requirements in these special provisions:

1. California Administrative Code, Title 24, Part 3, "Basic Electrical Regulations."
2. National Fire Protection Association standards.
3. Rural Electrification Administration standard, "Fully Color-Coded, Polyethylene-Insulated, Polyethlene-Jacketed Telephone Cable," shall apply to telephone communication conductors and cables.
4. Insulated Power Cable Engineering Association No. A-61-402, NEMA WC-5, "Thermoplastic-Insulated Wire and Cable For The Transmission and Distribution of Electrical Energy," shall apply to high voltage cable and 600 V class conductors.

10-3.04 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 45 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 breakdown shall include the following items in addition to those listed in the Standard Specifications:

1. Cables - each type.

2. The cost breakdown for electrical facilities described, in part, as "Girder Conduit Layout" and "Conductor Layout," at various locations, as a minimum, shall consist of the following:

A. Junction boxes - each type.
B. Channel struts.
C. Conduit and conduitlet - each type.
D. Conduit expansion joint - each type.

3. The cost breakdown for electrical facilities described, in part, as "Girder Lighting and Receptacle Layout," "Bent Lighting and Receptacle Layout," and "Pier Stairway Lighting," at various locations, as a minimum, shall consist of the following:

A. Lighting fixture and receptacle.
B. Conduit and conduitlet - each type.

4. The cost breakdown for marine navigational aids system, as minimum, shall consist of the following:

A. Lantern - each type.
B. Flashing beacon - each.
C. Flashing beacon control transmitter.
D. Fog horn.

5. The cost breakdown for the three substations (North Approach, Pier 3, and New Toll Plaza), as minimum, shall consist of the following:

A. 15 kV cable.
B. 15 kV metal clad switchgear.
C. Transformer - each type.
D. Low voltage control center - each type.
E. Molded case circuit breaker switchboard - each type.
F. 600 V(ac) switchboard - each type.

6. The cost breakdown for the supervisory control and data acquisition system, as minimum, shall consist of the following:

A. Programmable logic control (PLC).
B. Cabinet - each type.
C. Computers and monitors - each type.
D. Software.

10-3.05 FOUNDATIONS

Sleeve nuts shall be used on Type 1-B standard. Foundations for Type 1-B standards shall conform to the details on Standard Plan ES-7B, "Anchor Bolts With Sleeve Nuts", except that the bottom of the base plate shall be flush with the finished grade.

10-3.06 CONDUIT

Conduit to be installed underground shall be Type 1 or Type 3 unless otherwise specified. The conduit in a foundation and between a foundation and the nearest pull box shall be Type 1.

Conduit sizes shown on the plans and specified in the Standard Specifications and these special provisions are referenced to metallic type conduit. When rigid non-metallic conduit is required or allowed, the nominal equivalent industry size shall be used as shown in the following table:

Size Designation for Metallic Type Conduit	Equivalent Size for Rigid Non-metallic Conduit
21	20
27	25
41	40
53	50
63	65
78	75
103	100

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 with commercial quality concrete, containing not less than 250 kg of portland cement per cubic meter, to not less than 100 mm above the conduit before additional backfill material is placed.

Conduit runs shown on the plans to be located behind curbs may be installed in the street, within 0.9-m 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.

Pull ropes for use when installing cables in conduit shall consist of flat, woven, lubricated, soft-fiber polyester tape with a minimum tensile strength of 8000 N and shall have printed sequential measurement markings at least every meter.

After conductors have been installed, the ends of conduits terminating in pull boxes, 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 existing underground facilities require special precautions in conformance with the provisions in "Obstructions" of these special provisions, 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 0.6-m of conduit entering a pull box in a reinforced concrete structure may be Type 4.

Warning Tape.—Warning tape shall be provided and placed in the trench over conduits containing fiber optic cable as shown on the plans. The warning tape shall be 102 mm wide with bold printed black letters of approximately 19 mm on bright orange color background, and contain the printed warning "CAUTION BURIED FIBER OPTIC CABLE - CALTRANS (510) 286-6142", repeated at approximately 800 mm intervals.

The printed warning shall be non-erasable and shall be rated to last with the tape for a minimum of 40 years.

The construction of the warning tape shall be such that it will not delaminate when it is wet. It shall be resistant to insects, acid, alkaline and other corrosive elements in the soil. It shall have a minimum of 712 N tensile strength per 150 mm wide strip and shall have a minimum of 700 percent elongation before breakage.

Warning tape shall be from Condux International, Inc.; Allen System, Inc.; or equal.

Colored Concrete Backfill.—The concrete backfill for the installation of conduits that will contain fiber optic cable shall be a medium to dark, red color to clearly distinguish the concrete backfill from other concrete and soil. The concrete shall be pigmented by the addition of commercial quality cement pigment to the concrete mix. The red concrete pigment shall be LM Scofield Company; Orange Chromix Colorant; Davis Colors; or equal. The concrete shall conform to the provisions in said Section 90-10, "Minor Concrete."

For trenches in pavement areas, only the top 102 mm of concrete backfill will be required to be pigmented concrete. At the option of the Contractor, the full depth may have the pigment.

Conduit Markers.—Conduit markers shall be provided at 30 m spacings in places where fiber optic conduit is placed in non paved areas. These markers shall conform to Standard Plan A73C, Class 1, Type F, flexible post delineators, except that the marker shall be non reflective. The following text shall be written on each marker: "CAUTION BURIED FIBER OPTIC CABLE."

Conduit Sealing Plugs.—Except otherwise noted, all conduits shall have their ends sealed with commercial preformed plugs which prevent the passage of gas, dust and water into these conduits. Sealing plugs shall be installed within each splice cabinet, No. 6 (T) pull box and cabinet.

Sealing plugs shall be removable and reusable. Plugs sealing conduit, conductor or cable shall be the split type that permits installation or removal without removing conductors or cables.

Sealing plugs that seal the Size 78C fiber optic conduit shall seal the conduit simultaneously with one self contained assembly having an adjustable resilient filler of neoprene or silicone rubber clamped between backing ends and compressed with stainless steel hardware.

To provide suitable sealing between the varying size cables and the plugs, split neoprene or silicone adapting sleeves, used singularly or in multiples, shall be inserted within the body of the plugs.

Sealing plugs used to seal Size 78C fiber optic conduit shall be capable of withstanding a pressure of 34.5 kPa.

A sealing plug that seals an empty conduit shall have an eye or other type of capturing device (on the side of the plug that enters the conduit) to attach onto the pull rope, so the pull rope will be easily accessible when the plug is removed.

Payment.—Full compensation for furnishing and installing the warning tape, colored concrete backfill, conduit markers, conduit sealing plugs shall be considered as included in the contract price paid for the conduit involved and no additional compensation will be allowed therefor.

GALVANIZED RIGID STEEL CONDUIT, THREADED COUPLINGS, AND ELBOWS

The galvanized rigid steel (GRS) conduit, threaded couplings, and elbows shall conform to Section 86-2.05, "Conduit," of the Standard Specifications for Type 1 where shown on the plans.

POLYVINYL CHLORIDE COATED GALVANIZED RIGID STEEL CONDUIT, THREADED COUPLINGS, AND ELBOWS

The polyvinyl chloride (PVC) coated galvanized rigid steel (GRS) conduit, threaded couplings, and elbows shall conform to “Galvanized Rigid Steel Conduit, Threaded Couplings, and Elbows” as specified elsewhere in these special provisions shall conform to Section 86-2.05, "Conduit," of the Standard Specifications for Type 2 where shown on the plans.

POLYVINYL CHLORIDE COATED GALVANIZED RIGID STEEL CONDUIT BODIES

The polyvinyl chloride (PVC) coated galvanized rigid steel (GRS) conduit bodies shall conform to the following requirements before the PVC coating is applied:

a. The PVC-coated GRS conduit bodies shall conform to Federal Specification W-C-586D, and UL Standard No. 514B. The PVC-coated GRS conduit bodies zinc surfaces shall remain intact and undistributed on both the inside and outside throughout the preparation and application processing.
b. The PVC-coated GRS conduit bodies shall be "Hot Dipped" galvanized inside and out after fabrication with "Hot Dipped" galvanized threads. The zinc coating for PVC-coated GRS conduit bodies will be tested in accordance with ASTM Designation: A239.
c. The "Hot Dipped" galvanized threads, the exterior, and the interior for the PVC-coated GRS conduit bodies shall have a urethane coated of a nominal thickness of 50 microns.

d. The PVC-coated GRS conduit bodies shall conform to the following requirements when the PVC coating is applied:

(1). All PVC-coated GRS conduit bodies shall conform to NEMA Standard No. RN-1.
(2). The bond between the coatings and the metal shall be greater than the tensile strength of the coatings.
(3). All PVC-coated GRS conduit bodies shall have an exterior PVC coating of a minimum thickness of 1 mm applied by dipping in liquid plastisol.
(4). All Hubs on PVC-coated GRS conduit bodies shall have a PVC sleeve extending one pipe diameter or 53 mm whichever is less. The inside diameter (I.D.) of the sleeve to be equal to the outside diameter (O.D.) of the uncoated pipe.
(5). Stainless steel encapsulated screws shall be supplied with all form 7 and form 8 PVC-coated GRS conduit bodies.
(6). The PVC coating on all form 8 PVC-coated GRS conduit bodies shall form a gasket-like flange of at least 8 mm wide and 1 mm thick covering the top of the conduit body around the opening.
(7). The PVC coating on all form 8 conduit body covers shall form a gasket-like flange of at least 8 mm wide and 1 mm thick covering at the bottom of the cover and mating with the flange of the conduit body.
(8). All PVC-coated GRS conduit bodies for conduits less than 103 mm shall be form 7 conduit bodies.

10-3.07 PULL BOXES

Grout shall not be placed in the bottom of pull boxes.

TYPE 15 PULL BOXES

Type 15 pull boxes and extensions shall conform to the Western Underground Committee Recommended Guide No. 3.6, "Non-Concrete Enclosures." Type 15 pull boxes shall be 1200 mm (L), 750 mm (W) and 460 mm (D) (nominal inside dimensions). Each pull box shall have one 400 mm extension. Hold down bolts or cap screws and nuts shall be of brass, stainless steel or other non-corroding metal material. Cover markings shall be "LOW VOLTAGE." Enclosures, covers and extensions shall be concrete gray color.

Type 15 pull boxes shall be installed where shown on the plans for communication system.

HIGH VOLTAGE PULL BOXES

The high voltage pull boxes shall be 1524 mm (L), 914 mm (W), and 406 mm (D) (nominal inside dimensions) and conform to Wester Underground Committee Recommended Guide No. 3.6 "Non Concrete Enclosures." Covers for high voltage pull boxes shall be in two sections. Each cover shall be secured with at least four 9-mm stainless steel bolts. Cover markings for high voltage pull boxes should be marked on each cover section. Enclosures and covers shall be concrete gray color. Enclosures may be constructed of reinforced portland cement concrete or any equivalent material which meet the specified load rating. High voltage pull boxes shall be installed as shown on the plans. Enclosures and covers shall have an AASHTO HS 20-44 rating.

10-3.08 JUNCTION AND OUTLET BOXES

NEMA TYPE 4X CONTINUOUS HINGE JUNCTION BOX

NEMA Type 4X continuous hinge junction box shall conform to the following:

a. Junction boxes shall be constructed from Type 5052 H-32 aluminum minimum 2 mm thick.
b. Junction boxes seams shall be continuously welded and grounded smooth, no holes or knockouts.
c. Door and body stiffeners shall be provided in larger enclosure.
d. Rolled lip around three sides of door and all sides of enclosure opening shall exclude liquids and contaminants.
e. Stainless steel door clamp assembly shall assure watertight seal.
f. Door shall be easily removed by pulling stainless steel continuous hinge pin.
g. Data pocket shall be high impact thermoplastic.
h. Hasp and staple for padlocking shall be provided.
i. Panel screws shall be stainless steel.
j. Tapped pads shall be provided for mounting optional panels.
k. Oil-resistant gasket and adhesive shall be used.

NEMA TYPE 4X SCREW COVER JUNCTION BOX

NEMA Type 4X screw junction box shall conform to the following:

a. Junction boxes shall be constructed from cast aluminum with no welded seams or sharp corners.
b. Captivated cover screws shall be stainless steel.
c. Cover screws shall be placed outside sealed area.
d. Two to four grounding screws shall be located on the enclosure backwall.
e. Oil-resistant and O-ring gasket shall have tongue and groove construction.
f. Threaded internal bosses shall be provided for mounting optional panels, rails and other components.
g. Mounting holes shall be provided in corners outside of gasketed area.
h. Finish shall be ANSI 61 (RAL 7042) gray paint inside and out.
i. Panel shall be unpainted zinc-plated steel.

NEMA TYPE 12 SINGLE DOOR JUNCTION BOX

The NEMA Type 12 single door junction box shall conform to the following:

a. Enclosure bodies shall be either 14 gage or 16 gage steel. All doors shall be 14 gage steel.
b. Enclosure seams shall be continuously welded and grounded smooth, no holes or knockouts.
c. Enclosure shall have external mounting feet.
d. Enclosure shall have door and body stiffeners in larger enclosure.
e. Rolled lip around three sides of door and all sides of enclosure opening shall exclude liquids and contaminants.
f. Door clamps shall be quick and easy to operate.
g. Door shall be removed by pulling heavy gage continuous hinge pin.
h. Hasp and staple for padlocking.
i. Data pocket shall be high-impact thermoplastic.
j. Oil-resistant gasket shall be attached with oil-resistant adhesive and shall be held in place with steel retaining strips.
k. Collar studs shall be provided for mounting panels.
l. The finish shall be white inside with ANSI 61 gray outside finish over phosphatized surfaces. Optional panels shall be white.
m. The following Industry Standards shall apply:

   UL 508 Type 12
   NEMA/EEMAC Type 12
   JIC Standard EGP-1-1967 (14 gage only)
   CSA Type 12
   IEC 529, IP65

NEMA TYPE 12 CONTINUOUS HINGE JUNCTION BOX

The NEMA Type 12 continuous hinge junction box shall conform to the following:

a. Enclosure bodies shall be either 14 gage or 16 gage steel.
b. Continuous hinge shall be used.
c. External screw clamps shall be quick and easy to operate
d. Enclosure seams shall be continuously welded and grounded smooth, no holes or knockouts.
e. Enclosure shall have external mounting feet.
f. Welded nuts shall be provided for mounting optional panels and terminal kits in Size 152 mm x 102 mm or larger.
g. Oil-resistant gasket and adhesive.
h. The finish shall be ANSI 61 gray polyester powder coating inside and outside finish over phosphatized surfaces. Optional panels shall be white.
i. The following Industry Standards shall apply:

   UL 508 Type 12
   NEMA/EEMAC Type 12
   JIC Standard EGP-1-1967 (14 gage only)
   CSA Type 12
   IEC 529, IP65

10-3.09 CABLE TRAYS

Cable trays shall be made of high strength steel wires, ASTM A510, and shall be coated by a hot-dipped galvanizing process after fabrication in accordance with ASTM A123. Cable trays shall be designed to support the volume capacity of the cables and shall provide safe mechanical support for spans up to 2.4 meters on center.

Cable trays for Industry Standards shall conform to the following: NEMA VE1, IEC 61537, UL Classification.

10-3.10 CHANNEL STRUTS AND FITTINGS

Channel struts shall support all conduits, boxes, and cable trays. At every 1.2 m interval in both side walls of girder box, a vertical piece of channel strut with minimum depth of 100 mm shall be installed. The channels shall be fixed on the wall by use of embedded anchor and bolted as shown on the plans. Conduits and cable trays shall be secured on the vertical supports by using horizontal channels with a minimum depth of 41 mm.

All channel struts and fittings shall be made of hot-dipped galvanized steel and conform to provisions in Section 75-1.03, “Miscellaneous Bridge Metal.”

10-3.11 CONDUCTORS, CABLES AND WIRING

Splices shall be insulated by "Method B".

The minimum insulation thickness, at any point, for Type USE, RHH or RHW wire shall be 1.0 mm for conductor sizes No. 14 to No. 10, inclusive, and 1.3 mm for No. 8 to No. 2, inclusive. The minimum insulation thickness, at any point, for Type THW and TW wires shall be 0.69 mm for conductor sizes No. 14 to No. 10, inclusive, 1.02 mm for No. 8, and 1.37 mm for No. 6 to No. 2, inclusive.

CLOSED CIRCUIT TELEVISION CABLES AND CONDUCTORS

Television control cable.—Television control (TVC) cable shall consist of 15 No. 18 conductors, unshielded and with an outer jacket. Each conductor shall have a minimum of 16 tinned copper stands with a minimum of 400 µm insulation. Individual conductor insulation shall be chrome PVC with a nominal thickness of 1 mm. The outside diameter of the jacket shall not exceed 14 mm.

Color code for TVC cable shall be:

1. Black
2. White
3. Red
4. Green
5. Orange
6. Blue
7. White/ Black
8. Red/ Black
9. Green/ Black
10. Orange/ Black
11. Blue/ Black
12. Black/ White
13. Red/ White
14. Green/ White
15. Blue/ White

Television power conductors.—Television power (TVP) conductors shall be 3 No. 14 (120 V(ac), AC-, equipment ground) individually insulated, stranded copper conductors in conformance with Section 86-2.08, "Conductors" of the Standard Specifications. The conductors shall be color coded black, white, and green respectively.

Television control power cable.—Television control power (TVCP) cable shall consist of 12 No. 18 conductors, unshielded and with an outer jacket. Each conductor shall have a minimum of 16 tinned copper strands with a minimum of 400 µm insulation. Individual conductor insulation shall be polyvinyl chloride (PVC), rated for 300 V (see color code below). The jacket shall be chrome PVC with a nominal thickness of 1 mm. The outside diameter of the jacket shall not exceed 12 mm.

Color code for TVCP cable shall be:

1. Black
2. White

3. Red
4. Green
5. Orange
6. Blue
7. White/ Black
8. Red/ Black
9. Green/ Black
10. Orange/ Black
11. Blue/ Black
12. Black/ White

Television video cable.—Television video (TVL) cable shall consist of an RG-6/U coaxial cable. Each cable shall be provided with a solid No. 18 copper clad steel center conductor and shall conform to the following requirements:

Electrical	TVL
Capacitance (picofarads/m nominal)	54.1
Impedance (ohms-nominal)	75
Velocity of propagation (nominal)	84%
D.C. loop resistance (ohms/100 m)	11.7

Attenuation at 20˚C:

Frequency (MHz)	TVL (Nominal dB/ 100 m)
5.0	1.90
30	3.64
108	6.40

Physical Specifications	TVL Nominal O.D. (mm)
Copper-clad steel center conductor	1.00
Foam polyethylene dielectric	4.57
Sealed APA tape with 1.6 mm overlap	4.75
Woven aluminum braid	5.39
Sealed APA tape with 1.6 mm overlap	5.49
Woven aluminum braid	6.12
Flooding compound	
PVC outer jacket	7.55

(APA = Aluminum polyolefin and aluminum with adhesive)

TVL cable shall be terminated with BNC plug connector at both ends.

Coaxial Cable Connectors for TVL Coaxial Cables.—Coaxial cable connectors for attaching Type TVL coaxial cable shall meet the following requirements:

1. Electrical:

Impedance	75 Ω nominal
Return loss	30 dB minimum (5 MHz to 300 MHz)
Rated working voltage	500 V rms

2. Mechanical:

Type of construction	Integral sleeve BNC
Method of attachment	Crimp-crimp
Composition	Bodies - alloy Finish - chromate conversion, silver plating, or other corrosion resistant metal

3. Environmental:

Temperature	-10˚C to +50˚C
Moisture	Weather resistance design

The mating connector for TVL cable in junction box shall be provided. The center contact of this jack shall be beryllium copper.

4. Testing

Testing of TVL cables and connectors shall be performed in accordance with provisions in Section 86-2.14B, "Field Testing" of the Standard Specifications and these special provisions.

Cable lengths found to have faults shall be replaced and retested. The removed faulty cable shall be disposed of by the Contractor.

Prior to the beginning of work, each length of coaxial cable shall be tested for attenuation and faults to ensure compliance with specifications contained herein using a time domain reflectometer (TDR). For the purpose of these special provisions, a fault in a long length of cable is defined by one or more of the following:

a. Return loss measurements indicating that attenuation exceeds 3 dB at 5 MHz to 30 MHz in a portion of cable less than 3 m long.
b. A return loss measurement indicating that there is a short in the cable.
c. A return loss measurement indicating a cut or open circuit in the cable.
d. A visual inspection which reveals exposure of or damage to the cable shielding.

SUPERVISORY CONTROL AND DATA ACQUISITION COMMUNICATION CABLE

The supervisory control and data acquisition (SCADA) communication cable (SCC) in either 2, 4 or 50 pair No. 22 shielded conductors configurations shall conform to REA specification PE-39. The shielded conductors shall be solid annealed copper and insulated with polyiolifin with standard telephone coding. The individual conductors shall be twisted into pairs with varying twists to minimize crosstalk and specified color combination to provide pair identification. The cable shall have a non-hygroscopic tape applied longitudinally with an overlap. The cable shall be shielded with a 0.127 mm thick corrugated (On cable core diameter of less than 0.635 mm, a flat tape may be used.) solid copper tape applied longitudinally with an overlap to provide 100 percent electrical shielding coverage. The cable shall have an outer jacket of black, linear low density, high molecular weight polyethylene, constructed to withstand sunlight and temperature variations. The entire cable within the outer jacket shall be flooded with a petrolatum-polyethylene gel filling compound to eliminate moisture migration or ingress.

Splicing shall be as recommended by the cable manufacturer and suitable for the environment that the splice is located. The Contractor shall submit the splicing method to the Engineer for approval.

TELEPHONE CABLE

The telephone cable (TC) shall consist of 6 pairs of No. 19 solid copper conductors. Conductors shall be twisted in pairs. Each conductor shall be insulated with a high molecular weight, heat stabilized, color coded polyethylene material. The insulation shall be 440 µm nominal.

Color code for TC cable shall be as follows:

1. White/Blue
2. White/Orange
3. White/Green
4. White/Brown
5. White/Gray
6. Red/Blue

The core shall be protected by a non-hygroscopic polyester film with a single longitudinally applied 120 µm thick corrugated copper shield (or 190 µm thick plastic coated aluminum shield). A moisture barrier of petrolatum-polyethylene compound shall be applied over the core tape and over and under the cable shield to fill all cable interstices.

The cable shall be provided with an outer jacket of extruded, black, high molecular weight, heat stabilized polyethylene material. The outer jacket shall have a thickness of 1.5 mm nominal. The outer diameter of the cable shall be 15.25 mm maximum.

Splices will not be allowed, except where shown on the plans.

All conductors shall be terminated inside the telephone demarcation cabinet and the controller cabinet as shown on the plans. All connections from the TBO terminal block to the 8-position connecting block shall be via a cable consisting of 2 pairs of No. 22 solid conductors and shall meet the same specifications as the TC cable.

10-3.12 15 KILOVOLT CABLE

GENERAL

a. Section includes: 15 kilovolt class cable.

REFERENCES

a. National Electrical Manufacturers Association (NEMA).
b. Insulated Cable Engineers Association (ICEA).
c. National Electrical Code (NEC): Article 310 - Conductors for General Wiring and Article 326 - Medium Voltage Cable.
d. American Society for Testing and Materials (ASTM): B3 - Standard Specification for Soft or Annealed Copper Wire and B8 - Specification for Concentric - Lay - Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

SUBMITTALS

Provide six copies of shop drawings to Engineer for approval.

QUALITY ASSURANCE

a. Manufacturer Qualifications: Minimum of 10 years experience in manufacturing of medium voltage 15 kilovolt class power cables.
b. Installer qualifications: Submit cablemen training and work history to Engineer.

WARRANTY

Submit manufacturer's standard warranty to Engineer.

PRODUCTS

CABLES

a. Cable: Newly manufactured (not more than 12 months old) of soft drawn copper with not less than 97 percent conductivity, with size, grade of insulation, voltage, and manufacturer's name permanently marked on outer covering at not more than 610 mm intervals. Identify and mark conductors in accordance with NEC Article 310. Cable shall meet requirements of ICEA, NEMA, and AEIC. The 15 kV shielded single conductor cable shall be 15 kV rated power cable designed to operate at conductor temperatures of 90°C normal, 130°C emergency, and 250°C short circuit conditions as defined by ICEA S - 68 - 516 (NEMA WC - 8) and UL Standard 1072. The cable shall be suitable for installation above or below grade, indoors or outdoors, and in wet or dry locations. The qualifying cable shall be UL rated, in accordance with UL labeled as MV - 90, sunlight resistance and for CT use (UL), in accordance with UL standard 1072.
b. Conductor: The conductor shall be compressed, class B stranded copper and shall be in accordance with the requirements of ICEA S - 68 - 516. The copper conductor shall consist of all bare strands or tin coated strands in the outer layer in accordance with ASTM B3, B8 and B33.
c. Conductor Shield: The conductor shield shall be an extruded black - colored, non - conducting thermoset material in accordance with Section 2.7 of ICEA S-68-516. The minimum average thickness shall be 0.5 mm.

d. Insulation: The insulation shall be a discharge resistant, ethylene propylene (EP) based compound and be listed by UL. The average thickness of the insulation shall be 5.6 mm. The manufacturer shall perform the Insulation corona Discharge Resistance Test (see Section 3.9.3.3. of the ICEA S-68-518) tested in accordance with the method described in ASTM D2275-89 "Standard Test Method for Voltage Endurance of Solid Electrical insulating material subjected to partial discharges (Corona) on the Surface" and submit the result to the Engineer before accepting the cable.
e. Insulating Shielding: The insulating shielding shall consist of a nonmetallic conducting material extruded directly over the insulation and a 0.12 mm bare copper tape. The nonmetallic layer shall be black-colored with properties and thickness conforming to the requirements of Table 4a of ICEA S-68-516 and Tables 14.2 and 14.3 of UL-1072. The layer shall be free stripping from the EP insulation. The 0.12 mm bare copper tape shall be helical applied with a 15 percent overlap, directly over the nonmetallic layer.
f. Overall Jacket: The overall Jacket shall be extruded black-colored Polyvinyl Chloride (PVC) material with physical properties and thickness in accordance with Section 4.4.5 and Table 4-6 of ICEA S-68-516 and shall surface printed as required by UL Standard 1072.
g. Production Testing: Production testing shall consist of the following:

1. Continuous DC spark testing of the non-conducting stress control layer prior to extrusion of the EP insulation.
2. Mooney Viscosity, Scorch Viscosity, and Specific Gravity of each batch of the EP insulation prior to extrusion.
3. AC voltage withstand test for a 5 minute duration, of each finished cable at 35 kV.
4. Volume resistivity of the nonmetallic shield.
5. DC resistivity of all insulated conductors and metallic shields.
6. Dimensional verification of all extruded layers.
7. Absence of water in conductors and interfaces conformed.

INSTALLATION

a. Circuits : Continuous from origin to termination without splices in intermediate pull boxes. Where splices are necessary, furnish junction box or manholes properly installed and labeled. Leave sufficient slack at termination to make proper connections. Splice shall not be pulled into conduits.
b. Splice cables only as required to meet manufacturers pulling tension requirements. Make terminations in stress cones. Carefully make up stress cones in accordance with cable manufacturer's instructions. Cable terminations and splices shall be made by capable rated high cablemen. Splices in manholes and other wet locations shall be weatherproof.
c. Properly coat wires and cables with pulling compound recommended by cable manufacturer before pulling into conduits and prevent mechanical damage to conductors during installations.
d. Other lubricants substitute shall be accompanied by a statement from conductor manufacturer as to its acceptable use with conductor being installed.
e. Do not exceed pulling tension and side - wall pressures, as recommended by cable manufacturer. Pull boxes located as indicated on the plans are based on nominal pulling tension and side - wall pressures. Install additional pull boxes as required to meet cable manufacturer's recommendations.
f. Termination and Splices: Weatherproof, stress cones type, single conductor style.

PROGRAMMABLE LOGIC CONTROLLER COMMUNICATION CABLE

The programmable logic controller communication (PLCC) cable conform to the following:

a. Description: 22 AWG (19 x 34) tinned copper, 150 Ω twinax.
b. Electrical characteristics:

Nominal Impedance:150 Ω
Nominal Inductance:0.98 µH/m

c. Nominal Capacitance

Between conductors: 29.3 pF/m
Conductor to shield: 55 pF/m

d. Nominal Velocity of propagation:78 percent
e. Nominal Delay:4.3 ns/m

f. Nominal Attenuation:

Frequency (MHz)	dB/30.5 m
1	.122
5	.26
10	.365
20	.52
50	.83
100	1.31
200	1.9
400	2.68

Nominal Conductor DC resistance at 20°C: 42 Ω/1000 m
Nominal Shield DC resistance at 20°C: 18.9 Ω/1000 m
Maximum Operating voltage: 300 V(ac)
Physical Characteristics:
Temperature rating: -20° to +60° C
Insulation material: Foamed H.D. Polyethylene Duofoil, 100 percent, No. 22 (19 x 34) T.C. Drain
Twisted pair lay length: 78 mm (13 twists/meter)
Minimum Bend Radius: 90 mm
Nominal Weight/1000 m : 56 kg
Maximum Pulling Tension: 12.7 kg
Color Code: Black, Yellow
Nominal Diameter: 8.7 mm
Jacket Martial (color): PVC (Black)
Applicable Specifications: UL type CL2X or AWM 2668 or CMX CEC Type C(UL) CMX
Flame Resistance: UL VW-1

10-3.13 SERVICE

Type III service equipment enclosures shall be the aluminum type.

Circuit breakers shall be the cable-in/cable-out type, mounted on non-energized clips. All circuit breakers shall be mounted vertically with the up position of the handle being the "ON" position.

Type H service shall consist of a conduit and conductors with length and size as required by the serving utility company.

The neutral conductor shall run from the service equipment enclosure to the controller cabinet without splicing to any other neutral conductor.

The clearance between the bottom of the lowest circuit breaker and the bottom of the service equipment enclosure for a Type III-A series shall be 600 mm minimum, and for a Type III-C series shall be 460 mm minimum.

Installation of a barrier type terminal block in service equipment enclosures is not required.

10-3.14 SERVICE BOX

The service box shall be either from Square D Mini Power-Zone MPZ10S40F, Westinghouse Mini-Power Center P48G11S10P, or equal. In addition, the service box shall meet the following requirements:

Fabricated from aluminum.
Factory wired and conform to NEMA standard.

Have a dead front panel with a continuous stainless steel piano hinge. No live parts shall be mounted on the front panel.

The exterior door shall have provisions for padlocking. The padlock hole shall have a minimum diameter of 11 mm.

The housing shall have effectively screened ventilation louvers for the transformer.

Fasteners on the exterior of the service box shall be vandal-resistant and shall not be removable from the exterior. All screws, nuts, bolts and washers shall be stainless steel.

All terminals for incoming service conductors shall be compatible with either copper or aluminum conductors sized to suit the conductors shown on the plan. The terminal shall include but not limited to:

a. Incoming terminals (landing lugs)
b. Neutral lugs

c. Solid neutral terminal strip
d. Terminal strips for conductors within the enclosure

A plastic laminated wiring diagram shall be provided with brass mounting eyelets and attached to the inside of the enclosure, or the wiring diagram shall be mounted to the interior of the door with an UL or ETL approved method.

An engraved phenolic nameplate on the dead front panel indicating the function of each circuit within the enclosure shall be installed with stainless steel rivets or stainless screws:

a. Adjacent to the breaker or device. Character size shall be a minimum of 3 mm.
b. At top of the exterior door panel indicating system number, voltage level and number of phases. Character size shall be a minimum of 5 mm.

10-3.15 NUMBERING ELECTRICAL EQUIPMENT

The placement of numbers on electrical equipment will be done by others.

10-3.16 STATE-FURNISHED CONTROLLER ASSEMBLIES

The Model 170 controller assemblies, including controller unit, completely wired controller cabinet and inductive loop detector sensor units, but without 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.

Controller Assemblies Power Strip (Contractor-furnished)

The Contractor shall furnish and install one rackmount surge power strip with a switch in each State-furnished Model 334 controller cabinet. The power strip shall be plugged into the non-GFCI duplex outlet normally labeled with "Controller Unit Recp." in the back of the PDA unit. The power strip shall be mounted at the top of the standard EIA-310 rack cage and across the two vertical back rails with four stainless steel EIA mounting screws, two on each side. The power strip shall not hinder the accessibility to the back of all existing electrical equipment. All power cords for permanently field installed electrical equipment shall be plugged into the power strip.

The power strip, at a minimum, shall meet the following requirements:

1. It shall have a maximum rating of 15 A, 120 V(ac), 60 Hz.
2. It shall have a surge protection with UL 1449 Clamping Level of 400 V, an IEEE Let-Through Voltage rating of less than 336 V, a single-pulse energy rating of 210 J and EMI/RFI noise protection rating of 40 dB.
3. It shall be 46 mm (H) x 483 mm (W) x 70 mm (D) maximum and shall not weigh more than 2.0 kg.
4. The front plate of the power strip shall have four cut-off EIA mounting screw holes, two on each side.
5. It shall have six rear outlets with 38 mm minimum apart center to center. The power cord shall enter from the rear with a length of 2 meters minimum. The clearance between the power cord entrance and the nearest outlet shall be 90 mm minimum.
6. It shall have a 15 A circuit breaker and an internally illuminated switch to cut off power to all outlets. Both the circuit breaker and the switch shall be front mounted.

10-3.17 DETECTORS

Loop detector sensor units will be State-furnished in conformance with the provisions in "Materials" of these special provisions. At the Contractor's option, where a Type A loop is designated on the plans, a Type E loop may be substituted. All loops in a single lane shall be of the same type per location.

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 40 mm. Slot width shall be a maximum of 20 mm. Loop wire for circular loops shall be Type 2. Slots of circular loops shall be filled with elastomeric sealant or hot melt rubberized asphalt sealant.

The depth of loop sealant above the top of the uppermost loop wire in the sawed slots shall be 50 mm, minimum.

Where one ramp metering demand (D) detector consists of a sequence of 3 loops in a single lane, all 3 loops in each lane shall be connected in series.

10-3.18 SOFFIT AND WALL LUMINAIRES

A No. 7 pull box shall be installed adjacent to each soffit luminaire as shown on the plans.

10-3.19 EXTINGUISHABLE MESSAGE SIGN

Each extinguishable message sign shall be an internally illuminated weathertight and dust tight unit which will produce a clearly visible message only when internally illuminated and shall conform to these special provisions.

The design of each sign shall be as shown on the plans. Minor details of construction shown are typical and may be modified subject to approval by the Engineer.

Six sets of shop drawings shall be submitted to the Engineer for review prior to performing work on the signs.

HOUSING

The housing shall be ruggedly constructed, shall be rigid, weathertight, dust tight and corrosion resistant, and shall be made of durable materials.

Provisions shall be made for ease of maintenance of components.

Sign panels and housing window shall be made of acrylic plastic which, including painted portions, shall be highly resistant to crazing, staining, discoloration, creep, warping, and the long range deleterious effects of vehicle fumes, direct sunlight, heat (up to 90°C), water, oils and aging.

The housing skin shall be made of Type 5052-H32 aluminum alloy sheet with clad finish. The housing reinforcing and miscellaneous parts shall be made of suitable gages and types of aluminum, except external fasteners, machine screw parts, lock washers, hinge pins, and other mechanical parts, which shall be made of Type 316 stainless steel.

Interior metal parts shall be made of suitable gages and types of plated steel or aluminum, except fasteners, machine screw parts, lock washers and other miscellaneous parts shall be made of corrosion resistant metals other than aluminum.

The separable hinge for mounting the reflector shall be brass as shown on the plans or shall be stainless steel.

Gaskets shall be uniform and even textured, and shall be highly resistant to stiffening and setting and the long range deleterious effects of vehicle fumes, direct sunlight, heat (up to 70°C), water, oils and aging.

Terminal strips shall be used for input, output and tie point connections and shall be of the molded phenolic, barrier type.

BALLASTS, CONTROL RELAYS AND TERMINAL BLOCKS

Ballast inductors shall meet the requirements in ANSI Standard: C82.1, "Fluorescent Lamp Ballasts."

The inductors shall have the inductance noted on the plans (±10 percent), losses not exceeding 15 percent of lamp watts at rated current of inductor and a maximum current crest factor of 1.5 at rated current of inductor. The maximum temperature rise of the inductor coils shall be limited to 40°C above an ambient temperature of 40°C.

Heater transformers shall produce the rated secondary voltage (±10 percent) at full load and at one-third load. The maximum temperature rise of the transformer coils shall not exceed 40°C above an ambient temperature of 40°C.

Inductors and transformers shall have cores made of a suitable grade of silicon steel lamination material and shall have thorough resin impregnation.

Each mounting chassis shall be fabricated of 3 mm, Type 5052-H32 aluminum alloy sheet. Units shall be mounted on the chassis with plated brass or steel hardware, except for lock washers which shall be beryllium copper, externally toothed.

Capacitors shall be rated 660 V (ac), 60 Hz, for operation down to -20°C with capacity as shown on the plans and shall be oil filled, paper type, hermetically sealed with solder lug terminals. Capacitance shall be within ±10 percent of rating at 25°C. Each capacitor shall withstand a limited direct current, 15-second breakdown test at 25°C of 3000 V (ac) from each terminal to case. Minimum insulation leakage resistance from terminal to terminal, in megohms, shall be not less than 1500 divided by capacitance in microfarads.

Each magnetic control relay shall be of the heavy-duty, power type with 120-V (ac) coil and double-pole, double–throw contacts with a minimum rating of 2 A at 480 V (ac), 60 Hz. The coil shall consume not more than 10 VA with sealed armature.

The relay coil shall be designed to provide reliable service under the following conditions:

A. Maximum operating voltage: 10 percent over rated volts.
B. Ambient temperature: 60°C.

The relay coil shall meet NEMA requirements for temperature rise and voltage breakdown.

Maximum dimensions of the relay shall be: mounting base, 63.5 mm by 102 mm; overall height, 63.5 mm.

Fuseholders shall be the panel mounting type rated at 250 V (ac), complete with a 10.3-mm diameter by 38-mm length, slow blowing, cartridge type fuse.

Surge limiting and ballast resistors shall be ceramic coated, 20-watt, wirewound units. Resistor leads shall have plastic insulation rated 600 V (ac), for operation at 200°C.

Wiring connections from components shall be terminated on 2 molded phenolic, barrier type, terminal block assemblies rated at 15 A, 600 V (ac). Terminal designations shall be marked as indicated on the plans.

LAMPHOLDERS AND LAMPS

Lampholders shall have silver plated contacts.

Lamps shall be the extra-high output, rapid-start type with T-12 bulb of the length shown on the plans, cool-white color and plated contacts for operation up to 1500 mA.

CONDUCTORS AND WIRING

Ballast and sign conductors shall be No. 16 stranded copper wire and shall be labeled by UL as 105°C appliance wiring material (AWM) for use at 600 V (ac). Ballast conductors shall be secured with easily removable, spring cross straps (not clamped, cabled or served) on the underside of the chassis. Color coding and terminal markings shall be as shown on the plans.

Lead ends shall be fitted with spade lugs.

LUG DISCONNECT

Each plug disconnect shall consist of molded nylon plug and receptacle housings containing plug pins and individual sockets designed to be crimped to conductors and snapped into the housings. Housings shall have integral, molded, polarizing and locking devices. Minimum UL electrical rating shall be 10 A, 600 V (ac). Pins and sockets shall be tin plated phosphor bronze secured to conductors using a ratchet type precision crimping tool.

TESTING

Tests shall verify that the following conditions exist:

A. Transformer output voltage: 480 V (ac) ± 10 percent.
B. Sign input current (daytime level): 4 A maximum.
C. Lamp current each (daytime level): 1.4 A ± 15 percent (nighttime level) 30 mA ± 15 percent.
D. Cathode filament voltage: 3.6 V (ac) ± 10 percent and shall be supplied from a steady (non-flashing) source.

SIGN OPERATION

The sign shall operate as follows:

A. During daytime, the lamps shall operate at full rated brightness.
B. During nighttime, the lamps shall be dimmed to approximately one-thirty-fifth of daytime brightness.
C. Starting and flashing shall be positive, without flickering, during daytime and nighttime levels.

10-3.20 WIRELESS RADIO MODEM ASSEMBLY

The wireless radio modem assembly shall consist of installing the following equipment in the configurations shown on the plans and as directed by the Engineer:

1. Wireless radio modem.
2. Power Supply.
3. Terminal Blocks.
4. Enclosure.

1. Wireless Radio Modem

General.—Acceptable wireless radio modem shall meet all qualifying specifications identified herein, and is at least equivalent in functionality to Metricom Ricochet ICR-900 modem, and has the adaptability to the Metricom Ricochet wide-area wireless network.

The wireless radio modem shall utilize spread-spectrum, packet switching data technology. The modem shall operate within the FCC license-free radio frequency (RF) range from 902 MHz to 928 MHz.

Each radio modem shall work with wide-area wireless network which employs frequency-hopping spreading technique using 162 channels, with each channel having a bandwidth of 160 kHz. The hopping shall be asynchronous and pseudo-random. Minimum raw RF data rate shall be 100 kbps.

The communication protocol shall emulate existing State specified point-to-multipoint communication polling scheme. Each modem shall be polled by a front-end processor (FEP) every 30 seconds and the maximum latency shall be 4 seconds.

Each modem and software shall be designed to provide a migration path to an upgrade communication protocol in conjunction with an IP Gateway.

Radio modem.—Each radio modem shall meet the following specifications:

Receiver:	
Type	Double Conversion Superheterodyne
Dynamic range	-98 dBm to 0 dBm
Packet error rate	$1x10^{-1}$ ($1x10^{-6}$ BER)
Frequency stability	±5 ppm

Transmitter	
RF output minimum (at antenna connection)	+27 dBm
RF output typical	+30 dBm (1.0 W)
Out-of-band spurious radiation	FCC 15.205
Deviation	±37.5 kHz
Modulation bandwidth	160 kHz
Modulation type	Gaussian frequency-shift keying (GFSK)
Output impedance	50 Ω
Frequency stability	±5 ppm

Processing	
CPU	SH1-RISC
Clock speed	16 MHz minimum
Memory DRAM FLASH ROM	 2 MB minimum 512 kB minimum

Data Port	
Serial interface	EIA-232
Data rate	1200 bps to 115 kbps asynchronous
Parity	Odd, Even or None
Data bits	7 or 8
Stop bits	1 or 2
Duplex	full duplex

Electrical	
Voltage	12.0 V(dc) (10.0 - 24.0 V(dc) operating range)
Rx input current @ 12 V(dc) (average)	400 mA
Tx input current @ 12 V(dc)	1 A
Fuse	Internal thermal resettable
Voltage line protection	reverse polarity

Mechanical	
Interface connections: Power Data port Antenna	 2-pin ampere Mate-N-Lock DB-9, female, DCE N-type, female
Status indicator	LED
Case	sheet metal
Weight	0.5 kg
Size	136 mm (W) x 202 mm (D) x 50 mm (H)

Environmental	
Operating range	-40°C to +60°C
Operating vibration	FCC Part 68D paragraph 302 modified
Operating shock	20 g, 11 ms, Half sine per Military Standard 802
Humidity	Military Standard 202F, Method 106 Modified, 10 days

Agency approval	
FCC	Certified Part 15.247

EMI and power/control susceptibility	
Electromagnetic radiation	FCC Class B, Part 15.247
Electromagnetic susceptibility	ANSI C37.90.2 Modified
Surge withstanding capability	ANSI C37.90.1, FT and SWC
Electrostatic Discharge	IEC 801.2

Serial Cable Assembly
A serial cable assembly shall be provided to terminate the radio modem to the terminal blocks in the wireless radio modem enclosure. All connector pins shall be crimp-type.

Communication Protocol
The radio modem shall be compatible with State specified serial communication protocol via EIA-232 interface. The EIA-232 serial interface shall be the standard three-wire interface consisting of transmit, receive and signal ground. No handshaking shall be required.

Antenna.—Each Radio Modem shall be provided with an omnidirectional whip antenna, including cable, connectors and mounting accessories. The antenna shall have the following requirements:

Electronic	
Center frequency	915 MHz nominal
Frequency range	from 902 MHz to 928 MHz
WSWR over frequency range	1.6:1 maximum
Nominal impedance	50 Ω
Gain at beam peak	+5 dB minimum
Gain at horizon at +90 and -90	+4.5 dB minimum
Gain at horizon at +0 and -180	+3.5 dB minimum
Vertical 3 dB beam width over 0 to 359.9 degrees	25 ± 5 degrees
Vertical beam tilt with respect to horizon over 0 to 359.9 degrees	2.5 degrees maximum
Radiation pattern	omnidirectional
Polarization	vertical

Mechanical	
Whip material	2.54 mm diameter 17-7 stainless steel rod with 5.08 μm to 12.7 μm copper plating with electro-deposited nickel finish
Base material	Outer shell Makrolon Polycarbonate 3100 Finish color white Threaded insert nickel plated brass Molded insert (Center Pin) nickel plated brass
Length	572 mm
Base diameter	22.2 mm

Installation
The antenna shall be mounted on the top of a metallic pole cap. The base shall be tighten 1/4 to 1/2 turn past first point of o-ring contact.

Antenna cable
The antenna shall come with an appropriate length of RG58/U coax cable with Type N, male connector on the end. The antenna cable shall be routed through a waterproof cord-grip box (CGB) connector into the wireless radio modem enclosure.

Warranty.—The wireless radio modem shall have a one-year warranty during which the manufacturer shall replace or repair any units that proven to be defective at no additional cost to the State. The warranty period starts on the date the modem is registered with network name server after its installation has been accepted in the field.

2. Power Supply

The power supply shall have the following requirements:

Input	115 V(ac)
Output	+12 V(dc) at 3 A
Regulation	2% line, 2% load with 50 mV peak-to-peak ripple maximum

Input shall be fuse protected. Output shall be short circuit protected. A power "ON" LED shall be used to indicate that the power supply is on.

3. Terminal Blocks

Two DIN rail mounted terminal blocks shall be mounted inside the enclosure. A three position terminal block shall be for 120 V power and a 10 position terminal block shall be for DC power and signal, as shown on the plans.

4. Enclosure

The enclosure shall be a NEMA 3R, not exceed 300 mm x 300 mm x 150 mm in size and have a locking latch. The Contractor shall mount the above components as shown on the plans as a complete assembly.

10-3.21 MICROWAVE VEHICLE DETECTION SENSOR SYSTEM

The microwave vehicle detection sensor (MVDS) system shall be configured to be used in a hard wire or wireless communication configuration. Both shall include all microwave detector units, enclosures, connectors, cables, junction box, mounting equipment, software, firmware, power supply units and all other support equipment. In the wireless configuration a wireless radio modem assembly is provided, described elsewhere in these special provisions.

The microwave vehicle detection sensor (MVDS) system shall include all microwave detector units, enclosures, connectors, cables, junction box, mounting equipment, software, firmware, power supply units and all other support equipment.

Functional Requirements.—The MVDS signal shall emulate the response of an inductive loop detector. The MVDS units shall be tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. Each MVDS unit shall operate independently and not interfere with other MVDS units.

The microwave sensor unit shall operate in the frequency band of 10.525 GHz ± 25 MHz. The transmitter power shall be a maximum of 10 mW.

The MVDS field of view shall be covered by a maximum detection range defined as follows:

Elevation beam-width	45 degrees
Azimuth beam-width	15 degrees
Range	3 to 60 meters

Each MVDS unit shall have the capability of providing a minimum of 8 detection zones within each beam footprint. The size of each zone shall be user definable with a maximum range resolution of 2 meters. The minimum footprint shall be greater than or equal to 1.8 meters.

The time of events shall be measured in a maximum of 10 millisecond resolution.

Measurement accuracy shall be better than 95% certainty for vehicle presence.

Each MVDS unit shall be supplied with a connectorized MVDS cable harness with appropriate cable length for each installation. The MVDS cable shall consist of 15 unshielded twisted pairs of No. 20 conductors with an overall shield. Each conductor shall have a minimum of 19 tinned copper strands with a minimum of 1.60 mm PVC insulation rated for 300 V at 105 ˚ C. The outer jacket shall be chrome PVC with minimum thickness of 1.60 mm. The outside diameter of the cable shall not exceed 19.2 mm. A minimum of 4 meter slack of MVDS cable is required in each controller cabinet.

The connector shall be MS3476W18-32S or equivalent. This connector shall include contacts for powering the sensor unit, RS-232 serial data communications and contact pairs for each detection zone. The connector pinout is as follows:

No.	Pin No.	Designation	Signal	Remark
1	A	Contact Closure	Opto 1	
2	B	Contact Closure	Opto 1 Return	
3	C	Contact Closure	Opto 2	
4	D	Contact Closure	Opto 2 Return	
5	E	Contact Closure	Opto 3	
6	F	Contact Closure	Opto 3 Return	
7	G	Contact Closure	Opto 4	
8	H	Contact Closure	Opto 4 Return	
9	J	Contact Closure	Opto 5	
10	K	Contact Closure	Opto 5 Return	
11	L	Contact Closure	Opto 6	
12	M	Contact Closure	Opto 6 Return	
13	N	Contact Closure	Opto 7	
14	P	Contact Closure	Opto 7 Return	
15	R	Contact Closure	Opto 8	
16	S	Contact Closure	Opto 8 Return	
17	d	Contact Closure	Opto 9	
18	e	Contact Closure	Opto 9 Return	
19	f	DC Power	12-24 V(dc) +	
20	g	DC Power	12-24 V(dc) -	
21	h	AC Power	115 V(ac) +	Not Used*
22	j	AC Power	115 V(ac) -	Not Used*
23	V	RS-232 p2	Tx	
24	T	RS-232 p3	Rx	
25	U, W	RS-232 p5	Signal Ground	
26	b	Auxiliary	+5 V(dc) Out	Not Used
27	c	Auxiliary	+5 V(dc) Out Return	Not Used
28-32				Spares

* Used in the wireless communication configuration.

In the hard wired configuration the Contractor shall wire the MVDS cable harness and power conductors to the 10 position din rail mounted terminal blocks in the controller cabinet as directed by the Engineer. The RS-232 serial data communication output conductors shall be terminated at the service panel terminal block, TB-0. The contact pair output conductors shall be terminated at the input panel terminal block, TB-2. The ends of all unused and spare conductors shall be taped to prevent accidental contact to other circuits.

In the wireless communication configuration the Contractor shall wire the MVDS cable harness to the terminal blocks in the wireless radio modem enclosure as shown on the plans. The ends of all unused and spare conductors shall be taped to prevent accidental contact to other circuits.

All software for testing and set up procedures shall be supplied with the MVDS unit. The software shall test the MVDS unit performance and provide diagnostic information.

Operational Requirements.—The Contractor shall provide a certification from the manufacturer that the MVDS unit will interface and operate with a Model 170 controller. In addition, the MVDS unit shall meet the following requirements:

a. Electrical.—The unit shall operate with 12-24 VDC at 0.5 A power source. The unit shall have a feature of automatic recovery after a power failure.
b. Physical.—The unit shall be encased in a weatherproof NEMA-3R enclosure. The unit shall not exceed 160 mm x 240 mm x 250 mm in size and shall not weigh more than 4.5 kg. The unit shall operate over a temperature range from -37˚ to +74˚ C, up to 95 percent relative humidity.
c. Installation and Testing.—Prior to installing any MVDS units, the Contractor shall perform functional tests to verify that all MVDS units comply with these specifications. The MVDS units shall be installed as shown on the plans and

in accordance with the manufacturer's recommended installation procedures. The Contractor shall confirm equipment placement with the Engineer before installing any equipment. The Contractor shall test the MVDS units for the following functions:

1. Presence and passage at all ramp and connector metering locations.
2. Speed, volume and occupancy for all mainline monitoring locations.
3. Correct speed and count readings of mainline traffic with a portable detection equipment.

The Contractor shall make sure that the MVDS system will not cause harmful interference to radio communication. If the operation of the MVDS system in a residential area is to cause harmful interference, the Contractor will be required to correct the interference at the Contractor's expense.

10-3.22 FIBER COMMUNICATION CABLE AND ACCESSORIES

FIBER OPTIC GLOSSARY

Breakout.—The cable "breakout" is produced by (1) removing the jacket just beyond the last tie-wrap point, (2) exposing 1 to 2 m of the cable buffers, aramid strength yarn and central fiberglass strength member, and (3) cutting aramid yarn, central strength member and the buffer tubes to expose the individual grass fibers for splicing or connection to the appropriate device.

Connector.—A mechanical device used to align and join two fibers together to provide a means for attaching to and decoupling from a transmitter, receiver, or another fiber (i.e., patch panel).

Connectorized.—A term that describes the termination point of a fiber after connectors have been affixed.

Connector Module Housing (CMH).—A patch panel used in the FDU to terminate singlemode fibers with most common connector types. It may include a jumper storage shelf and a hinged door.

Couplers.—Couplers are devices which mate two fiber optic connectors to facilitate the transition of optical light signals from one connector into another. Couplers may also be referred to as: adapters, feed-thrus, and barrels. They are normally located within FDUs mounted in panels. They may also be used unmounted, to join two simplex fiber runs.

Fiber Distribution Unit (FDU).—A combination of the Connector Module Housing (CMH) and the Splice Module Housing (SMH) in the same enclosure.

Fiber Storage Enclosure (FSE).—Designed for holding excess cable slack for protection. The FSE allows the user flexibility in equipment location and the ability to pull cable back for resplicing.

F/O.—Fiber optic.

FOIP.—Fiber optic inside plant cable.

FOP.—Fiber optic outside plant cable.

FTC.—Fiber Trunkline Cable. Singlemode, 72 fibers.

FPC.—Fiber Pigtail Cable. Singlemode, 12 fibers.

FOTP.—Fiber optic test procedure(s) as defined by EIA/TIA standards.

Light Source.—A transportable piece of fiber optic test equipment that, when coupled with a power meter, is used to perform end-to-end attenuation testing. It contains a stabilized light source operating at the designed wavelength of the system under test. It also couples light from the source into the fiber to be received at the far end by the receiver.

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 video F/O transmitter to video F/O receiver.

Link Loss Budget.—A calculation of the overall permissible attenuation from the fiber optic transmitter (source) to the fiber optic receiver (detector).

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.

Optical Time Domain Reflectometer (OTDR).—A piece of fiber optic test equipment similar in appearance to an oscilloscope that is used to measure the total amount of power loss between two points. It provides a visual and printed display of the relative location of system components such as fiber sections, splices and connectors as well as the losses that are attributed to each component.

Patchcord.—A short jumper used to join two Connector Module Housing (CMH) couplers, and or a CMH and an active device (Optical Electronic devices).

Pigtail.—Relatively short length of fiber optic cable that is connectorized on only one end. All pigtails shall be tight buffer cable.

Power Meter.—A transportable piece of fiber optic test equipment that, when coupled with a light source, is used to perform end-to-end attenuation testing. It contains 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 fiber optic cable that is not connected to any active device and may or may not have splices per the design.

Splice.—The permanent joining of fiber ends to identical or similar fibers.

Splice Closure.—An environmentally sealed container used to organize and protect splice trays. The container allows splitting or routing of fiber cables from multiple locations.

Splice Module Housing (SMH).—Stores splice trays as well as pigtails and short cable lengths.

Splice Tray.—A container used to organize and protect spliced fibers.

Tight Buffer Cable.—Type of non-breakout cable construction where each glass fiber is tightly buffered (directly coated) with a protective thermoplastic coating to 900 m with the exception of the protective thermoplastic coating. The tight buffer cable shall meet all the characteristics of the fiber in the fiber optic outside plant cable specified elsewhere in these specifications.

FIBER OPTIC CABLE

GENERAL.—Each fiber optic cable for this project shall be all dielectric, gel filled, duct type, with loose buffer tubes construction with a maximum outside diameter of 14 mm, and shall conform to these special provisions. Cables shall contain singlemode (SM) dual-window (1310 nm and 1550 nm) fibers with the numbers described below and as shown on the plans:

Fiber trunkline cable (FTC)	72 SM fibers
Fiber pigtail cable (FPC)	12 SM fibers

The optical fibers shall be contained within loose buffer tubes. The loose buffer tubes shall be stranded around an all dielectric central member. Aramid yarn shall be used as a primary strength member, and a polyethylene outside jacket shall provide for overall protection.

All F/O cable of each specific type shall be from the same manufacturer, who is regularly engaged in the production of this material.

The cable shall be qualified as compliant with Chapter XV11, Title 7, Part 1755.900 of the Code of Federal Regulations, "REA Specification for Filled Fiber Optic Cables" (which replaced the United States Department of Agriculture Rural Electrification Administration specifications REA-PE-90).

FIBER CHARACTERISTICS.—Each optical fiber shall be glass and consist of a doped silica core surrounded by concentric silica cladding. All fibers in the buffer tube shall be usable fibers, and shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of these specifications. The required fiber grade shall reflect the maximum individual fiber attenuation, to guarantee the required performance of each and every fiber in the cable.

The coating shall be a dual layered, UV cured acrylate. The coating shall be mechanically strippable without damaging the fiber.

The cable shall comply with the optical and mechanical requirements over an operating temperature range of -40°C to +70°C. The cable shall 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." The change in attenuation at extreme operational temperatures (-40°C to +70°C) for singlemode fiber shall not be greater than 0.20 dB/km, with 80 percent of the measured values no greater than 0.10 dB/km. The singlemode fiber measurement is made at 1550 nm.

For all fibers the attenuation specification shall be a maximum attenuation for each fiber over the entire operating temperature range of the cable.

Singlemode fibers within the finished cable shall meet the requirements in the following table:

Fiber Characteristics Table

Parameters	**Characteristic**
Type	Step Index
Core diameter	8.3 µm (nominal)
Cladding diameter	125 µm ±1.0 µm
Core to Cladding Offset	≤1.0 µm
Coating Diameter	250 µm ±15 µm
Cladding Non-circularity defined as: [1-(min. cladding dia ÷max. cladding dia.)]x100	≤2.0%
Proof/Tensile Test	345 MPa, min.
Attenuation: @1310 nm @1550 nm	 ≤0.4 dB/km ≤0.4 dB/km
Attenuation at the Water Peak	≤2.1 dB/km @ 1383 ±3 nm
Bandwidth: @ 850 nm @1310 nm (SM)	 N/A N/A
Chromatic Dispersion: Zero Dispersion Wavelength Zero Dispersion Slope	 1301.5 to 1321.5 nm ≤0.092 ps/(nm^2∗km)
Maximum Dispersion:	≤3.3 ps/(nm∗km) for 1285 - 1330 nm <18 ps/(nm∗km) for 1550 nm
Cut-Off Wavelength	<1250 nm
Mode Field Diameter (Petermann II)	9.3 ±0.5 µm at 1300 nm 10.5 ±1.0 µm at 1550 nm

COLOR CODING.—In buffer tubes containing multiple fibers, each fiber shall 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)

The colors shall be targeted in accordance with the Munsell color shades and shall meet EIA/TIA-598 "Color Coding of Fiber Optic Cables."

The color formulation shall be compatible with the fiber coating and the buffer tube filling compound, and be heat stable. It shall not fade or smear or be susceptible to migration and it shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

CABLE CONSTRUCTION.—The fiber optic cable shall consist of, but not be 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 shall be provided in the loose buffer tubes between the fibers and the inside of the tube to allow for expansion without constraining the fiber. The fibers shall be loose or suspended within the tubes. The fibers shall not adhere to the inside of the buffer tube. Each buffer tube shall contain 12 fibers.

The loose buffer tubes shall be extruded from a material having a coefficient of friction sufficiently low to allow free movement of the fibers. The material shall be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.

Buffer tube filling compound shall be a homogeneous hydrocarbon-based gel with anti-oxidant additives and used to prevent water intrusion and migration. The filling compound shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound shall be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member by a method that will prevent stress on the fibers when the cable jacket is placed under strain, such as the reverse oscillation stranding process.

Each buffer tube shall be distinguishable from other buffer tubes in the cable by the color coding specified for the fibers.

Central Member**.—**The central member which functions as an anti-buckling element shall be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fibers and buffer tubes. A linear overcoat of Low Density Polyethylene shall be applied to the central member to achieve the optimum diameter to provide the proper spacing between buffer tubes during stranding.

Filler rods**.—**Fillers may be included in the cable to maintain the symmetry of the cable cross-section. Filler rods shall be solid medium or high density polyethylene. The diameter of filler rods shall be the same as the outer diameter of the buffer tubes.

Stranding**.—**Completed buffer tubes shall be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable shall meet mechanical, environmental and performance specifications. A polyester binding shall be applied over the stranded buffer tubes to hold them in place. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.

Core and Cable Flooding.—The cable core interstices shall be filled with a polyolefin based compound to prevent water ingress and migration. The flooding compound shall be homogeneous, non-hygroscopic, electrically non-conductive, and non-nutritive to fungus. The compound shall also be nontoxic, dermatologically safe and compatible with all other cable components.

Tensile Strength Member.—Tensile strength shall be provided by high tensile strength aramid yarns and fiberglass which shall be helically stranded evenly around the cable core and shall not adhere to other cable components.

Ripcord.—The cable shall contain at least one ripcord under the jacket for easy sheath removal.

Outer jacket.—The jacket shall be free of holes, splits, and blisters and shall be medium or high density polyethylene (PE), or medium density cross-linked polyethylene with minimum nominal jacket thickness of 1 mm ±76 µm. Jacketing material shall be applied directly over the tensile strength members and flooding compound and shall not adhere to the aramid strength material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The jacket or sheath shall 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. The actual length of the cable shall be within -0/+1 percent of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm.

GENERAL CABLE PERFORMANCE SPECIFICATIONS.—The F/O cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end. Testing shall be done in accordance with EIA-455-82 (FOTP-82), "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

A representative sample of cable shall be tested in accordance with EIA-455-81A, "Compound Flow (Drip) Test for Filled Fiber Optic Cable." The test sample shall be prepared in accordance with Method A. The cable shall exhibit no flow (drip or leak) at 80°C as defined in the test method.

Crush resistance of the finished F/O cables shall be 220 N/cm applied uniformly over the length of the cable 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 the fibers shall be ≤0.10 dB at 1550 nm for a cable subjected to this load. The cable shall not exhibit any measurable increase in attenuation after removal of load. Testing shall be in accordance with EIA-455-41 (FOTP-41), except that the load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for 10 minutes.

The cable shall withstand 25 cycles of mechanical flexing at a rate of 30 ±1 cycles/minute. The average increase in attenuation for the fibers shall be ≤0.20 dB at 1550 nm at the completion of the test. Outer cable jacket cracking or splitting observed under 10x magnification shall constitute failure. The test shall be conducted in accordance with EIA-455-104 (FOTP-104), "Fiber Optic Cable Cyclic Flexing Test," with the sheave diameter a maximum of 20 times the outside diameter of the cable. The cable shall be tested in accordance with Test Conditions I and II of (FOTP-104).

Impact testing shall be conducted in accordance with EIA-455-25 (FOTP-25) "Impact Testing of Fiber Optic Cables and Cable Assemblies." The cable shall withstand 20 impact cycles. The average increase in attenuation for the fibers shall be ≤0.20 dB at 1550 nm. The cable jacket shall not exhibit evidence of cracking or splitting.

The finished cable shall withstand a tensile load of 2670 N without exhibiting an average increase in attenuation of greater than 0.20 dB. The test shall be conducted in accordance with EIA-455-33 (FOTP-33), "Fiber Optic Cable Tensile Loading and Bending Test." The load shall be applied for one-half hour in Test Condition II of the EIA-455-33 (FOTP-33) procedure.

PACKAGING AND SHIPPING REQUIREMENTS.—Documentation of compliance to the required specifications shall be provided to the Engineer prior to ordering the material.

Attention is directed to "Fiber Optic Testing," elsewhere in these special provisions.

The completed cable shall be packaged for shipment on reels. The cable shall be wrapped in a weather and temperature resistant covering. Both ends of the cable shall be sealed to prevent the ingress of moisture.

Each end of the cable shall be securely fastened to the reel to prevent the cable from coming loose during transit. Two meters of cable length on each end of the cable shall be accessible for testing.

Each cable reel shall have a durable weatherproof label or tag showing the manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the contract number, and the reel number. A shipping record shall also be included in a weatherproof envelope showing the above information and also include the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number and any other pertinent information.

The minimum hub diameter of the reel shall be at least thirty times the diameter of the cable. The F/O cable shall be in one continuous length per reel with no factory splices in the fiber. Each reel shall be marked to indicate the direction the reel should be rolled to prevent loosening of the cable.

Installation procedures and technical support information shall be furnished at the time of delivery.

CABLE INSTALLATION.—Installation procedures shall be in conformance with the procedures specified by the cable manufacturer for the specific cable being installed. Mechanical aids may be used, provided that a tension measuring device is placed in tension to the end of the cable, and the allowable tension does not exceed the manufacturers recommended pulling tension.

F/O cable shall be installed using a cable pulling lubricant recommended by the F/O manufacture and a non-abrasive pull tape conforming to the provisions described under "Conduit" elsewhere in these special provisions.

During cable installation, the bend radius shall be maintained at not less than twenty times the outside diameter of the cable.

F/O cable shall be installed without splices except where specifically allowed on the plans or described in these special provisions. Minimum slack of F/O cable as shown on the plans shall be provided at each splice cabinet without a cable splice. At fiber optic splice closure, a minimum of 9 m of each cable (2 or 3) exiting the closure shall be stored in the splice cabinet.

CABLE SPLICING.—Unless otherwise allowed, F/O cable splices shall be fusion type. The mean splice loss shall not exceed 0.10 dB per splice.

The field splices shall connect the fibers of the two F/O cable lengths together. These splices shall be placed in splice trays and these splice trays shall then be placed in the splice closure.

The termination splices shall connect the F/O cable span ends with pigtails. The termination splices shall be placed in splice trays and the splice trays shall then be placed in the fiber distribution unit (FDU). The individual fibers shall be looped at least one full turn within the splice tray to avoid micro bending. A 45 mm minimum bend radius shall be maintained during installation and after final assembly in the optical fiber splice tray. Each bare fiber shall be individually restrained in a splice tray. The optical fibers in buffer tubes and the placement of the bare optical fibers in the splice tray shall be such that there is no discernable tensile force on the optical fiber.

All splices shall be protected with a metal reinforced thermal shrink sleeve.

FIBER OPTIC SPLICE CLOSURE

The F/O field splices shall be enclosed in splice enclosures which shall be waterproof, rodent proof and re-enterable. The fiber optic splice closure shall consist of an outer closure, an inner closure and complete with splice organizer trays, brackets, plugs, clips, cable ties and sealants as needed and shall conform to the following special provisions.

The fiber optic splice closure shall be suitable for a temperature range of 0°C to 50°C.

The size of the closure shall allow all the fibers of the largest fiber optic trunk cable or buffer tube to be spliced to a second cable or buffer tube of the same size, plus fibers from Fiber optic pigtail cable. The closure shall be not more than 901 mm in length and not more than 203 mm in diameter.

All materials in the closures shall be nonreactive and shall not support galvanic cell action. The outer-closure shall be compatible with the other closure components, the inner closure, splice trays, and cables.

The end plate shall consist of two sections and shall have capacity for two fiber optic trunk cables and fiber optic branch cables.

The outer-closure shall protect the splices from mechanical damage, shall provide strain relief for the cable, and shall be resistant to salt corrosion.

The outer-closure shall be waterproof, re-enterable and shall be sealed with a gasket. The outer-closure shall be flash-tested at 103 kPa.

The inner-closure shall be of metallic construction. The inner-closure shall be compatible with the outer closure and the splice trays and shall allow access to and removal of individual splice trays. The splice trays shall be compatible with the inner closure and shall be constructed of rigid plastic or metal.

Adequate splice trays shall be provided to splice all fibers of the largest communication cable or buffer tube plus FPC in the splice cabinet.

Vinyl markers shall be used to identify each spliced fiber in the trays as described under "Fiber Optic Cable Labeling" elsewhere in these special provisions.

Each splice shall be individually mounted and mechanically protected in the splice tray.

The Contractor shall install the fiber splice closure in the splice cabinet where splicing is required. The fiber optic splice closures shall be securely fastened to the splice cabinet using standard hardware found in communications manholes.

The Contractor shall provide all mounting hardware required to securely mount the closures to the splice cabinet.

The fiber splice closure shall be mounted as shown on the plans in a manner that allows the cables to enter at the end of the closure. Not less than 9 m of each cable (2 or 3) shall be coiled in the splice cabinet to allow the fiber splice closure to be removed for future splicing.

The unprotected fibers exposed for splicing within the closure shall be protected from mechanical damage using the fiber support tube or tubes and shall be secured within the fiber splice closure.

Upon completion of the splices, the splice trays shall be secured to the inner closure.

The closure shall be sealed using a procedure recommended by the manufacturer that will provide a waterproof environment for the splices. Encapsulant shall be injected between the inner and outer closures.

Care shall be taken at the cable entry points to ensure a tight salt resistant and waterproof seal is made which will not leak upon aging. It is acceptable to have multiple pigtails enter the fiber splice closure through one hole as long as all spaces between the cables are adequately sealed.

PASSIVE CABLE ASSEMBLIES AND COMPONENTS

The F/O assemblies and components shall be compatible components, designed for the purpose intended, and manufactured by a company regularly engaged in the production of material for the fiber optic industry. All components or assemblies shall be first class, non-corroding, with a design life of at least 20 years. All components or assemblies of the same type shall be from the same manufacturer.

FIBER OPTIC CABLE LABELING

Marking and labeling of fiber optic cable plant throughout this project shall be as follows:

Cable to Cable Splices**.—**The cable jackets labeled at entry to splice closure with cable ID and cable direction relative to the splice point (E, SW, etc.). In addition, the buffer tubes labeled at entry to splice trays with cable ID and cable direction, and the fibers labeled at splice with cable direction and fiber number.

Cable to Fiber Distribution Unit Splices**.—**The cable jackets labeled on the inside of the distribution panel with cable ID, and buffer tubes labeled at entry to splice tray with cable ID. In addition, fibers labeled at entry to splice with fiber number, pigtails labeled at connector with cable ID and fiber number, and front panels labeled at connector with cable ID and fiber number.

Patchcords.—The fibers labeled at each connector with "FUNCTION" of signal being carried.

For labeling purposes, "IN" shall be used to describe the segment of cable, buffer tube, or fiber which runs towards the hub. For labeling purposes, "OUT" shall be used to describe the segment of cable, buffer tube, or fiber which runs away from the hub towards the elements.

All labels shall be made from vinyl sleeving or tags permanently affixed to the jacket, buffer tube or fiber and shall be marked with permanent ink.

FIBER OPTIC CABLE TERMINATIONS

DISTRIBUTION BREAKOUT.—The jacketed cable shall be lashed with tie wraps to the rack prior to entering the FDU. The cable shall also be tie-wrapped to the inside of the FDU near the point of entry. The glass fibers shall not be damaged during cutting and removal of the buffer tubes.

The jacketed area and bare fibers shall be cleaned to remove the moisture blocking gel. The transition from the buffer tube to the bundle of jacketed fibers shall be treated by an accepted procedure for sleeve tubing, shrink tube and silicone blocking of the transition to prevent future gel leak. A subsequent transition shall then be made, with flexible tubing, to isolate the fiber bundles of each buffer tube to serve as a transition from the bundle to the separation point and to protects the individual coated fibers. The last transition point (bundle to single fiber) shall consist of inserting the individual fibers into No. 26 AWG clear teflon tubing, to protect the fiber as it is routed toward the splice tray and to allow clear color identification of fibers for proper distribution. The final transition from bundle to individual fiber tube shall be secured with an adhesive heat shrink sleeve. The individual fibers shall then be stripped and prepared for splicing.

All fibers inside a fiber optic cable entering an FDU shall be properly terminated, whether they are used or not.

DISTRIBUTION INTERCONNECT PACKAGE.—Distribution involves connecting the fibers to the active electronic components. The distribution equipment consists of FDUs with connector panels, couplers, splice trays, fiber optic pigtails and cable assemblies with connectors. The distribution interconnect package shall be assembled and tested by a company who is regularly engaged in the assembly of these packages. Attention is directed to "Fiber Optic Testing" elsewhere in these special provisions. All distribution components shall be products of the same manufacturers, who are regularly engaged in the production of these components, and the respective manufacturers shall have quality assurance programs.

FIBER OPTIC CABLE ASSEMBLIES AND PIGTAILS

General.—Cable assemblies and pigtails shall be products of the same manufacturer. The cable used for cable assemblies and pigtails shall be made of fiber meeting the performance requirements of these special provisions for the F/O cable being connected.

Pigtails.—Pigtails shall be of simplex (one fiber) construction, in 900 μm tight buffer form, surrounded by aramid for strength, with a PVC jacket with manufacturer identification information. Singlemode cable jackets shall be yellow in color. All pigtails shall be at least one meter in length.

Patchcords.—Patchcords may be of simplex or duplex design. Duplex jumpers shall be of duplex round cable construction, and shall not have zipcord (siamese) construction. All patchcords shall be at least 2 m in length, sufficient to avoid stress and orderly routing.

The outer jacket of duplex patchcords shall be colored yellow. The two inner simplex jackets shall be color coded white and slate, respectively, to provide easy visual identification for polarity.

Connectors.—Connectors shall be of the ceramic ferrule ST "push-pull" type. Indoor ST connector housings shall be either nickel plated zinc or glass reinforced polymer construction. Outdoor connector body housing shall be glass reinforced polymer.

The associated coupler shall be same material as the connector housing.

All F/O connectors shall be 2.5 mm ST connector ferrule type with Zirconia Ceramic material with a physical contact pre-radiused tip.

The ST connector operating temperature range shall be from -40°C to +70°C. Insertion loss shall not exceed 0.4 dB and the return reflection loss shall be at least 40 dB. Connection durability shall be less than 0.2 dB change per 500 mating cycles per EIA-455-21A (FOTP-21). All terminations shall provide a minimum 223 N pull out strength. Factory test results shall be documented and submitted to the Engineer prior to installing any of the connectors. Singlemode connectors shall have a yellow color on the body or the boot.

Field terminations shall be limited to splicing of adjoining cable ends or cables to ST pigtails.

ST Couplers.—The ST couplers shall be made of nickel plated zinc or glass reinforced polymer that is consistent with the material forming the associated ST connector body. The design mechanism for mounting the coupler to FDU connector module panel may be flanged or threaded but shall coincide with FDU panel punch-outs.

All coupler sleeves shall be ceramic of the split clamshell or clover leaf design.

The temperature range for the couplers shall be the same as that specified for the ST connectors.

FIBER DISTRIBUTION UNIT

Fiber distribution unit (FDU) shall be EIA-310 standard mount type as shown on the plans. The connector panel shall be located internal to the unit so as not expose fiber optic connections. Cable accesses shall have grommets.

FDUs shall be sized to contain sufficient connector module housings (CMHs) to handle the associated cables and their respective breakouts. In cables with smaller fiber counts, more than one cable may be assigned to an FDU but fibers from the same cable shall not be split between two FDUs. In all cases, FDUs shall be capable of housing and securing required splice trays in splice module housings (SMH).

All FDUs shall house the splice trays needed to store the termination (breakout to pigtail) splices.

Connector module housings (CMH), splice module housings (SMH) shall be mounted with adjustable mounting brackets for horizontal positioning. The front covers shall be Lexan with a rear cover of metal of the same gage and color as the remainder of the FDU rack. Panels shall have twelve coupler capacity and all panel positions shall be filled with couplers. Where panels have spare ST positions, the couplers shall have dust covers on both sides.

Coupler capacities shall usually range from 12 to 72 fibers or couplers, as indicated on the plans. Couplers shall be mounted in panels housed within the FDU. Spare panel positions within the FDU shall have blanks or panels ready for future expansion. The front and back covers of the FDU shall be retractable or removable to facilitate internal installation.

Full compensation for the fiber distribution unit shall be considered as included in the contract lump sum price paid for "Fiber Optic Termination in Model 334 Cabinet" at location involved (excluding the units needed for hub communication system), and no additional compensation will be made therefor.

FIBER OPTIC TESTING

GENERAL.—Testing shall include the tests on elements of the passive fiber optic components: (1) at the factory, (2) after delivery to the project site but prior to installation, (3) after installation but prior to connection to any other portion of the system, and (4) during final system testing. The active components shall be tested after installation. The Contractor shall

provide all personnel, equipment, instrumentation and materials necessary to perform all testing. The Engineer shall be notified two working days prior to all field tests. The notification shall include the exact location or portion of the system to be tested.

Documentation of all test results shall be provided to the Engineer within 2 working days after the test involved. The Contractors attention is directed to "As-Built Plans" elsewhere in these special provisions, regarding the requirements for recording test results.

Prior to arrival of the cable, the Contractor shall provide detailed test procedures for all field testing. The procedures shall include the tests involved and how the tests are to be conducted.

FACTORY TESTING.—Verification of the fiber specifications as listed in the "Fiber Characteristics Table" shall be supplied by the manufacturer with the appropriate documentation. After cabling, before shipment but while on the shipping reel, 100 percent of all fibers shall be tested for attenuation. Copies of the results shall be (1) maintained on file by the manufacturer with a file identification number for a minimum of 7 years, (2) attached to the cable reel in a waterproof pouch, and (3) submitted to the Contractor and to the Engineer.

ARRIVAL ON SITE.—The cable and reel shall be physically inspected on delivery and 100 percent of the fibers shall be attenuation tested to confirm that the cable meets requirements. Test results shall be recorded, dated, compared and filed with the copy accompanying the shipping reel in a weather proof envelope. Attenuation deviations from the shipping records greater than 5 percent shall be brought to the attention of the Engineer. The cable shall not be installed until completion of this test sequence and the Engineer provides written approval. Copies of traces and test results shall be submitted to the Engineer. If the test results are unsatisfactory, the reel of F/O cable shall be considered unacceptable and all records corresponding to that reel of cable shall be marked accordingly. The unsatisfactory reels of cable shall be replaced with new reels of cable at the Contractor's expense. The new reels of cable shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

AFTER CABLE INSTALLATION.—After the fiber optic cable has been pulled but before breakout and termination, 100 percent of all the fibers shall be tested with an OTDR for attenuation. Test results shall be recorded, dated, compared and filed with the previous copies of these tests. Copies of traces and test results shall be submitted to the Engineer. If the OTDR test results are unsatisfactory, the F/O cable segment will be unacceptable. The unsatisfactory segment of cable shall be replaced with a new segment, without additional splices, at the Contractor's expense. The new segment of cable shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

Attenuation tests shall be performed with an OTDR capable of recording and displaying anomalies of 0.02 dB as a minimum. Singlemode fibers shall be tested at 1310 nm and 1550 nm. Attenuation readings for each direction shall be recorded on the cable data sheet.

The OTDR shall have a printer capable of producing a verifying test trace with fiber identification as shown in Appendix A "Link Loss Budget Work Sheet," numerical loss values, the date and the operator's name. It shall also have a DOS based 89 mm disk recording capability that has associated software to do comparisons and reproductions on 216 mm x 280 mm paper, via a personal computer.

OUTDOOR SPLICES.—At the conclusion of all outdoor splices at one location, and before they are enclosed and sealed, all splices shall be tested with the OTDR, in both directions. Splices in singlemode segments shall be tested at 1310 nm and at 1550 nm. Individual fusion splice losses shall not exceed 0.10 dB. Measurement results shall be recorded, dated, validated by the OTDR trace printout and filed with the records of the respective cable runs. Copies of traces and test results shall be submitted to the Engineer. If the OTDR test results are unsatisfactory, the splice shall be unacceptable. The unsatisfactory splice shall be replaced at the Contractor's expense. The new splice shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

DISTRIBUTION INTERCONNECT PACKAGE TESTING AND DOCUMENTATION.—All the components of the passive interconnect package (FDUs, pigtails, couplers and splice trays) shall comprise a unit from a manufacturer who is regularly engaged in the production of the fiber optic components described.

In developing the distribution interconnect package, each SC termination shall be tested for insertion attenuation loss with the use of an optical power meter and source. In addition, all singlemode terminations shall be tested for return reflection loss. These values shall meet the loss requirements specified earlier and shall be recorded on a tag attached to the pigtail or jumper.

Once assembly is complete, the manufacturer shall visually verify that all tagging, including loss values, is complete. Then as a final quality control measure, the manufacturer shall do an "end to end" optical power meter/light source test from pigtail end to jumper lead end to assure continuity and overall attenuation loss values.

The final test results shall be recorded, along with previous individual component values, on a special form assigned to each FDU. The completed form shall be dated and signed by the manufacturer's quality control supervisor. One copy of this

form will be attached in a plastic envelope to the assembled FDU unit. Copies will be provided separately to the Contractor and to the Engineer, and shall be also be maintained on file by the manufacturer or supplier.

The assembled and completed FDU unit shall then be protectively packaged for shipment to the Contractor for installation.

FIBER OPTIC SYSTEM GAIN MARGIN.—The installed system gain margin shall be at least 6 dB for each and every link. If the design system gain margin is less than 6 dB, the Engineer shall be notified and informed of the Contractor's plan to meet that requirement.

ACTIVE COMPONENT TESTING.—The transmitters and receivers shall be tested with a power meter and light source, to record the transmitter average output power in (dBm) and receiver sensitivity in (dBm). These values shall be recorded in the "Link Loss Budget Work Sheet" shown in Appendix A.

SYSTEM VERIFICATION AT COMPLETION

OTDR Testing.—Once the passive cabling system has been installed and is ready for activation, 100 percent of the fiber links shall be tested with the OTDR for attenuation. Test results shall be recorded, dated, compared and filed with previous copies. A hard copy printout and a electronic copy of the traces and test results along with a licensed copy of the associated software on a DOS based 89 mm disk shall be submitted to the Engineer. If the OTDR test results are unsatisfactory the link shall be replaced at the Contractor's expense. The new link shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

Installed System Link Loss Budget.—The "Link Loss Budget Work Sheet" shown in Appendix A shall be completed for each link in the fiber optic system, using the data gathered throughout the installation process. The completed work sheets shall be included as part of the system documentation in the As-Built Plans.

The "Total System Gain" shall be calculated by subtracting the measured "Optical Receiver Sensitivity" (line 1B on the "Link Loss Budget Work Sheet") from the measured "Optical Transmitter Average Power" (line 1A), which were obtained using a power meter and source. The resulting difference shall be the maximum allowable loss between the transmitter and the receiver, within 0 percent to +10 percent of the manufacturers specified loss budget for the transmitter/receiver pair. The "Total System Gain" shall be recorded on line 1C.

The "Fiber Losses" for a link shall be calculated by multiplying the length of the fiber link (line 2A) by the normalized cable attenuation (dB/km, line 2B) at the operating wavelength. The normalized attenuation for this calculation shall be the maximum value throughout the operating temperature range of the cable. The product shall be recorded on line 2C.

The total connector losses shall be calculated by summing the individual attenuation values for each connector pair in the link, excluding the transmitter and receiver connectors. The sum shall be recorded on line 2D.

The total splice losses shall be calculated by summing the individual attenuation values for each splice in the link. The sum shall be recorded on line 2E.

The total of other losses shall be calculated by summing the individual attenuation values for each component in the link not previously addressed. The sum shall be recorded on line 2F. These items may include, but are not limited to, couplers, splitters, routers and switches.

The "Total System Loss" shall be recorded on line 2G of the "Link Loss Budget Work Sheet."

The "Design System Gain Margin" shall be calculated by subtracting the Total System Loss (line 2G) from the Total System Gain (line 1C). The resulting difference shall be recorded on line 3A. The Contractor's attention is directed to "F/O System Gain Margin," elsewhere in these special provisions.

Power Meter and Light Source.—At the conclusion of the final OTDR testing, 100 percent of all fiber links shall 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 the OTDR tests. These tests shall be conducted in both directions. Test results shall be recorded, compared and proven to be within the design link loss budgets, and filed with the other recordings of the same links. Test results shall be submitted to the Engineer.

Test Failures.—If during any of these system verification tests, the results prove to be unsatisfactory, the F/O cable will not be accepted. The unsatisfactory segments of cable shall be replaced with a new segment of cable at the Contractor's expense. The new segment of cable shall undergo the same testing procedure to determine acceptability. Copies of the test results shall be submitted to the Engineer. The removal and replacement of a segment of cable shall be interpreted as the removal and replacement of a single contiguous length of cable connecting two splices, two connectors, or a splice and a connector. The removal of only the small section containing the failure and therefor introducing new unplanned splices, will not be allowed.

APPENDIX A

Link Loss Budget Work Sheet

Contract No. _____

Contractor: _____

Approved by Caltrans: _____

Date: _____ Operator:_____

Link Number: _____ Fiber Color: _____

Buffer Color: _____ Cable No : _____

Section 1: Total System Gain Measured Optical Transmitter Average Power: Measured Optical Receiver Sensitivity (this should be a negative value):	 _____ dBm _____ dBm	 1A 1B
Subtract line 1B from 1A to obtain Total System Gain:	_____ dB	1C
Section 2: Total System Loss Measured length of the link: Measured loss per km of the fiber:	 _____ km _____ dB/km	 2A 2B
Multiply line 2A by 2B to obtain the Total Fiber Loss:	_____ dB	2C
Sum of all Connector Losses in the link: Sum of all Splice Losses in the link: Sum of all Other Losses from other components (couplers, splitters, routers, switches, etc.)	_____ dB _____ dB _____ dB	2D 2E 2F
Add lines 2C, 2D, 2E and 2F to obtain Total System Loss:	_____ dB	2G
Section 3: Design System Gain Margin Subtract line 2G from line 1C (This number must be at least 6 dB):	 _____ dB	 3A

10-3.23 TRUNKLINE SPLICE CABINET

The trunkline splice cabinet (TSC) shall be a Type P cabinet. The Contractor shall construct each TSC foundation as shown on Standard Plan ES-4B including furnishing and installing anchor bolts, shall install the cabinet on the foundation, shall furnish and install fiber optic splice closure, cable retainer and shall make all cable breakout and field splice connections in the cabinet as shown on plans.

10-3.24 FIBER SLACK ENCLOSURE AND FIBER INTERCONNECTING UNIT

FIBER SLACK ENCLOSURE (FSE).—Each FSE shall be manufactured of heavy gage galvanized steel ASTM 526 or 527 with G-60 coating, with a hingeless removable slip up and slip down door, four 50 mm slots are located on each side for cable entry and exit, and four tie wrap brackets for securing the cable coil in position. The enclosure shall be coated in orange colored plastic chlorinated rubber based enamel. The FSE shall be designed to be wall mounted. The dimensions of the FSE shall be 55.8 cm (W) x 50.8 cm (H) x 20.3 cm (D). The FSE shall be unaffected by acids, alkalines, salts, moisture, or fungus growth.

FIBER INTERCONNECTING UNIT (FIU).—Each FIU shall be EIA-310C rack mounted and shall provide a compact modular unit for the interconnection of fibers between the incoming field cable and the end equipment. The unit shall also house the fan-out kit for the twenty-four fiber strands and shall accommodate twenty-four interconnection points for singlemode fibers. It shall be equipped with rack mounting provisions, with dimensions no more than 90 mm (W) x 430 mm (L) x 280 mm (D) and shall weigh no more than 2.6 kg. The FIU shall be designed to control bend radius of fibers, the cable and the fan-out tubes within the units. The unit shall also include four connector panels with six pre-installed ST compatible inter-connection sleeves, each with ceramic inserts in a composite housing for singlemode fiber.

Fiber Patch Cord.—Each fiber patch cord shall serve as the fiber optic connection between the FIU and the VRDD at the fiber distribution unit. The patch cord shall be terminated with ST compatible super physical contact singlemode connector at both ends. The fiber strands shall meet the specifications as those of the FCT and the connectors shall meet the specifications as specified elsewhere in these special provisions. The patch cord shall have a length of 3 m.

10-3.25 TRAFFIC OPERATIONS SYSTEM HUB

Traffic Operations System (TOS) hub equipment shall conform to all rules and regulations of the Federal Communications Commission (FCC).

Prototype equipment is not acceptable. All equipment shall be current standard production units and shall have been in use for a minimum of 6 months. Rebuilt or reconditioned equipment will not be allowed. All rack mounted equipment and card cage assemblies shall have metal filler plates to cover any unused channel slots or card slots.

The communication equipment shall include associated power supplies and interconnect cables.

The communication equipment shall be designed for testing, monitoring, and adjustment without service interruption.

Front access shall be provided for all routine adjustments normally required to be performed by field personnel.

The Contractor shall install TOS Hub equipment with the following equipment, associated cable connectors and other necessary components for a functional and fully integrated system:

1 - Multi-Function MPEG-1 Video Encoder Unit MMVEU).
1 - Master traffic control unit (MTCU).
1 - Ethernet Switch Hub - (State-furnished).
1 - Multi-Service Access Router - (State-furnished).
1 - Multi-Port Traffic Controller Translator (MTCT) - (State-furnished).
1 - CDPD Frame-Relay Router (State-furnished).
7 - Fiber optic data modems (FODM) with 1- Card cage assembly with power supply.
1 - Video and PTZ control data matrix switch system.
1 - Fiber distribution units (FDU) - (described elsewhere in these special provisions).
1 - Fiber storage enclosures (FSE) - (described elsewhere in these special provisions).
21 - Video receiver duplex data (VRDD) units with 3 - Card cage assemblies with power supplies.
7 - Power strips.

The TOS hub center is located in Benicia Toll Plaza Administration Building.

MASTER TRAFFIC CONTROLLER UNIT

Each master traffic controller unit (MTCU) shall be supplied as a functional and fully integrated system and shall consist of the following:

1. VMEbus boards.
2. Peripherals.
3. Chassis.
4. Software.
5. Documentation.

VMEbus boards.—Each VMEbus board shall meet the VMEbus Specification, Revision C.1.

1. One MC68060 VMEbus CPU board. The board shall have a minimum clock speed of 50 MHz. The board shall have the necessary hardware and firmware resident on board to support the following:

a. 32 MB DRAM.
b. One SCSI interface, capable of transferring data with system memory through DMA.
c. One IEEE 802.3 Network controller.
d. Two EIA-232C asynchronous serial ports.
e. VMEbus System Controller/Arbiter.

2. One transition module shall be supplied for the CPU board. The transition module shall provide the following industry standard connections for each of the CPU board peripherals:

a. 25-pin D shell connector for each EIA-232C port.
b. 50-pin connector for the SCSI port.
c. 10Base-T or AUI connector for the IEEE 802.3 port. If the connector provided is the AUI type, one 10Base-T transceiver shall be provided with indicator lights for CP, RCV, XMIT, SQE and power signals.
d. SCSI terminator.

3. One or more identical VMEbus asynchronous serial port board(s), with a minimum total of 32 serial ports. Each port shall have access to its RTS and DCD signals. Each board shall contain a co-processor which shall perform the following functions:

a. Low-level control and operation of each serial port.
b. Handling of character interrupts to/from each serial port.
c. Shared memory interface with CPU board.
d. Block transfer capability to/from serial port directly from and to either CPU board memory or shared memory.
e. VMEbus interrupt on error or block transfer complete.

4. One transition module for each VMEbus asynchronous port board. The transition module shall have one EIA-561 connector for each serial port.

Peripherals.—The following peripherals shall be provided:

1. One each 89 mm SCSI floppy disk drive, configured as SCSI address No. 7.
2. One each 89 mm (1 GB) SCSI hard disk drive, configured as SCSI address No. 1.
3. One each 4 mm SCSI DAT tape drive, configured as SCSI address No. 4.

Chassis.—The following chassis shall be provided:

1. 12-slot, 6U by 160 mm VMEbus card cage.

2. 12-slot monolithic P1/P2 VMEbus backplane with automatic IACK* and BGx* jumpering and integral, on-board bus terminators. This backplane shall meet the VMEbus Specification, Revision C.1.

3. One 120 V(ac) input, 500 W output VMEbus power supply, accessible and removable from the chassis rear.

4. One 8U EIA-310B rack-mountable chassis, with a maximum depth of 560 mm.

5. One transition module cage capable of supporting 7 single-wide modules, mounted in the chassis rear.

6. One panel with the following features, mounted in the chassis front:

a. Power ON/OFF switch.
b. VMEbus system reset pushbutton.
c. Voltage indicator lights for +5 V(dc), +12 V(dc) and -12 V(dc).

7. Horizontal mount bays for each peripheral listed above, with each peripheral and its corresponding indicator lights

accessible from the chassis front.

8. Chassis ventilation with the following features:

a. Active forced air cooling with fans rated at 80 cfm minimum.
b. Front air intake.
c. Rear air exhaust.
d. One air filter, removable from the chassis front.
e. Hinged Plexiglas front door.

9. One each of a 2 m removable AC power cord.

10. 100 each of 2-position Berg type header jumper clips.

11. The chassis shall be configured as follows:

a. The VMEbus CPU board shall be installed in slot No. 1.
b. The VMEbus asynchronous serial port board(s) shall be installed in adjacent slots, starting with slot No. 6.
c. Each empty slot shall be covered with a single-wide blank panel.
d. If an external 10Base-T transceiver is provided with the CPU board transition module above, it shall be mounted in the rear of the chassis, in a recessed location, removable without disassembly of the chassis, with its indicator lights visible from the chassis rear.

12. All wiring in the chassis shall conform to the following:

a. Cabling shall be properly bundled and tie-wrapped.
b. Each wire and cable shall be of adequate length to allow any conductor to be connected to its associated connector or termination point.
c. Cables shall be neat and routed to minimize crosstalk and electrical interference.
d. Wiring containing AC power shall be bundled separately from all DC logic circuits.
e. Wiring containing DC power shall be bundled separately from all DC logic circuits.
f. Wiring shall be routed to prevent conductors and cables from being in contact with metal edges.
g. Wiring shall be arranged so that any removable assembly may be removed without disturbing conductors and cables not associated with that assembly.

13. If an external 10Base-T transceiver is provided with the CPU board transition module above, two additional 10Base-T transceivers, identical to the one provided above, shall be provided.

14. One each 2 m cable with RJ-45 connectors at each end, wired straight through, shall be provided for each serial port on the VMEbus asynchronous serial port board(s).

15. One each 25-pin D connector to RJ-45 modular adapter kit, with blue shell, shall be provided, unassembled, for each serial port on the VMEbus asynchronous serial port board(s).

Software.—The following VMEbus CPU board software shall be provided, both on 4 mm tape cartridge and installed on the SCSI hard disk drives:

1. The following Microware OS-9, v3.0.2 or higher, software shall be provided:

a. Atomic and Development kernels.
b. IOMan.
c. Pipe file manager.
d. SCF, RBF, SBF, and SPF file managers.
e. ISP.
f. NFS client support.
g. Standard utilities.
h. PCF file manager.

2. The following device drivers and descriptors shall be provided:

a. VMEbus CPU board asynchronous serial ports under SCF.
b. VMEbus CPU board DRAM ramdisk under RBF.
c. VMEbus CPU board SCSI floppy disk drive under RBF.
d. VMEbus CPU board SCSI hard disk drive under RBF.
e. VMEbus CPU board SCSI tape drive under SBF.
f. VMEbus asynchronous serial port board asynchronous HDLC under SPF with full support for HDLC framing and addressing. Driver shall allow the HDLC address to be either read from the descriptor or provided by the application with a standard function call.
g. VMEbus asynchronous serial port board asynchronous SDLC under SPF with full support for SDLC framing and addressing. Driver shall allow the SDLC address to be either read from the descriptor or provided by the application with a standard function call.

Documentation.—The following documentation shall be provided:

1. Complete operational and technical documentation for each VMEbus board.
2. Complete technical documentation for each peripheral.
3. Complete operational and technical documentation for the chassis.
4. Complete operational and technical documentation for all software.
5. Written and pictorial documentation for the configuration of the MTCU including, but not limited to, VMEbus board addressing, jumper and switch settings, system memory maps and assignments, chassis layouts and SCSI device addresses.

COMPLIANCE WITH ENGINEER'S APPROVAL.—The supplied equipment shall be approved by the Engineer in writing prior to delivery.

AVAILABILITY OF EQUIPMENT.—The supplied equipment (computer board, chassis, cable, power supply, cooling equipment, floppy disk, or tape drive) shall be an off-the-shelf component which are readily available for purchase.

FIBER OPTIC DATA MODEM

The fiber optic data modem (FODM) shall be RS-232 compatible fiber optic modem with dual optics for drop/insert capability which can be configured as master or local (slave) in either daisy chain or fault tolerant dual redundant (counter rotating) ring network architecture. These four modes of operations shall be selectable via an external Mode DIP-switch. All signals received via an optical port and retransmitted via fiber or via an expansion port shall be retimed to 0.01 percent pulse width accuracy by a crystal controlled timebase, eliminating pulse width distortion and eliminating virtually unlimited repeating. The FODMs shall have anti-streaming circuitry for both the optical fiber and the electrical (RS-232) sides. On RS-232 side, when enabled, the anti-streaming shall limit the amount of time an external device is allowed to transmit data onto the network for each Request to Send (poll). On the fiber side, the anti-streaming shall disable an optical receiver in the event that the receiver output stays high longer than maximum allowable time thus preventing the whole fiber network from being disabled by a continuous "on" failure by receiver or optical emitter. External (TIMEOUT) DIP-switch shall allow user to disable or select the timeouts for both the optical side anti-streaming feature and the RS-232 side anti-streaming feature as well as to enable or disable the "Fiber Activity CTS Disable" feature. LED indicators to display power "on", anti-streaming "Fault" time-out and RS-232 fiber optic activity (selectable via dual function switch).

The FODMs at the field element shall be stand-alone type and shall be securely fastened on a EIA-310 rack-mount shelf. At the hub location, the FODMs shall be rack-mount type installed in card cage assembly. The card cage assembly shall be EIA-310 rack mount type with at least 14 slots and with two power supplies for redundancy.

The FODM shall meet the following requirements:

Electrical Signaling:	EIA RS-232 with full handshake control signals
Electrical Power:	115 VAC, 60 Hz
Operating Temperature	-40_C to 70_C
Operating Mode:	1. Daisy chain Master mode 2. Daisy chain Local mode 3. Fault tolerant Master mode 4. Fault tolerant Local mode
Emitter type:	Laser
Wavelength	1310 nm
Minimum coupled transmit power into: 9/125_m at 25_C	-11(-9.5) dBm
Output Variation	-0.015 dB/_C

Minimum receiver input power for 10^{-9} BER	-40 dBm
Maximum receiver input	-11 dBm
Optical port type	ST
RS-232 connector type	DB25S
Data Rates (auto)	1200 baud to 57.6 kbaud
Bit Error Rate:	10^{-9}
Link Budget(Range) via singlemode 1310 nm	31 dB for (56 km)

FODMs shall be tested as follows:

Each optical modem shall be functionally tested by looping back optical transmit connector to the optical receive connector using a variable optical attenuator with measured optical loss at 31 dB at 1310 nm. A test set shall be connected to the modem and set for RS-232 communication testing. Fifteen minutes BER test burn-in test shall be error free.

After performing the 15 minutes BER test, at least two modems shall be tested for receiver dynamic range. The following procedure shall be followed: First, the optical attenuation shall be increased to the point at which the data test just begins to register bit errors. The optical receive power into the modem shall be measured and recorded. The optical attenuation shall be then decreased until data test once again register errors. At no time shall the optical power into the receiver exceed the manufacturer's specified saturation level. The optical receive levels shall once again be measured and recorded. These minimum and maximum receiver power levels define modem receiver's dynamic range and shall meet or exceed the manufacturer's specifications.

One pair of modem shall be interconnected using optical patchcords and attenuators with a loss of 31 dB in each direction. The RS-232 interface shall be looped back onto one modem and a test set connected to the RS-232 interface of the other modem. A bit error rate of less than 10^{-9} shall be demonstrated.

VIDEO AND PTZ CONTROL DATA MATRIX SWITCH SYSTEM

Video and PTZ control data matrix switch system shall consist of the following main equipment:

One each video matrix switch (VMS).
One each data matrix switch (DMS).
One each main control frame (MCF).
One each multi-destination control panel (CP).
One each network management computer - laptop.

The video and PTZ control data matrix switch system shall consist of components equivalent to Grass Valley Group Series 7000:

Qty	Description
1	GVG Model SMS-64x64V video/video matrix frame
1	GVG Model SMS--PSV-117V power supply for 64x64 video frame
2	GVG Model SMS-VIN wideband analog video input module with mezzanine
2	GVG Model SMS-VXS wideband video crosspoint modules
1	GVG Model SMS-VOU video output modules
1	GVG Model SMS-NCS node controller module for 64/64 video frame
1	GVG Model SMS-64DM-FRM 64X64 data matrix frame
1	GVG Model SMS-PSC-117V power supply for 64x64 data frame
2	GVG Model SMS-DMMS 32x32 data matrix module
1	GVG Model SMS-IBOP-C1 breakout panel control input data port 1-32
1	GVG Model SMS-IBOP-M1 breakout panel control output data 1-32
16	GVG Model SMS-DM-CBL data matrix frame-to-IBOP cable 36 mm with 50-pin D-connector.
1	GVG Model SMS-NCS node controller module for data matrix frame
1	GVG Model SMS-CTL-FRM-117 control frame with MCPU and 117V power supply
1	GVG Model SMS-CIF communication interface module for control frame
1	GVG Model SMS-SER-MZ mezzanine for serial protocol I/F used in control frame
1	GVG Model SMS-CIF-RP2 rear panel for CIF, I/O for 2 serial and 2 coax mezzanine.

1	GVG Model SMS-MB8 programmable 8-bus panel
1	GVG Model SMS-VERS Series 7000 application diskette package, ver. 6.0
1	Network management computer-laptop
1	GVG Model SMS-VERS Series 7000 application diskette package, ver. 6.0

Prior to obtaining equipment, the Contractor shall provide the name and model of the equipment for the Engineer's approval.

All system components shall be from the same manufacturer. The VMS and DMS shall simultaneously route and switch both the corresponding video and PTZ control data inputs to an corresponding video and PTZ control data outputs. Native communication protocol documentation and system application software shall be provided to allow external device to control the VMS and DMS via an RS-232 interface.

Physical.—Matrix physical size shall be according to ultimate capacity.

Requirements for power supplies.—Each of the system components shall have it's own power supply.

Input voltage shall range from 95 V to 130 V, 47 Hz to 63 Hz, single phase. Power consumption for 12-rack unit video matrix frame, when utilizing DC restored input modules, shall be no greater than 600-W. Power consumption for 6-rack unit data matrix frame shall be no greater than 150 W. Power consumption for 6-rack unit control frame shall be no grater than 225 W. All power supply voltages shall be individually regulated on each printed circuit module. The fuses shall be quickly and easily replaced (i.e. Not soldered in place.) Input voltages to each module shall be pre-regulated in order to minimize power dissipation by the on-board regulator.

Qualifying Performance:

Operating temperature range	0 to +40°C ambient
Operating humidity range	0% to 95% relative at +40°C (non-condensing)

The Contractor shall provide the Engineer complete proposed analog video and PTZ data matrix switch system, specifications, technical manuals and a qualified technical representative to assist the Engineer in functional tests. Test methods followed by the state for evaluation of supplied equipment will follow EIA recommendations where applicable.

All equipment shall be new and not previously used. Prototype equipment is not acceptable. All equipment shall be current standard production units and standard production units shall have been in use for a minimum of 6 months by Contractor's customers.

Video Matrix Switch

Qualifying Features.—The Video Matrix Switch (VMS) shall provide for 32 inputs by 16 outputs. By the addition of the required modules, the VMS shall be expandable to support the ultimate configuration which requires 64 inputs by 64 outputs. The system shall support "hot" expansion in that the system shall not require shut down to install additional elements or software during the expansion process.

The equipment shall be designed in accordance with good engineering practice and shall provide a level of performance consistent with the state of the art.

The manufacturer shall maintain an inventory of service spares at multiple strategically located worldwide service centers and shall provide 24 hour emergency service.

Where practical, integrated circuits shall be mounted in sockets for ease of replacement.

All active circuitry shall be mounted on plug in printed circuit modules.

All printed circuit modules shall be fully solder masked and shall bear complete silk screened component legends.

All printed circuit module edge connectors shall be gold plated.

Module extenders shall provide full access to all board mounted components and shall provide all electrical connections required for functional board testing. For safety reasons, module extenders shall not permit power supplies to be operated outside the frame.

Each type of printed circuit module within the matrix shall be fully interchangeable with all other modules of the same type. Reprogramming shall not be required when modules are interchanged.

Video output modules shall incorporate provision for plug-in installation of fixed cable equalizers.

Video input/output connectors shall be female BNC type connectors.

Video performance.—All of the specifications in this section shall be applicable to systems operating in either NTSC or PAL environments.

Video inputs shall be 75 Ω internally terminated. Input return loss shall be 40 dB or greater to 5 MHz. Input return loss for 5 MHz to 30 MHz shall greater than 30 dB.

For NTSC or PAL applications the system shall provide dc restoration of video input signals in order to ensure a clean bounce-free switch.

Transmission characteristics.—System level shall be 1 Vp-p nominal, 3 Vp-p maximum.

Gain scatter shall not exceed +0.1 dB (measured at 1 MHz) for any input to output path.

Timing scatter shall not exceed ±1.0 degree for any input to one output.

Linear Distortions.—Frequency response shall be flat within _0.10 dB over the range of 100 kHz to 10 MHz. Response from 10 to 30 MHz shall be _0.50 dB.

2T pulse and bar response shall be 0.25 percent or better for pulse shape, bar slope, and pulse-to-bar ratio.

Field rate tilt (low frequency square wave response) shall not exceed 0.5 percent.

Slew rate shall be greater than 180 V/_s.

Nonlinear Distortions.—Differential gain shall be no more than 0.15 percent measured at 1 Vp-p output over a range from 10 to 90 percent with APL at 3.58 MHz and 4.43 MHz.

Differential phase shall be no more than 0.15 degrees measured at 1 Vp-p output over a range from 10 to 90 percent with APL at 3.58 MHz and 4.43 MHz.

Two 75 Ω source terminated outputs shall be provided for each bus. Return loss shall be 40 dB or greater to 6 MHz and no more than 30 dB over the range from 6 MHz to 30 MHz.

Crosstalk shall be less than -60 dB at 4.43 MHz. The measurement shall be made by terminating any single input in 75 Ω, the "friendly" input, and driving all other inputs with a 1 Vp-p phase-coherent "hostile" signal. The hostile signal shall be selected on all busses except the one under test. The friendly signal shall then be selected on the test bus and the amplitude of hostile signal artifacts observed.

System signal-to-noise ratio shall be greater than 75 dB measured as p-p signal versus rms noise over a bandwidth of 5.0 MHz.

Switching transients shall not exceed 50 mV.

The blanking level of output video signals shall be 0 V ±50 mV except when selecting inputs served by DC coupled modules.

A sync input shall be provided to lock the system trigger pulse generator to plant sync. Switch timing shall be adjustable and shall be factory set to line 10 of the vertical interval. Sync stripper circuitry shall be incorporated to allow the substitution of color black or any 1.0 Vp-p (nominal) video signal in lieu of composite sync. In the absence of a reference signal, the trigger pulse generator shall free run and provide random switch timing.

Data Matrix Switch

Qualifying Features.—The data matrix switch (DMS) unit shall switch full duplex EIA-RS 232 data signals. The DMS shall provide 32 inputs by 32 outputs. Maximum frame configuration shall be 64 inputs and 64 outputs. Only one input shall be connected to one put at a time. Input and output breakout panels shall be included and mount in the rear of the equipment rack to convert 50-pin "D" connectors on the DMS to DB-25 connector input/output. All cable assemblies between the DMS frame and the breakout panels shall be included. The Contractor shall make all necessary connections between the DMS and the VEUs and VRDTs specified elsewhere in these special provisions.

Main Control Frame

Matrix control functions for the VMS and DMS, including interface to external control devices, shall be managed by a separate Main Control Frame (MCF). The main control frame shall include a master CPU (MCPU), a communications interface module (CIF) with a serial mezzanine board, a dual serial port CIF rear panel, a serial interface mezzanine and a 117 V(ac) power supply module. The MCF shall accept a second MCPU and a second power supply for redundancy.

The MCPU shall include ethernet port for Graphic User Interface (GUI) that provides initial configuration of the system and crosspoint switching via GUI menus. This ethernet port shall interface with a Windows_ based laptop computer and the GUI application software shall be provided by the Contractor. A serial control port in the CIF rear panel shall interface with an external device that provides crosspoint switching control commands using the native communication protocol provided by the manufacturer. The MCF shall provide tie line video and PTZ control source destination sharing.

The system shall be designed to accept backup control module in a "hot stand-by" configuration which shall be ready to assume full control at any time. It shall be possible to program this backup module with absolute/transcode input tables and input exclusion tables different from those programmed to the primary controller if desired to accommodate changing operational scenarios. It shall be possible to copy the contents of these tables from one module to the other at any time

without interrupting system operation.

The system shall incorporate a changeover to provide a fail-safe means for selection of either the main or the backup control module.

Status LED's and alarm relays shall provide an immediate indication of failure of either module.

The changeover controller shall provide both manual and automatic operating modes. Manual selection of either control module shall be possible in either mode. In the automatic mode, failure of active control module shall cause the alternate module to be automatically selected if, the alternate module is present and functional.

Specifically, no control paths shall pass through the changeover module nor shall the presence of the changeover module be required for proper operation of the system.

The primary and backup controller modules shall be accommodated within the main electronics frame of the system and shall be powered by the power supply and any backup power supply in place for that frame.

The primary control module shall incorporate a real-time system clock with battery backup. This clock shall be the time reference for reporting of system abnormalities, and actuation of time salvo switching (when appropriate).

User control shall interface to the system via a high speed bi-directional command bus. Physical connection shall be via 75 Ω coaxial cable terminated in BNC connectors.

Minimum of four command bus connections shall be provided, each with its own line driver and receiver. Failure of one of the command busses shall not affect the operation of the other three.

The command busses shall employ time division multiplex techniques to allow expansion up to 240 distinct control devices to be connected to the system. The data rate shall be sufficiently high to assure that under normal circumstances, a control panel command is processed within 150 milliseconds or less. The number of control device addresses (polling addresses) shall be user-selectable from a minimum of 15 upward to a maximum of 240, ensuring the fastest possible command bus speed.

Physical connection of a control device to the command bus shall be by means of a loop through. Control devices shall have only a single BNC connector, making it obligatory to effect the connection with a "tee" fitting. Thus, it shall not be necessary to break the control loop to remove or replace a control device.

All interfaces to the command bus shall incorporate hardware and software interlocks to prevent the accidental transmission of random or spurious data in the event of a control device failure.

The command bus shall be designed so that failure of a line driver on a single control device shall not affect the operation of other control devices on the bus.

Proper command bus operation shall be possible with as much as 305 m of coaxial cable.

The system shall provide two dedicated selectable RS-232/RS-422 serial ports for external control. These ports shall provide terminal control via system-supplied control menus. The ports shall also support ASCII message protocol.

One RS-232/RS-422 port shall also provided to function as the system configuration port. It is used for initial system configuration (or modification) via system supplied menus.

The configuration/installation port shall provide access to the following functions: define matrix maximum input, maximum output, maximum level; write/edit input transcode table; write/edit remote control panel programming table (for button-per-source single destination panels and machine control options); set/read system real time clock; display system module map; display system error registers; display control panel serial data; display system memory; display system protect map; log (when used with external printer) protect transactions (or both type transactions); plus create, preview, and erase "phantom transcodes," capable of instituting multiple switching transactions in response to control panel commands.

Installation dependent data entered through the terminal shall be stored in EEPROM (electrically erasable programmable read-only memory).

Matrix status shall be stored in battery protected RAM (random access memory). Each control module shall have sufficient memory to store the status of a 32 input by 16 output 4 level matrix. The battery supply shall have sufficient capacity to power the memory for a minimum of 10 days.

The matrix control system support, as a minimum, the following bus-specific commands: "take" specified input, "tally" bus status, "protect" bus, and "chop" specified input with the input currently selected.

The system shall include two registers for storage of true salvo (simultaneous ganged-bus) switching.

The command bus protocol shall be designed to prevent execution of an erroneous or improperly formatted command message.

External control devices (including control panels) shall append a checksum to all messages sent to matrix control module. Upon receipt of a message, the active control module shall compute its own checksum and compare it to the value of the received checksum. Processing of the command shall take place if, and only if, the two checksums match. If they do not match, the control module shall transmit an error response on the command bus.

The matrix control module shall perform the following checks on all messages received: command opcode validity, proper message format, crosspoint presence, crosspoint protect status, and checksum match. Failure of any of these checks shall cause the control module to abort further processing of the message and to transmit a coded error response on the command bus.

Maximum permissible length of logic inter-connect cables between matrix levels (e.g. Video) shall be 152 m.

The system shall accept multiple control panel types. Among these shall be multi-destination control panel (CP).

Multi-Destination Control Panel

Multi-destination control panel shall permit field programming of destinations driven by each of eight operational segments. These segments shall individually display the source currently selected to their associated destination. These panels shall also be capable of being programmed on-site to operate a single level, any combinations of levels, or all levels of system. It shall also be possible to program these panels for control of no levels, effectively locking the panel from unauthorized operation. Multi-destination panels shall support at least ten locations for multi-level "breakaways" which may be recalled at any time for use to any destination represented on the panel. Programming the front of the panel, requiring the holding down of two switches plus actuation of a third to enter each programming mode. Such panels shall incorporate front-panel accessible diagnostics to test all indicators and readouts.

Programming via the graphic user interface shall allow user to: (1) Enable/disable function push buttons (DEST, LEVEL, SALVO, PROT, CHP); (2) Enable/disable control of output monitor cross points; (3) Program buttons to select any combination of source and destination names; (4) Select if PROT, when active, does or does not source changes at this panel.

Each destination shall have an independent source STATUS window. A common source preset window shall also provide error/system messages when necessary. Front panel level selection shall be via PREV/NEXT buttons. Independent destination protection (PROT) on one or more of the 8 destinations shall prevent other panels from changing sources. Front panel ID button shall display panel name, destination being controlled, tally level, and panel software version.

The multi-destination control panel shall be rack-mount on an EIA-310 rack cabinet taking up 2 rack units, maximum.

The system shall support multiple optional interface devices which permit bi-directional communication between the matrix and "dumb" terminals or computers (equipped with a serial data port).

Each interface device shall have physically separate and electrically dissimilar ports for maintenance/installation and operational purposes to prevent unauthorized access to configuration tables.

Each interface device shall support minimum of two operational ports, each of which shall be independently configurable for: EIA-422 or EIA-232 operation; baud rate; parity; number of stop bits; number of data bits per character; signaling protocol; exclusion of control over any destination or list of destinations (which need not be contiguous).

Each interface frame shall accommodate at least two processor modules as described above plus a single independently removable power supply.

Provision shall be made in each interface frame to allow two command bus connections per interface module, permitting the use of up to four command busses to each frame for maximum protection against bus interruption.

Accessory Items.—Service manual describing the analog video and PTZ control data matrix system as provided and in accordance with these specifications.

Service Manual Requirements.—Two sets of service manual shall be provided. Each manual shall contain a general information section which shall include the following items:

A list of applicable subassemblies that comprise the specified equipment.

Overall description of the equipment design features (including all enhanced features if applicable), performance, and applications.

Equipment specifications summary.

Equipment installation instructions including step-by-step alignment and adjustment procedures, and removal and installation procedures.

1. Theory Of Operations Section**.—**Each manual shall contain equipment theory of operation section which shall include the following items:

A. Theory of operation of the standard equipment, with unique or unusual circuitry described in detail.
B. Theory of operation reflecting any modifications to the standard equipment.

2. Maintenance Section**.—**Each manual shall contain an equipment maintenance section which shall include the following items:

A. Recommended test equipment and fixtures, or minimum operational and performance requirements for appropriate test equipment.
B. Troubleshooting information and charts.
C. Removal and installation procedures for replacing assemblies and subassemblies, if not obvious or if improper sequencing of steps may result in component damage.

3. Replacement Parts Section.—Each manual shall contain an equipment replacement parts section which shall include component parts list including electrical parts, mechanical parts, and assemblies. All semiconductors shall be identified by the supplier's numbers and, as applicable, by JEDEC numbers.

4. Diagram Section.—Each manual shall contain an equipment diagram section which shall include the following items:

A. Schematic diagram(s) identifying all circuit components and showing normal test voltages and levels.
B. An overall functional block diagram.
C. Detailed interconnecting diagram(s) showing wiring between modules, circuit boards, and major components.
D. Diagram(s) showing location of circuit boards and other subassemblies.
E. Exploded view diagram(s) of complex mechanical assemblies.

5. Physical Requirements.—Each manual shall conform to the following physical requirements:

A. All pages, including latest revisions, shall be securely fastened together between protective covers (a standard 3-hole loose-leaf ring binder is acceptable).
B. Each manual page shall be sequentially numbered.
C. Each manual page which is larger than 215 mm wide by 280 mm high shall be folded down to 215 mm wide by 280 mm high and shall be completely visible when the manual is unfolded.
D. No page shall be subject to fading from exposure to any normal source of ambient lighting (ozalid reproduced pages are not acceptable).

Network management computer - laptop.—The network management computer (laptop) shall include the following specifications as a functional and operational unit:

1. Processor - Pentium 166 MHz or faster with internal 256 kB level 2 cache.
2. Memory - a minimum of 32 MB of RAM upgradable to 64 MB.
3. A 10.4" Active-Matrix SVGA TFT.
4. Fax modem and Ethernet (801.3 IEEE compatible) combo PCMCIA card, 33.6 K baud rate.
5. One 1.2 GB internal hard disk drive.
6. A minimum of 16-bit sound blaster with build-in microphone/speaker.
7. Simultaneous display on external monitor.
8. One 3.5-inch MS-DOS/IBM compatible internal floppy drive with a minimum formatted capacity of 1.44 MB.
9. One internal CD ROM drive, access time less than 150 ms, with 1200 Kbps (8X mode) data transfer rate.
10. Two serial ports.
11. AC adapter/battery charger.
12. Parallel and serial ports.
13. 32-bit local-bus and hardware.
14. Laplink remote access.
15. Track ball or mouse included.
16. Long lasting lightweight Lithium ion battery.
17. Carrying case.

The network management computer shall include the following pre-installed software:

1. MS-DOS 6.22 and Windows 95.
2. Procomm/Kermit, latest version.
3. Software and licenses for Microsoft Office’97 Professional, latest version.
4. Software and licenses for FileMaker Pro, latest version.
5. SUN PC-NFS Network software.
6. GVG Series 7000 Graphic User Interface (GUI) software.
7. All software media shall be in CD-ROM format.

POWER STRIP

Each power strip shall have maximum rating of 15 A, 126 V(ac), 60 Hz, 1835 W (continuous duty). The power strip shall have surge protection with UL_ 1449 Clamping Level of 400 V, a IEEE Let-Through Voltage rating of less than 340 V and a single-pulse energy rating of 360 J. The power strip shall rated for EMI/RFI noise protection at 20 dB. Each power

strip shall be 43 mm (H) x 432 mm (W) x 114 mm (D) and shall not weigh more than 2.3 kg. The power strip shall rack mount to a standard EIA-310, 483 mm rack cabinet. The power strip shall have four outlets in front and four in back, each 53 mm apart and rotated 90 degree, "U" ground facing down.

VIDEO AND PTZ CONTROL DATA TRANSMISSION SYSTEM

A video transmitter duplex data (VTDD) unit and a video receiver duplex data (VRDD) unit shall be connected by singlemode optical fiber to form a video and PTZ control data link. The video and PTZ control data link is to provide simplex transmission and reception of a full-motion NTSC baseband video signal from camera end to video matrix switch as well as full-duplex data between the camera end and the data matrix switch.

Link budget via single mode optical fiber (9/125 _m) shall be at least 25 dB from VTDD to VRDD and at least 37 dB from VRDD end to VTDD. For the direction from VTDD to VRDD (9/125 _m SM fiber), the transmit coupled power shall be -7 dBm and the minimum receiver input shall be -32 dBm. For the direction from VRDD to VTDD via 9/125 _m SM fiber, the transmit coupled power shall be -7 dBm and the minimum receiver input shall be -44 dBm.

A loopback test shall test the data encoding and decoding and input/output circuitry by looping the data input back to the local output. At the optical side, the fiber optic data will be loopback from the local receiver to the local transmitter, effecting a data loopback at the remote unit. This shall test both the remote data encoder and the decoder as well as both directions of the optical link.

Both VTDD and VRDD shall operate over a temperature range of 0°C to 70°C. The VTDD shall be stand-alone type shall be mounted securely on a shelf that fastened to EIA-310 standard equipment rack in each cabinet. The VRDD at the hub location shall be rack mount type installed in a card cage assembly. The card cage assembly shall be EIA-310 rack-mount type with at least 14 slots and with power supplies for redundancy. The size and mounting arrangements shall be consistent with the space allocated in the cabinet layout drawings as shown on the plans. The equipment shall be mounted in a manner which allows easy access to all connections and indicators. All mounting hardware and mounting shelfshall be provided by the Contractor.

10-3.26 VIDEO TRANSMITTER/ DUPLEX DATA

The video transmitter/duplex data (VTDD) unit shall accept any NTSC baseband video signal and an EIA-232 data signal to convert it to a signal suitable for launching into one singlemode optical fiber.

The video interface to VTDD shall be a nickel plated, bulkhead female BNC-style connector with a gold plated contact. The video transmitter shall accept a composite video signal at a level of 1.0 V peak to peak between sync tip and reference white, as measured on an oscilloscope. The transmitter shall operate as specified when the peak-to-peak value of the signal varies between 0.71 and 1.4 V. The nominal input impedance shall be 75 Ω and the return loss shall be at least 30 dB in compliance with EIA RS-250 for an unbalanced to ground connection. Differential gain shall be less than 3 percent typical, 5 percent maximum at 3.58 MHz. Differential phase shall be less than 3 degree typical, 5 degree maximum at 3.58 MHz. Bandwidth with at -3 dB points shall be between 2 Hz to 15 MHz. Weighted signal to noise ratio (SNR) shall be 60 dB for greater than or equal to -21 dBm input to the receiver.

The video signal and the EIA-232 data shall be applied to the optical source to produce a pulse rate modulated optical signal using pulse frequency modulation (PFM) technique. The VTDD shall have a laser emitter with a wavelength at 1550 nm to transmit simplex video and EIA-232 signals. The VTDD shall receive EIA-232 data using 1310 nm wavelength. The transmission range shall be up to 60 km via a singlemode fiber optic (9/125 _m). The transmitter shall interface to fiber with an ST style compatible connector. The video transmitter launch power shall be defined as the power launched by the transmitter into at least one meter of step index optical fiber with a nominal core diameter of 8.3 µm, a nominal cladding diameter of 125 µm and a theoretical numerical aperture of 0.275. The video transmitter launch power shall be at least 18 dB greater than the video receiver sensitivity. The optical modulation bandwidth required by the video transmitter for specified video link performance shall be 60 MHz, maximum.

The video transmitter shall include a power supply, which may be external to the remainder of the video transmitter components. The transmitter shall be powered from existing 120 V(ac) ±15 percent, 60 Hz ±5 percent power receptacle. The power supply shall supply all voltages required by the video transmitter for operation. The video transmitter shall have a panel indicator visible from the front that shows power "ON".

VIDEO RECEIVER/ DUPLEX DATA (VRDD).—The VRDD unit shall be compatible with the VTDD and from the same manufacturer. The VRDD shall receive the optical signal launched into the singlemode optical fiber by the corresponding VTDD. The optical interface to the receiver shall be a ST-style connector. The video receiver shall use a PIN photodiode or an avalanche photodiode to convert the optical signal into an electrical signal. The receiver sensitivity shall be defined as the minimum optical power required to operate at the minimum video link and EIA-232 data signal performance specifications. The VRDD shall have an optical dynamic range of at least 10 dB. If the saturation level of the receiver is not greater than the transmitter launch power level minus one dB, attenuators shall be installed between the fiber and the receiver to attenuate the received signal level. The video output interface from the video receiver shall be a nickel-plated, bulkhead

BNC-type connector with a gold plated contact.

The baseband video signal output from the video receiver when it is receiving an optical signal from the video transmitter at an average power level equal to the video receiver sensitivity shall meet the following performance specifications defined and measured in accordance with EIA-250 for end-to-end modified performance:

Output signal level.
Amplitude vs. frequency characteristic.
Chrominance to luminance gain inequality.
Chrominance to luminance delay inequality.
Field time waveform distortion.
Line time waveform distortion.
Insertion gain variation.
Differential gain.
Differential phase.
Signal-to-noise ratio.
Signal-to-low frequency noise ratio.

The video receiver installation shall include all mounting hardware necessary to mount it in the EIA-310 standard equipment rack in each cabinet. The size and mounting arrangements shall be consistent with the space allocated in the cabinet layout plans. It shall be mounted in a manner that allows easy access to all connections and indicators.

The video receiver shall operate over a temperature range of 0˚C to 70˚C. Power shall be supplied from an existing 115 V(ac) ±15 percent, 60 Hz ±5 percent, power receptacle inside the cabinet reserved for communications equipment. The video receiver shall include a power supply, which may be external to the single video receiver. The power supply shall supply all voltages required by the video receiver for operation, and panel indicators visible from the front of the receiver that show DC power on and received optical signal present.

The Contractor shall perform pre-installation testing to verify that the single VTDD and single video VRDD are compatible, meet manufacturers specifications and the requirements of these special provisions.

INSTALLATION OF VIDEO AND PTZ CONTROL DATA TRANSMISSION SYSTEM.—The Contractor shall be responsible for all testing and documentation required to establish approval and acceptance of the production, installation and operation of these materials and equipment. The specific quality control requirements require the Contractor to input a video test signal into the video transmitter and set the optical power measured at the receiver end of the fiber to the video receiver sensitivity level. The optical signal shall then be connected to the video receiver with a monitor connected to its output. The Engineer shall then qualitatively assess the monitor output. The signal-to-noise ratio and signal-to-low frequency noise ratio shall be measured and recorded.

All indicators shall be verified to function correctly.

10-3.27 SERVICE MANUAL REQUIREMENTS

The Contractor shall provide to the Engineer a minimum of one copy of service manual per camera station for the camera unit, pan/tilt unit, camera control unit (CCU), video encoder unit (VEU), video decoder unit (VDU) and integrated services digital network terminal adapter (ISDN TA) unit under this special provisions. Each manual shall contain the following sections and sub-sections.

GENERAL INFORMATION SECTION

a. A list of applicable subassemblies that comprise the specified equipment.
b. Overall description of the equipment design features (including all enhance features if applicable), performance, and applications.
c. Equipment specifications summary.
d. Equipment installation instructions.

THEORY OF OPERATIONS SECTION

a. Theory of operation of the standard equipment, with unique or unusual circuitry described in detail.
b. Theory of operation reflecting any modifications to the standard equipment.

MAINTENANCE SECTION

a. Recommended test equipment and fixtures, or minimum operational and performance requirements for appropriate test equipment.
b. Trouble shooting information and charts.
c. Removal and installation procedures for replacing assemblies and subassemblies, if not obvious or if improper sequencing of steps may result in component damage.

REPLACEMENT PARTS SECTION

a. Each manual shall contain an equipment replacement parts list including electrical parts, mechanical parts and assemblies.
b. All semiconductors shall be identified by the supplier's numbers and by JEDEC numbers if applicable.

DIAGRAM SECTION

a. Schematic diagrams(s) identifying all circuit components and showing normal test voltages and levels.
b. An overall functional block diagram.
c. Detailed interconnecting diagram(s) showing wiring between modules, circuit boards and major components.
d. Pictorial circuit board layout diagram(s) showing both component placement and printed wiring detail.
e. Diagram(s) showing location of circuit boards and other subassemblies.
f. Exploded view diagram(s) of complex mechanical assemblies.

PHYSICAL REQUIREMENTS

a. All pages, including latest revisions, shall be securely fastened together between protective covers (loose-leaf ring binding is acceptable).
b. No page shall be subject to fading from exposure to any normal source of ambient lighting (ozalid reproduced pages are not acceptable).

10-3.28 TRAFFIC OPERATION SYSTEM

The traffic operation system shall include the installation of closed circuit television camera stations, traffic monitoring stations, ramp metering system, extinguisable message sign system, microwave vehicle detection sensor system, fiber optic data modems and fiber optic system, as shown on the plans and in conformance with these special provisions.

The contract unit prices paid for items listed in the Engineer's Estimate to be installed under traffic operation system shall cover all requirements and delivery to the project for installation by the Contractor. The cost of installing, testing after installation and receiving the Engineer's approval for traffic operation system, of those items listed below, shall require the proper operation and approval of their respective sub-systems they are part of:

Camera unit.
Pan and tilt unit.
Camera control unit.
Video transmitter duplex data.
Microwave vehicle detection sensor system (wireless and hard-wired)
Fiber optic data modem.
Fiber optic cable termination.
Service box.

TRAFFIC OPERATIONS SYSTEM EQUIPMENT TESTING

Prior to shipping to the project, the Contractor shall submit the following items to the State of California, Department of Transportation Laboratory, 5900 Folsom Blvd., Sacramento, CA 95819 for acceptance testing:

1. Camera units
2. Pan and tilt units
3. Camera control units
4. Extinguishable message sign panels

Approximately 30 days will be required for the testing. The Contractor will be notified upon completion of the testing

and shall arrange for delivery of the equipment to a storage location designated by the Contractor. The costs of such testing and the transportation to and from the Laboratory shall be borne by the Contractor.

CLOSED CIRCUIT TELEVISION CAMERA STATION

The Contractor shall install the following closed circuit television (CCTV) equipment at each camera station as described in these special provisions and as shown on the plans:

1. One camera unit.
2. One pan and tilt unit.
3. One closed circuit television camera pole.
4. One camera junction box.
5. One camera control unit.
6. One video transmitter duplex data (described elsewhere in these special provisions).
7. One Fiber Distribution Unit (described elsewhere in these special provisions).
8. Cables and conductors (as required).

1. Camera Unit

Each camera unit shall consist of a camera, lens, environmental housing and camera unit cable assembly. The camera, lens and environmental housing, combined, shall not weigh more than 6.8 kg. Each camera unit shall be interchangeable with the existing camera units already installed on various traffic operations system (TOS) projects without changes or adjustments to either the system or the camera unit.

Each camera unit shall be assembled, inspected, and tested in accordance with these special provisions prior to delivery to the job site. Installation, operations and maintenance manuals shall also be submitted at the time of delivery.

Applicable Documents - The following documents of the U.S. Military Specification (MIL-SPEC), Underwriters' Laboratory, Inc. (UL), Electronics Industries Association (EIA) Standards, and other Standards form parts of the specification to the extent specified in these standards. In the event of a conflict between the content of this section and the content of the specification, the standards defined in this section shall supersede.

Military Specification Documents	
MIL-I-45208A	Inspection System Requirements, Dec. 16, 1963
MIL-C-45662	Calibration System Requirements, June 10, 1980
MIL-STD-416A	Electromagnetic Interface Characteristics Requirements for Equipment, Subsystems & Systems, Aug. 1, 1968
MIL-E-5400T	Electronic Equipment, Airborne General Specification
MIL-STD-810	Environmental Test Methods, 19 July 1983
MIL-C-5541	Chemical Conversion Coatings on Aluminum Alloys, June 3, 1970

Underwriters' Laboratory, Inc. and other documents	
UL-796	Printed Circuit Boards
EIA-170A	Electrical Performance Standards Color Television Studio Facilities
EIA RS-330	Electrical Performance Standards for Closed Circuit Television (CCTV) Camera 525/60 Interlaced

A. Camera

Approved Camera - The cameras listed below have been approved by the Engineer. Further information such as the source of the cameras can be provided upon demand. Any camera submitted by the Contractor that is not one of the approved cameras listed below shall be stringently compared to the specifications set forth in these special provisions before it is approved by the Engineer. Approved cameras are (1) Cohu 8240, (2) Sony SSC-C374 and (3) Burle/Philips TC293C-Z0P2X596.

(1) General

a. Each camera shall be self-contained and designed for continuous unattended 24-hour operation.
b. Camera performance shall meet or exceed EIA-170A standards.
c. Each camera shall have automatic sensitivity and black level control so that it operates without further

adjustment when illumination ranges from the minimum specified herein to that of full daylight.

d. Each active electronic device within the camera shall be solid-state.

e. Each camera shall have a switch selectable electronic shutter. The shutter speed shall range from 1/60 of a second (off) to 1/10,000 of a second in 8 steps. The control of the electronic shutter rate shall be accessible through a side panel opening. Remote on/off control of the shutter shall be accomplished via an output connector on the rear of the environmental housing.

(2) Light sensitivity - At a scene with 50 percent light reflectivity and with light level on the scene measured to be 10 lux and greater, each camera with its 10:1 zoom lens shall generate a picture on the monitor specified in these special provisions which resolves all 10 shades of gray on the EIA Television Test Chart. Not every camera shall be required to resolve the same gray scale when the light level on the same scene is measured to be less than one lux.

(3) Electrical Power - Each camera shall operate when the applied voltage is between 95 to 130 V(ac), 60 Hz ±0.3 Hz, single phase. The power consumption of camera shall not exceed 10 W. All camera circuitry shall be powered by a regulated, over-voltage protected DC power supply contained in the camera.

(4) Synchronization

a. Each camera shall generate synchronization signals by means of a single integrated circuit.

b. Each camera shall operate with the internal EIA-170A crystal as the sync reference source with the field rate of 59.94 Hz.

c. Each camera shall have the capability of synchronizing to an external input source.

d. The synchronization signal at the video output shall conform to EIA-170A.

(5) Scanning - Each camera's mode of scanning shall be two-to-one interlaced at 525 lines, 60 fields per second, as specified by EIA-170A.

(6) Video Processing

a. The video output level shall be maintained to within 3 dB for changes in scene brightness of 0.17 to 109 600 cd/m^2 using a motorized iris lens having a transmission range of F/1.2 to F/1200.

b. Each camera shall have a black-level control system.

c. Each camera shall have an automatic white (color) balance control to maintain proper color rendition by automatically referencing to white areas of the scene. Manual control of the white balance shall be accessible through side panel or remotely controlled via the rear connector on the environmental enclosure.

d. Automatic gain control (AGC). The switch selectable fixed gain response shall maintain the output video level to 90 percent video when the light level on the image sensor falls too low to maintain full video output. The video out will be maintained at 90 percent peak-average setting to optimize video output under varying lighting conditions. The controls for the on/off and peak average adjustments shall be accessible through the side panel of the camera.

e. One 75 Ω (±1 percent) source-terminated, single-ended video output jack shall be provided.

f. An adjustable white clipper shall be provided to limit highlight brightness.

g. The video output level shall be 1.0 V peak-to-peak composite (0.7 V video, 0.3 V sync) signal, polarity black negative, across a 75 Ω load impedance.

h. The minimum signal-to-noise ratio shall be 50 dB at 25°C.

(7) Imager

a. Each camera shall be designed to use a 12.7 or 16.9 mm format solid-state, color, interline transfer charged-coupled device (CCD) imager.

b. The imager shall have a minimum resolution of 768 horizontal by 493 vertical active picture elements.

c. When provided with 6.89 lux of highlight illumination on the environmental housing window, the camera shall provide the following resolution with AGC off:

i. Horizontal center resolution shall be 460 TV lines minimum.

ii. Vertical resolution shall be 350 TV lines minimum in the center and all corners simultaneously.

(8) Mechanical

a. All camera circuitry shall be on a printed circuit board which shall be removable and replaceable using no more than common hand tools.
b. Test points and adjustment identifications shall be etched or silk-screened on the boards.
c. Each camera shall be self-supporting and operable when removed from the environmental housing and shall have a lens adapter ring which accommodates a standard 16 mm C-mount. A back focal distance adjustment shall be provided.
d. Each camera shall utilize the rigidity of the environmental housing for strength against shock and vibration.

(9) Environmental Operation - Each camera within its environmental housing shall withstand the following requirements:

a. Operate over an ambient temperature range on -10°C to +50°C with the use of heaters.
b. Peak random vibration of 5 g from 60 to 1000 Hz, with camera in operation.
c. Shock up to 15 g in all axes under non-operating conditions.
d. Exposure to sand, dust, fungus, and salt atmosphere as per MIL-E-5400T paragraphs 3.2.24.7, 3.2.24.8, 3.2.24.9, and 3.2.24.10.
e. Up to 100 percent relative humidity as per MIL-E-5400T, paragraph 3.2.24.2.

(10) Picture Quality

a. The quality of the picture shall be such that most objects in low light levels can be distinguished without excess interference from undesirable picture attributes.
b. Undesirable picture attributes include blooming, transfer smear and vertical register shifting.

B. Lens

(1) General

a. Each lens shall be fully compatible with the camera provided.
b. Each lens shall have a maximum aperture of no less than F/1.2, and a minimum range of F/1.2 to F/1200.
c. Each lens shall be a 16 mm C-mount.
d. Each lens shall have a minimum zoom range from 10 to 1. The lens focal length for a 16.9-mm CCD camera shall be shall be 10-100 mm, 10.5-105 mm or 11-110 mm. The lens focal length for a 12.7 mm CCD camera shall be shall be 8-80 mm. A 1.5-X extender shall be included with the lens.
e. Each lens shall be equipped with a motorized zoom and focus control.
f. Each lens shall have an automatic, motor-driven iris with manual override. The iris shall be controlled directly through the camera in automatic mode and from the camera control unit in the manual mode. The automatic iris shall provide continuous aperture adjustments of the lens as determined by the amount of light reaching the camera imager. The power supply and electronics for iris motor shall be contained within the environmental housing.
g. Each lens shall be fitted with an intra-spot neutral density filter.
h. Each lens shall be able to respond to the following inputs from camera control unit (CCU) for lens control:

Focus near	+9.0 V(dc) @ 100 mA
Focus far	-9.0 V(dc) @ 100 mA
Zoom in	+9.0 V(dc) @ 100 mA
Zoom out	-9.0 V(dc) @ 100 mA
Iris closed	+9.0 V(dc) @ 100 mA
Iris open	-9.0 V(dc) @ 100 mA

i. The travel time for the upper limit stop to the lower limit stop for zoom and focus shall be from 5 seconds minimum to 10 seconds maximum.
j. Each lens shall have the capability of at least 10 pre-positioning positions.

(2) Environmental Operation - Each lens within its pressurized environmental enclosure shall withstand the following requirements:

a. Operate over an ambient temperature range on -10°C to +50°C with the use of heaters.

b. Peak random vibration of 5 g from 60 to 1000 Hz, with lens in operation.
c. Shock up to 15 g in all axes under non-operating conditions.
d. Exposure to sand, dust, fungus, and salt atmosphere as per MIL-E-5400T paragraphs 3.2.24.7, 3.2.24.8, 3.2.24.9, and 3.2.24.10.
e. Up to 100 percent relative humidity as per MIL-E-5400T, paragraph 2.24.2.

C. Environmental Housing

(1) General

a. Each camera and lens shall be mounted in a sealed, cylindrical, environmental housing which shall not exceed 165 mm in diameter and 560 mm in length.
b. The housing shall be fabricated of seamless aluminum tubing Type 6061-T6 and shall be finished with heat reflecting, weather resisting enamel. The rear plate shall be fabricated of Type 6061-T6 aluminum.
c. The front of the housing shall be closed with a clear optically flat glass or Lexan window.
d. The housing shall include a sun shroud which shall be strapped to the housing bindings in such a manner as to minimize heat conduction by maintaining air space between shroud and housing. The shroud shall shield the entire top portion of the housing from the sun, and shall extend a minimum of 76 mm in front of the housing's glass plate.
e. The housing shall not interfere with the widest viewing angle of the lens.
f. The housing shall include a thermostatically controlled heating pad rated at 115 V(ac), 100 W maximum.
g. The backplate, which is an integral part of the housing, shall have a nameplate attached bearing the manufacturer's camera assembly model number and serial number.
h. Camera connector

i. The camera connector shall be designed to MIL-C-28462 Series 1 specifications with solder contacts. It shall be Type PT-07C-20-39 P, the male counterpart to Type PT-06A-20-39 S (SR).
ii. The connector shall be made of the same shell material and pin arrangement as the Type PT-06A-20-39 S (SR) connector on the end of the wiring harness.
iii. The pinout of the connector shall be as shown on the plans.
iv. Each camera connector shall be mounted on the rear plate with an airtight connection and a watertight seal for each conductor on its connecting cable.

i. Each camera shall be designed for operating with the housing purged of air and filled with dry nitrogen to 35 kPa.
j. Valves

i. The housing shall have two valves, both on the rear end plate of the housing.
ii. One valve shall be a standard Schrader valve. It shall have a tube running from the valve to the front end of the housing.
iii. The other valve shall be an air escape/pressure relief valve preset to 140 kPa.
iv. The two valves shall be arranged such that filling with dry nitrogen from the Schrader valve will force gas to flow from front end of the housing to the rear end and vent through the air escape valve.
v. The leakage rate with both valves closed and the housing pressurized to 70 kPa, shall leak less than 7 kPa per year, and less than 0.7 kPa per month.

k. The enclosure shall be factory pressurized to 35 kPa with dry nitrogen.
l. The notation "CAUTION PRESSURIZED" shall be printed on the rear plate of the enclosed.
m. A safety pressure release bolt shall be incorporated such that the enclosure may not be opened without first releasing the internal pressure.
n. A low-pressure (LP) sensor with related circuitry shall be provided to send an LP alarm (dry contact closure) via the camera connector. The LP sensor threshold shall be preset to activate the LP alarm at 14 kPa.
o. Two units of desiccant shall be placed inside the housing but will not obstruct the camera view or operation.
p. A humidity level indicator strip with discrete indications for 10, 20 and 30 percent humidity, shall be installed inside the housing in a position that allows inspection, while facing directly, through the window without obstructing the view of the camera at the widest viewing angle of the lens.

(2) Mounting Base

a. A mounting base shall surround the enclosure to provide a tamper-resistant attachment of the environmental housing to the pan and tilt unit and securely hold the housing in either an upright or inverted position. The combined height of camera housing and mounting base shall be less than 254 mm. The mounting base attachment shall be as shown on the plans.
b. All fasteners and nuts used in attaching the mounting base to the environmental housing shall be of Type 18-8 stainless steel.
c. Each camera unit shall be provided with three stainless steel hex head bolts to secure the camera unit to the pan and tilt unit.

D. Camera Unit Cable Assembly

(1) General - Each camera unit cable assembly shall consist of box mounting socket connector and a wiring harness.

(2) Box Mounting Socket Connector

a. Each box mounting socket connector shall be in conformance with Military Part Numbering System Designation: MS-3102E-28-21S-F80.
b. One full set of crimp contacts shall be provided with each box mounting socket connector.
c. The pinout of the connector shall be as shown on the plans.

(3) Wiring Harness
a. The camera unit cable assembly wiring harness shall be 3 m long and shall be COHU AC27E or other cable approved by the Engineer. The coaxial cables' impedance shall be 75 Ω. One end of each wiring harness shall be Type PT06A-20-39S (SR) and shall mate with the camera connector. It shall have a 90-degree end bell, Bendix 10-25997-203 or equal, for strain relief. The end bell shall be positioned such that the opening is 180 degrees from the main key on the connector. The other end of each wiring harness shall be in conformance with Military Part Numbering System Designation: MS-3106E-28-21P and shall mate with the box mounting socket connector.
b. All connectors shall be potted with an appropriate potting compound for environmental sealing.
c. All connectors' pinout shall be as shown on the plans.

2. Pan and Tilt Unit

A. General
(1) Each pan and tilt unit, with camera unit attached, shall pan 355 degrees minimum in either direction, and tilt 60 degrees minimum from horizontal position to either up or down positions.
(2) Each pan and tilt unit shall be capable of minimum ten preset positions for each pan and tilt operation.

B. Electrical
(1) Each pan and tilt unit shall operate with input voltage of 115 V(ac), 60 Hz ±0.3 Hz.
(2) Each pan and tilt unit shall not exceed 200 W power consumption.
(3) The motors shall be impedance overload protected, two phase induction type, rated for continuous duty and shall be instantaneous reversing.
(4) The limit switches shall be rated 5 A, 10 million cycles and with external adjustments.
(5) Each pan and tilt unit shall be provided with box-mounting type connector.
(6) One mating connector with full set of crimp contacts and strain relief shall be provided with the box-mounting connector.

C. Mechanical
(1) The maximum load shall be 45 kg at 127 mm from tilt table to center of gravity in both upright and inverted position.
(2) Each pan and tilt unit shall have maximum dimensions of 400 mm high, 355 mm wide and 230 mm deep.
(3) Each pan and tilt unit shall not exceed the maximum mass of 27 kg.
(4) Each pan and tilt unit shall be constructed in aluminum casting and plate. All internal parts shall be corrosion protected.
(5) Each pan and tilt shall have textured semi-gloss beige enamel finish.
(6) All bearings shall be heavy duty ball or roller bearing.
(7) All gears shall be hardened steel.
(8) All gasket seals shall be designed for all weather protection.

(9) Each pan and tilt unit shall have a mounting hole pattern as shown on the plans.
(10) Each pan and tilt unit shall have a minimum pan torque rating of 34 N·m and an instantaneous minimum tilt torque of 68 N·m.
(11) The pan speed at no load shall be 6 to 8 degrees per second, nominal.
(12) The tilt speed at no load shall be 3 to 4 degrees per second, nominal.

D. Environmental
(1) Ambient operating temperature shall be from -10°C to 50°C.
(2) The pan and tilt unit shall be able to withstand vibration of 760 µm total excursion from 5 to 30 Hz and a peak random vibration of 5 g from 30 to 1000 Hz.
(3) The pan and tilt unit shall be able to withstand shock up to 15 g in all axes under non-operating conditions, conforming to MIL-E-5400R, Para. 3.2.24.6.
(4) The pan and tilt unit shall be able to operate in atmospheres up to 95 percent relative humidity, conforming to MIL-E-5400R, Para 3.2.24.4.
(5) The pan and tilt unit shall be able to withstand exposure to sand, dust, fungus, and salt atmosphere, conforming to MIL-E-5400R, Para 3.2.24.7, 3.2.24.8 and 3.2.24.9.

E. Pan and tilt unit mounting

The nuts and bolts securing the pan and tilt unit to the camera platform shall be hex head and made of stainless steel. Before each bolt is fastened, a locking type coating shall be applied to the threads. The coating shall lock the bolts and nuts in place making it impossible to turn bolt or nut without tools. This coating shall last and be effective through at least 10 insertions and withdrawals of the bolt or nut.

3. Closed Circuit Television Camera Pole

Closed circuit television camera poles shall conform to the provisions in Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

4. Camera Junction Box

The camera junction box (JCB) shall be constructed as shown on the plans and described in these special provisions. All seams shall be continuously welded. All JCB mounting Hex head stainless steel nuts and bolts shall be 6 mm □-20 x 25 mm. Steel surfaces on which JCB is to be mounted shall be drilled and tapped 6 mm □-20 thread. Each JCB shall be fabricated from 14-gage sheet steel. Two 8-32 threaded studs for terminal strip mounting shall be welded on the bottom of the box as shown on the plans. After fabrication the JCB shall be hot-dip galvanized.

A twenty position terminal block with No. 8 lugs and cover shall be mounted on the bottom of the box. Permanent terminal position markings shall be used. A laminated wiring schematic shall be permanently attached to the inside of box cover showing wiring from the camera unit box mounting connector to the terminal block.

5. Camera Control Unit

Each part of each camera control unit (CCU) shall be electrically and physically interchangeable with the like part in any other CCU furnished under this contract. The CCU shall be installed inside State-furnished control cabinet as shown on the plans.

A. Mechanical
(1) Each CCU shall mount in 133 mm of EIA-310 rack space with a maximum depth of 356 mm.
(2) The front panel shall be white gloss color Number 17886 as per Federal Standard Color Chart 595B.
(3) The front and rear panel lettering shall be black color Number 17986 of Federal Standard Color Chart 595B.
(4) A high-impedance panel jack BNC (Bayonet Nut connector) connector shall be installed on the front panel as shown on the plans. This connector shall provide video input to a test monitor without affecting the remainder of the CCTV system. This connector shall be directly connected to the video input on the rear panel.
(5) A glass type, size 6.35 mm x 31.75 mm (AG) slow blow fuse shall be installed on the front panel. The fuse shall be replaceable from the outside of the front panel.
(6) Switches shall protrude no more than 25 mm from the front panel and shall be mounted as shown on the plans.
(7) The rear panel connectors shall be mounted as shown on the plans and shall meet the following requirements:

a. Connectors C1-C3 shall be of the following type or equivalent:

C1	AMP 206430-1

C2	AMP 206043-1
C3	AMP 206306-1

b. The pin and socket contacts for connectors C1-C3 shall be constructed with brass contact body material and with stainless steel spring that are sub-plated with 1.27 µm nickel and plated with 0.762 µm gold. Pin diameter shall be 1.575 mm. Contact size shall be 16.
c. Each C1, C2 and C3 connector shall use the AMP No. 601105-1 or No. 91002-1 contact insertion and the AMP No. 305183 contact extraction tool.
d. One mating connector with a full set crimp contacts and strain relief shall be supplied with connectors C1, C2 and C3.
e. The connectors C4 and C5 shall be a DB-25 socket connector.

(8) Serial cable assemblies (SCA1 and SCA2) with length of 3 m shall be provided to mate with C4 and C5, respectively.
(9) Pin and socket contacts for DB-25 connectors shall be copper alloy body; finished with 0.762 µm gold over 1.27 µm nickel.
(10) The rear and front panel BNC connectors shall be of copper material with bright nickel (tarnish resistant) finish for the body and silver finish for the contact.
(11) Each printed circuit board shall be vertically installed.
(12) Each LED shall be equal to Hewlett Packard High Intensity Red Untinted, Non-diffused LED (Part Number HLMP-D105). Each LED shall be mounted as shown on the plans.
(13) A front panel on/off switch shall turn the CCU on/off and shall also control AC power to the rear panel power output connector (C1). The indicator used for AC power shall be green when energized.
(14) One coaxial cable labeled "AVO" (Analog Video Output) terminated with BNC plug connectors on each end shall be provided. This cable shall be RG-59/U with overall length of one meter.

B. Electrical
(1) Each CCU shall have auto-iris override.
(2) Each CCU shall have circuitry to detect the absence and presence of video sync on its video input. Each CCU shall also have circuitry to monitor the low-pressure alarm contact closure from the camera unit. A local/remote control switch shall be provided to override the lens and pan and tilt controls through C4 when the switch is in local mode. When in local mode, the local control alarm shall be active. Alarm status shall be constantly monitored and updated. Upon receipt of a "status query" message, the CCU shall send alarm status message with data as follows:

"0"	None of the alarms active.
"1"	Local Control (LC) alarm active.
"2"	Low Pressure (LP) alarm active.
"3"	LP/LC alarms active.
"4"	Video Sync Absence (VSA) alarm active.
"5"	VSA/LC alarms active.
"6"	VSA/LP alarms active.
"7"	VSA/LP/LC alarms active.

The front panel alarm light shall be lit if any the alarms are active.
(3) Each CCU shall have circuitry for a source character generator. The source character generator shall display 16 alphanumeric characters superimposed on the video image. Each character shall be 28 TV lines high and shall be derived from a standard 5 x 7 dot matrix. The programmed characters shall be stored in a non-volatile memory. Upon receipt of "Set ID" message, the CCU shall position from the camera ID in the video image as follows:

"1"	Upper 15% limit of the left viewing area
"2"	Upper 15% limit of the right viewing area
"3"	Lower 15% limit of the left side viewing area
"4"	Lower 15% limit of the right side viewing area

The characters shall be superimposed on the video signal using non-additive mixing techniques.
(4) Each CCU shall be designed to prevent simultaneous operation of pan right/left, tilt up/down, zoom in/out, focus near/far or iris open/close.

(5) Each CCU shall have power supply(ies) for camera zoom, focus, motors, control and interface circuits. The voltage for zoom, focus and iris shall be selectable internally by one jumper for 12.0 V(dc), 9.0 V(dc) or 5.0 V(dc) at 100 mA. The CCU shall be pre-configured with the voltage jumper select set to 9.0 V(dc). The operation of zoom, focus and iris shall be as follows:

Zoom in	+V(dc)
Zoom out	-V(dc)
Focus near	+V(dc)
Focus far	-V(dc)
Iris close	+V(dc)
Iris open	-V(dc)

(6) The maximum power consumption for the CCU shall not exceed 450 W. Power consumption of equipment attached to pin 1 of connector C1 shall not exceed 100 W. Power consumption of equipment attached to pin 12 of connector C2 shall not exceed 200 W.

(7) Each CCU shall have eight independently operating 24 V(dc) relays (options 1 to 8). Each relay shall be single pole, double throw (SPDT), with contacts rated 1.25 A at 120 V(ac).

(8) Each CCU shall be capable of a minimum of ten presets and capable of controlling camera units and pan and tilt units equipped with pre-positioning feedback potentiometers. Each CCU shall have circuitry to filter out any electrical noise interference on each of the pre-positioning feedback voltage signal for the camera unit and pan and tilt unit.

(9) A system reset switch shall be a momentary-pushbutton type and be mounted on the front panel to function as external reset input to the microprocessor. System reset shall not cause existing pan and tilt and lens positions to change. System reset shall be executed without requiring the operator to hold the momentary-pushbutton for more than one second.

(10) The front panel of the camera control unit shall have LEDs and switches to provide the following control functions as shown on the plans.

Function	Hardware	Indicator
Zoom (In/Off/Out)	(ON)-OFF-(ON)	2 LED
Focus (Near/Off/Far)	(ON)-OFF-(ON)	2 LED
Pan (Left/Off/Right)	(ON)-OFF-(ON)	2 LED
Tilt (Up/Off/Down)	(ON)-OFF-(ON)	2 LED
Iris (Open/Off/Close)	(ON)-OFF-(ON)	2 LED
Iris override (Manual/Auto)	ON-OFF	1 LED
Option 1 (On/Off)	ON-OFF	1 LED
Option 2 (On/Off)	ON-OFF	1 LED
Option 3 (On/Off)	ON-OFF	1 LED
Option 4 (On/Off)	ON-OFF	1 LED
Option 5 (On/Off)	ON-OFF	1 LED
Option 6 (On/Off)	ON-OFF	1 LED
Option 7 (On/Off)	ON-OFF	1 LED
Option 8 (On/Off)	ON-OFF	1 LED
Alarm (On/Off)	ON-OFF	1 LED
Control (Local/Remote)	ON-OFF	
Reset	(ON)-OFF (momentary pushbutton)	

(11)

CCU connector assignments	
C1	4 contact connector
C2	14 contact connector
C3	37 contact connector
C4, C5	DB-25 connectors

C1 -- AC Power

Position	Function
1	AC +
2	AC -
3	Equipment Ground
4	NA

C2 -- Pan and Tilt			
Pos.	Function	Pos.	Function
1	Pan right	8	Pan feedback
2	Pan left	9	Tilt feedback
3	AC-	10	Preset -V(dc)
4	Tilt up	11	NA
5	Tilt down	12	AC+
6	AC-	13	AC-
7	Preset +V(dc)	14	Ground

C3 -- Camera			
Pos.	Function	Pos.	Function
1	Zoom	20	Option 3 N.O.
2	Z/F/I Common	21	Option 3 Common
3	Focus	22	Option 3 N.C.
4	Iris	23	Option 4 N.O.
5	Iris Override Common	24	Option 4 Common
6	Iris Override	25	Option 4 N.C.
7	Preset +V(dc)	26	Option 5 N.O.
8	Zoom Preset feedback	27	Option 5 Common
9	Focus Preset feedback	28	Option 5 N.C.
10	Preset -V(dc)	29	Option 6 N.O.
11	LP alarm	30	Option 6 Common
12	LP alarm	31	Option 6 N.C.
13	NA	32	Option 7 N.O.
14	Option 1 N.O.	33	Option 7 Common
15	Option 1 Common	34	Option 7 N.C.
16	Option 1 N.C.	35	Option 8 N.O.
17	Option 2 N.O.	36	Option 8 Common
18	Option 2 Common	37	Option 8 N.C.
19	Option 2 N.C.		

Note:
N.O. = Normally open
N.C. = Normally closed
NA = Not Available

C4, C5 -- Serial communication ports to and from external device.			
Pos.	Function	Pos.	Function
1	NA	14	NA
2	Transmit Data	15	NA
3	Receive Data	16	NA
4	NA	17	NA
5	NA	18	NA
6	NA	19	NA
7	Signal Ground	20	NA

8	NA	21	NA
9	NA	22	NA
10	NA	23	NA
11	NA	24	NA
12	NA	25	NA
13	NA		

Serial cables			
SCA1		SCA2	
DB-25 Pin	DB-25 Pin	DB-25 Pin	DB-25 Socket
2	2	2	2
3	3	3	3
7	7	7	7

C. Environmental

(1) Each CCU shall operate in an ambient temperature environment range from -10°C to 50°C.

(2) Each CCU shall conform to MIL-STD-810D-516.1 and MIL-STD-810D-514.1 shock and vibration test.

D. CCU Messages

(1) Each CCU shall communicate through the C4 serial port with the following communication message codes:

DIRECTION	MESSAGE	CHARACTER		DATA
		1ST CODE	2ND CODE	
Transmit	Alarm status	A	space	"0"-"7"
Receive	Status query	Q	space	NONE
Receive	Pan stop	p	space	NONE
Receive	Tilt stop	t	space	NONE
Receive	Zoom stop	z	space	NONE
Receive	Focus stop	f	space	NONE
Receive	Iris stop	i	space	NONE
Receive	Pan left	L	space	NONE
Receive	Pan right	R	space	NONE
Receive	Tilt up	U	space	NONE
Receive	Tilt down	D	space	NONE
Receive	Zoom in	I	space	NONE
Receive	Zoom out	O	space	NONE
Receive	Focus near	N	space	NONE
Receive	Focus Far	F	space	NONE
Receive	Iris open	J	space	NONE
Receive	Iris close	K	space	NONE
Receive	Iris manual	M	space	NONE
Receive	Iris auto	m	space	NONE
Receive	Set ID word	C	"1"-"4"	16-ASCII char.
Receive	Home position 0-9	H	"0"-"9"	NONE
Receive	Home position program 0-9	P	"0"-"9"	NONE
Receive	Option on 1-8	S	"1"-"8"	NONE
Receive	Option off 1-8	s	"1"-"8"	NONE
Receive	Enter Echo mode	E	space	NONE
Receive	Exit Echo mode	^]C	This sequence is not in a communication packet	

(2) After receiving the "enter echo" command the CCU shall pass all characters from C5 to C4 and C4 to C5. The CCU shall disable all camera movement.

(3) When the "exit echo" mode sequence is received on C4, the CCU shall return to normal operation.

E. Serial communications protocol

(1) The communication protocol shall consist of 8 data bits, 1 stop bit and no parity.
(2) Communication handshaking shall use XON/XOFF.
(3) The communication packet shall contain the following items: ADDRESS, CODE, DATA, CHECKSUM, CR. The packet is sent as a string of ASCII printable characters. The ADDRESS, which has its $80 bit set in order to signal the start of the packet. The CHECKSUM is generated by Exclusive-ORing the ADDRESS, CODE, and DATA. The communication byte count shall be as follows:

ADDRESS	1
CODE	2
DATA	≥0
CHECKSUM	2
CR	1

(4) The receiver will compute the CHECKSUM. If the computed CHECKSUM is correct the receiver will send ACK, otherwise the receiver will send NAK.

6. Cables and Connectors

The camera unit cable assembly box mounting connector shall be mounted on one side of the JCB and shall be prewired to the 20 position terminal block as shown on the plans. The video signal pins of the camera unit cable assembly box mounting connector shall be terminated to a Bayonet Nut Connector (BNC) jack connector via Type RG-59/U coaxial cable stub.

The television control cable (TVC) and television power conductors (TVP) shall be wired to the 20 position terminal block as shown on the plans. The television control power cable (TVCP) cable shall go through but does not terminate inside the JCB. A watertight strain-relief box connector shall installed at the JCB hole for the TVCP cable.

7. Installation of Camera Station

The work to be done at each camera station, as shown on the plans, as a minimum, shall consist of the following:

A. Attach pan and tilt unit to the mounting plate.
B. Attach camera unit to the pan and tilt unit.
C. Install JCB junction box.
D. Terminate TVC and TVP inside JCB junction box.
E. Terminate television video cable (TVL) inside JCB junction box with a BNC plug connector.
F. Install camera unit cable assembly wiring harness (Type JC).
G. Terminate TVCP with pan and tilt mating connector.
H. Connect TVCP to the pan and tilt unit.
I. Terminate TVL inside controller cabinet with BNC plug connector.
J. Terminate TVP, TVCP and TVC with CCU mating connectors C1, C2 and C3, respectively.
K. Adjust limit stops of the pan and tilt unit as directed by the Engineer.
L. Adjust camera unit to provide the optimum picture for the full range of daylight and night time conditions as directed by the Engineer.

8. Camera Unit Mounting

The camera unit shall be secured to the pan and tilt unit using the stainless steel bolts provided with the camera unit. Before each bolt is fastened, a locking type coating shall be applied to the threads. The coating shall lock the bolt and nut in place, making it impossible to turn the bolt or nut without tools. This coating shall last through and be effective through at least ten insertions and withdrawals of the bolt or nut.

The work to be done between the camera mount and the controller cabinet, as shown on the plans, as a minimum, shall consist of the following:

A. Install conduits and pull boxes as required up to the controller cabinet.
B. Install and terminate TVL, TVC, TVCP, and TVP as shown on the plans.

The work to be done at each CCTV controller cabinet, as shown on the plans, as a minimum, shall consist of the following:

A. Install CCU.
B. Connect TVC, TVCP, TVP and TVL to CCU via their respective connectors.

C. Install VTDD.
D. Install FDU.
E. Connect CCU to VTDD.
F. Connect VTDD to FDU.

The Contractor shall furnish all materials necessary to provide a complete and functional camera station in accordance with these special provisions. Miscellaneous equipment, and materials not mentioned but necessary to provide a complete and fully operational camera station shall be furnished by the Contractor as incidental to the work for which no additional compensation will be allowed therefor.

All items furnished under this contract shall be new and shall be the latest version.

The Contractor shall be responsible for demonstrating proper operation of the camera station using test software and diagnostics which shall be provided to the Engineer as incidental items at no additional cost. Testing procedures are described elsewhere in these special provisions.

9. Camera Station Testing

Prior to removal or relocation of existing CCTV equipment including cables, pole, camera, pan and tilt unit and controller cabinet, the camera station will be tested in the field by the Engineer in the presence of the Contractor. Existing equipment that fail during this test period will be replaced or repaired by the State or, if directed by the Engineer, by the Contractor, and such work will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. The Contractor shall notify the Engineer in writing fifteen days prior to the scheduled testing.

Upon completion of work, each camera station shall be subjected to post-installation tests as outlined herein. All testing shall be performed by the District Electrical Systems Branch personnel, arranged by the Engineer and in the presence of the Contractor. The Contractor shall notify the Engineer in writing fifteen days prior to the scheduled testing. Upon receipt of the notification, the Engineer shall contact the Electrical Systems Branch at Telephone: (510) 286-6142. The Contractor shall provide all necessary equipment required to access the CCTV equipment for testing.

The testing shall consist of five consecutive days of continuous satisfactory operation of each camera station. If any material and equipment furnished and installed by the Contractor in this project is found defective or otherwise unsuitable, or the workmanship does not conform with the accepted standards, the Contractor shall replace such defective material and equipment at no cost to the State.

Rejected material or equipment may be offered again by the Contractor for consideration provided all non-compliance has been corrected and pretested by the Contractor. After all defects have been corrected, the camera station shall be re-tested until five consecutive days of continuous satisfactory operation is obtained.

The post-installation tests shall consist of, but not be limited to, inspection and functional testing in accordance with these special provisions.

Inspection shall consist of, but not be limited to, verification of correct wiring terminations, correct cable interconnections, good workmanship and compliance with these special provisions.

Functional testing shall include, but not be limited to, the following:

A. Verification of all local mode CCTV operations using the CCU front panel controls.
B. Verify video signal output from CCU with a National Television Systems Committee (NTSC) monitor.
C. Verify the correct operation of the auto/manual iris and power zoom.
D. Verify the correct operation of the pan and tilt unit. The pan and tilt unit shall be functionally tested over 355 degrees in the horizontal plane and ±60 degrees in the vertical plane. The pan and tilt unit limit stops shall then be adjusted to optimize the camera viewing coverage of the freeway as directed by the Engineer.
E. Verify the correct operation of the preset positions.

10-3.29 LIGHTING

GIRDER LIGHTING

The wall-mounted luminaire shall consist of a precisely contoured, specular anodized aluminum reflector, molded prismatic thermal shock resistant, borosilicate glass refractor and integral HID (High Intensity Discharge) ballast in weather-resistant, copper-free cast aluminum housing. Unit shall have a self-hinged door secured by two captive stainless steel threaded fasteners. Overall dimensions shall be 200 mm (D) x 370 mm (L) x 430 mm (W). Luminaire ballast and socket shall be pre-wired and the unit designed to be mounted directly on a wall for surface wiring. The integral ballast shall operate reliably with starting temperatures as low as -29°C. The luminaire shall be rated for 70 W high pressure sodium and 480 V, 60 Hz.

PIER STAIRWAY LIGHTING

Pier stairway lighting shall be a compact UL listed fluorescent light and shall be in conformance with the following requirements:

1. Housing shall be made of one piece, injection molded, bronze polycarbonate which provides a permanent color with a textured finish.
2. Internal reflector shall have a white finish for excellent reflectivity and uniformity.
3. Refractor shall be made from ultraviolet (UV) stabilized prismatic polycarbonate and provide low brightness. Refractors shall have high spacing to mounting height ratios (this shall punch the light side-to-side while bending the light 15 degree below horizontal for reduced glare).
4. Ballast shall be Class H with normal power factor reactor, -29°C starting, 277 V, 60 Hz, and the fluorescent lamps shall be 42 W PL-T 3500 K.

10-3.30 15 KILOVOLT METAL CLAD SWITCHGEAR

System Description

The 15 kilovolt (kV) metal clad switchgear shall include indoor 15 kV class metal-clad switchgear assembly with vacuum interrupter power circuit breakers. The switchgear shall be factory assembled, factory wired and factory tested. The switchgear and the major components to be products of a single manufacturer including, but not limited to, circuit breakers, transformers, instruments, meters, and other equipment specified or indicated on the plans except relays and control devices.

References

The 15 kV metal-clad switchgear shall conform to the following:

1. American National Standards Institution (ANSI)

   A. C37.06 - Switchgear - Rating Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
   B. C37.09, Section 4 - Test Procedures for AC High Voltage Circuit Breakers.
   C. C37.20.2, Section 5.2 - Metal - Clad and Station type Cubical Switchgear.
   D. C39.2 - Requirements for Electrical Analog Indicating Instruments.
   E. C57.13 - Requirements for Instrumentation Transformers.

2. American Wire Gage (AWG)
3. Institute of Electrical and Electronic Engineers (IEEE).
4. Insulated Cable Engineers' Association (ICEA)
5. National Electrical Code (NEC).

   A. Article 110 - Requirement for Electrical Installations, Part B: Over 600 Volts/Nominal.
   B. Article 230 - Services, Part H: Services over 600 Volts, Nominal.
   C. Article 710 - Over 600 Volts, Nominal - General.

6. National Electrical Manufacturers, Association (NEMA).

Submittals

The Contractor shall submit the following to the Engineer for approval:

1. Shop drawings shall be submited as a minimum with the following information:

   A. Plan, front, and side view drawing including overall dimensions and bus layout of each switchgear line-up. Identify shipping splits and show conduit stub-up area locations.
   B. Internal schematics elementary diagrams and wiring diagrams of each unit or compartment, including wiring identification and terminal numbers.
   C. Internal cell-to-cell interconnection wiring diagrams, including wiring identification and terminal numbers.
   D. Complete one-line diagrams for each switchgear line-up and complete three-line diagrams for each cubicle. Drawings shall indicate devices comprising the switchgear assembly including, but not limited to, circuit breakers, control power and instrument transformers, meters, relays, control devices, and monitoring devices. Clearly indicate device electrical rating on drawings.

E. Assembly drawings (cross-section as a minimum) for each cubicle with major layout dimensions indicated.
F. Complete bill of material list and equipment data sheets identifying appropriate information specific to switchgear being supplied.
G. Nameplate schedule.

2. Product Data.

Warranty

The Contractor shall submit manufacturer's standard warranty.

Qualification

The manufacturer shall be ISO 9000 and either ISO 9001 or ISO 9002 certified. The manufacturer of this equipment shall have produced similar electrical equipment. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided.

The switchgear assembly and circuit breakers shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment.

Swithgear

The Contractor shall furnish medium voltage 15 kilovolt Class metal-clad switchgear as specified and indicated on the plans. The switchgear and equipment shall conform to current applicable standards indicated in references above.

The Contractor shall furnish complete and functional lineups of switchgear and respective controls. The Contractor shall furnish and install devices or accessories not herein described but necessary for the proper installation and operation of the equipment.

The switchgear shall conform to ANSI Standards C37.09 Section 4 and C37.20.2 Section 5.2.

Short-Circuit and Protective Device Evaluation and Coordination Study

The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards. Software used shall be windows based, and capable for 300 buses. The digital program used for short circuit study shall conform to the following requirements:

1. Integrated Electrical Analysis Software: Comprehensive three phase and unbalanced short circuit study, load flow study, demand load study, feeder and transformer sizing study, impact motor starting, load schedules.
2. Transient Motor Starting Simulation: Time-based motor starting simulation with graphical output.
3. ANSI Short Circuit Study: Three phase and unbalanced short circuit per ANSI/IEEE C37 standards.
4. Device Evaluation Report: Automatically compares equipment ratings with short circuit calculations.
5. Time Current Coordination: Interactive protective coordination TCC drawings.
6. Cable Pulling Calculations: Calculates cable pulling tensions and sidewall pressures.
7. Harmonic Investigation and Filter Design: Frequency scan, harmonic current and voltage distortion, harmonic load flow, interactive low and high pass filter design.
8. Dynamic Simulation and Transient Stability: Dynamic response to power system electro-mechanical disturbance, generator sizing and stability, flux level machine representation.

In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusion, and recommendations. Provide the copy of program used with applicable licenses for at least three users, to the Engineer (to be provided to the Electrical Design Group) for review and verifications. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include a impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in each motor control center, and main breaker in branch panelboard. Include all adjustable setting for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand Parameters, and significant symmetrical fault currents. Terminate device characteristic curve at a point reflecting the maximum symmetrical fault current to which the device is exposed.

Select each primary protective device required for a delta-wye connected transformer so that its characteristics or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line to ground fault protection. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium voltage relay characteristic curves from curves for other devices by at least a 0.4 second time margin.

Include complete fault calculations as specified herein based on these special provisions and the plans.

Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Engineer for review prior to delivery of the study to the State.

The Contractor shall furnish all data as required by the short-circuit and coordination study vendor. The Contractor shall utilize the data from the study as part of the final documents.

The Contractor shall notify the Engineer in writing of circuit protective devices not properly rated for fault conditions.

Study Report: The result of the power system study shall be summarized in a final report. Six bound copies of the final report shall be submitted to the Engineer. The report shall include the following sections:

1. Description, purpose, basis, and scope of the study.
2. Tabulations of circuitbreaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

Four copies of the final report shall be submitted to the utility company for their review coordination study. Approved copies of the report shall be submitted to the Engineer after all corrections are made by the Contractor.

The Contractor shall perform field adjustments of the protective device as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, and protective device coordination study.

Necessary field setting of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the State.

Voltage Ratings

The manufacturer shall design and construct the switchgear for use on a 15 kV(ac), 3-phase, 3-wire, 60 Hz, solidly grounded system. Basic insulation level shall be rated for 95 kV(ac).

Main Bus

The main bus shall conform to the following requirements and as shown on the plans:

1. Fabricate buses of high conductivity, flat, silver plated copper bar having rounded edges suitably braced and supported on high dielectric strength insulators. Buses to have a continuous current-carrying capacity of not less than indicated on the plans. Provide a bus compartment totally enclosed by metal plates to house the buses.
2. Provide the 3-phase bus of each unit with molded insulation having a basic insulation level of 95 kV(ac). Insulation to completely encase each bar, including where provision have been made for splicing adjacent units together, or making connections to disconnecting devices.
3. Provide silver-plated splice plates and ends of the unit buses. From splice plates and ends of the units buses so as to obtain a self-aligning, silver to silver, high pressure contact.

4. Mount insulated bus insulated supports with coordinated dielectric properties, with strength to withstand magnetic stresses developed by current at least equal to the vacuum interrupter circuit breaker momentary and interrupting ratings. Barriers shall be arranged to isolate the bus compartment of each unit.
5. Make bus bar molded insulation, molded insulation covers for bus joints, and bus insulated supports from insulation possessing flame-retardant and self-extinguishing, dielectric and anti-hydroscopic properties.

Ground Bus

The ground bus shall conform to the following requirements and as shown on the plans:

1. The ground bus shall be made from tin-plated copper bar, 6.35 mm by 51 mm minimum, extended through all cubicles. Ground each housing directly to ground bus.
2. The ground frame of each circuit breaker unit through a rugged ground contact shoe shall be tied to the ground bus so that it is grounded at all times, except when primary disconnecting devices are safely separated.
3. Connect switchgear ground bus to relay panel's (12.7 mm by 3.2 mm copper) ground bus by a Number 6 AWG insulated green copper wire.

Stationary Structure

The stationary structures shall conform to the following requirements and as shown on the plans:

1. Utilize unit type construction in formation of housing in order to provide a rigid, self-supporting and self-contained enclosure for each circuit breaker unit and other units comprising switchgear. Fabricate each stationary structure of heavy, formed, smooth and level steel sheets and structural members, bolted or electrical welded to form a rigid assembly with hinged steel panel suitable for mounting of instruments, meters, relays, and control devices.
2. Isolate circuit breakers units, buses, instrument transformers, and outgoing cables within separate compartments formed by sheet steel barriers. Mount heavy close-fitting bus supports at bus openings between units. The support shall form a barrier to isolate each unit from adjacent units. Provide each compartment with a separate cover for individual servicing without exposing the circuit in adjacent compartment.
3. Provide simple one-piece unit shutter to automatically close the opening to the insulators for the primary disconnecting devices when the circuit breaker unit is moved to the TEST or WITHDRAWN position.
4. Switchgear finish shall be ANSI-61 epoxy paint applied to pre-cleaned and phosphatized steel for internal and external parts. Coating shall be rated to have a resistance of 300 hours to 5 percent salt spray. Paint complete assembly with a 0.038 mm to 0.051 mm thick exterior finish spray coat of ANSI-61 gray enamel prior to shipment. The Contractor shall construct the stationary structure and circuit breaker units so that each unit is interchangeable with every other unit.

Cable Compartment

The circuit breaker disconnecting contacts shall be supported by means of flame-retardant, track-resistant polyester glass or porcelain. Cable compartments shall be provided at outgoing terminals with NEMA 4-hole pads suitable for connection and termination of 15 kV shielded cables.

Utility Metering Compartment

Where shown on the plans, provide separate barriered-off utility metering compartment or structure complete with hinged sealable door, bus work shall include provisions for mounting utility company current transformers and potential transformers as required by the utility company. Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements.

Removable Element

Removable element of each circuitbreaker unit shall consist of a 3-pole vacuum interrupter power circuit breaker with trip-free stored-energy mechanism, positive mechanical interlock, primary and secondary disconnecting devices, auxiliary switches, operation counter, position indicator, and control wiring.

The manufacture shall utilize master jigs to determine accurately the correct stud locations of the removable and the stationary element. Removable elements of comparable rating shall be entirely interchangeable with each other.

The manufacture shall provide provisions for mechanically locking removable element in either the OPERATING or DISCONNECTED positions. Locking shall not interfere with the operation of the breaker and its mechanism.

The manufacture shall provide interlock on each circuit breaker unit to prevent circuit breaker from being removed from OPERATING position and from being replaced in operating position while breaker is closed. If the circuit breaker is in the closed position, the interlock shall trip the breaker before it can be placed in the OPERATING position.

The manufacture shall accurately align stud and socket primary disconnecting devices. Silver to silver pressure contacts shall be provided to prevent harmful temperature rise due to oxidation, together with nonmagnetic corrosion-resisting springs

to provide high pressure line contacts. Stationary contacts shall be mounted in an one piece glazed wet process porcelain shell, or equal, to provide ample insulation from the framework. Movable contact shall be mounted on the circuit breaker stud to ensure direct contact.

The manufacture shall provide secondary disconnecting devices for bringing control leads to circuit breaker operating mechanism and auxiliary switches on removable element. Spring mount self-aligning receptacles shall be provided on the stationary framework. The manufacture shall mount the plugs on the removable element. Contacts in the receptacles shall be recessed to ensure against accidental short-circuit of control or secondary wiring. The manufacture shall provide the secondary contacts that automatically engage with the breaker in the OPERATING position and be capable of being manually engaged with the breaker in the Test position.

Circuit Breakers

Circuit breakers shall be rated in Accordance with ANSI Standard C37.06, conform to the following minimum ratings:

1. Nominal 3-phase Fault Interrupting Capability: 500 megavolt -ampere (MV-A) symmetrical at 12.47 kV and 60 Hz.
2. Nominal Voltage: 12.47 kV.
3. Maximum Design Voltage: 15 kV.
4. 60 Hertz Withstand Test Voltage: 36 kV.
5. Basic Impulse Insulation Level (BIL): 95 kV.
6. Continuos Current Rating: 1200 A.
7. Short Circuit Current at Rated Maximum kV: 18,000 A.
8. Closing and Latching Capability: 58,000 A.
9. Rated Interrupting Time: 5 cycles.

Circuit breakers shall be operable by means of a stored-energy mechanism, normally charged by a small universal motor which can be charged by a manual handle for emergency closing or test. The mechanism closing speed of the contacts shall be independent of both control voltage or the operator. Circuit breakers shall provide contact wear gap indicator for each vacuum interrupter to indicate available contact life, which requires no tools and is easily visible when breaker is removed from it compartment.

Each circuit breaker shall be provided with secondary disconnecting contacts which automatically engage in the OPERATING or TEST position to complete circuit operations as required.

Circuit breakers shall provide a mean for racking in and out of the compartment and also between positions. A means of holding circuit breaker in the compartment shall be provided in all positions.

Interlocks shall be provided to prevent closed circuit breaker from racking to or from any position. Additional interlocks shall be provided to assure automatic discharging of the closing springs upon insertion or removal of the breaker into or out the compartment.

Circuit breakers shall provide a means for manually closing and opening contacts.

Circuit breakers shall be electrically operated by a 125 V(dc) control voltage.

All circuit breakers of equal rating to be completely interchangeable.

Direct Current Battery System for Switchgear Control

The Contractor shall install the direct current battery system as indicated on the plans to operate breaker mechanisms and protective relays and conform to the following requirements:

1. The direct current battery system shall be capable of operating all circuit breakers simultaneously, through four operation, without recharging.
2. Batteries shall be sealed pocket plate nickel-cadmium type and configured to produce a 125 V(DC) output. Minimum battery system rating shall be 55.0 ampere-hour (A-hr), for a 5 hour period at the 5 hour rate to 1.14 volt per cell (VPC) at 25°C.
3. Each switchgear cubicle shall have a fused direct current circuit as indicated on the plans. Each switchgear cubicle shall provide batteries with a rack assembly to house the batteries and charger.
4. The direct current battery system shall furnish constant voltage, current limited battery charger designed to float charge nickel-cadmium batteries. Audible noise level shall be less than 65 dBA at one meter from the direct current battery system while operating at 100 percent load. The direct current battery system shall provide alarm contacts for remote indications as indicated on the plans.

Current Transformers

Current transformers shall have current ratios as shown on the plans and conform to the following requirements:

1. Current transformers shall be a ring type, dry, for indoor service, suitable for service within medium voltage

switchgear. The current transformers shall be designed to have a mechanical and thermal rating to withstand short-circuit current, stresses, and heating effects equal to the rating of the circuit breaker of the application.

2. Current transformers shall be rated in accordance with ANSI Standard C57.13, with accuracy of the current transformers suitable for metering or relay accuracy class and standard burden for the required devices.
3. Current transformers shall be identified for polarity with standard marking or symbols. Current transformers shall be capable of carrying rated primary current continuously without damage, and have ample capacity and accuracy for metering or relay accuracy class, and standard burden, for the required devices.
4. Current transformers shall have install secondary wiring from current transformers in a suitable wiring trough, or conduit to provide for proper short-circuiting type terminals blocks for connections to relays, instruments, and other devices.
5. The Contractor shall provide a compartment enclosed by metal plates to house separately the current transformers in a unit. Isolate current transformers shall be provided with metal barriers from their component parts and adjacent circuits. Tops and rears of overlapping removable covers shall be provided to give access to the current transformers.

Potential Transformers

Potential transformers shall be installed where shown on the plans and conform to the following requirements:

1. Potential transformers shall be the indoor dry type, single-phase, 60 Hz, with a minimum thermal capacity of not less than 400 volt-amperes (VA) at 55°C rise above a 30°C ambient temperature.
2. Potential transformers shall have an accuracy classification conforming to ANSI Standard C57.13, suitable for metering or relay accuracy class, and standard burden for the required devices with secondary voltage of 120 V, with Basic Impulse Insulation Level (BIL) of 95 kV and a winding ratio of 100:1.
3. Potential transformers shall be identified with polarity using standard marking or symbols. The Contractor shall connect secondary conductors to potential buses as required. The Contractor shall protect the medium voltage potential transformers on the primary side with medium voltage current-limiting fuses.
4. The Contractor shall mount medium voltage potential transformers on a drawout device which, when in the OPEN position, disconnects both primary and secondary terminals of the transformer and provides grounding to the primary potential fuses.

    A. The Contractor shall mount the potential transformer in a separate steel enclosed compartment. The Contractor shall connect the compartment doors to the drawout device so that when the door is opened, both high voltage and low voltage terminals are disconnected, and the transformer and fuse assembly shall move forward. Forward movement shall not interrupt the ground connection to the transformer cases.
    B. When a potential transformer is in the FULLY WITHDRAWN position, grounding of the high voltage terminals of the transformer and the potential fuses shall take place.

Control Power Transformers

The Contractor shall provide roll-out drawers in designated cells as an integral part of the switchgear assembly. The control power transformers shall have capacity for 125 percent of the designed load to be served and be protected by both primary and secondary fuses. The primary side shall be protected with current limiting fuses.

Control Wiring and Testing

The Contractor shall furnish to the Engineer a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," for the switchgear to be provided. The certificate shall be signed by the manufacturer's quality control representative and shall state that all materials and workmanship comply with the approved shop plans and these special provisions.

The manufacturer shall test and verify the wiring and operation of the switchgear conform to the following:

1. All operational requirements shown on the plans and these special provisions are provided.
2. The switchgear wiring shall be NEC Type SIS, single-conductor, stranded copper, rated 600 V. The conductors shall be flexible stranded for applications in swinging panels. The minimum wire size shall be No. 14 for control circuits, and No. 12 for potential and current transformer circuits.
3. The manufacturer shall route outgoing control wires to the master terminal blocks with suitable numbering strips, numbered in agreement with the manufacturer's detailed wiring diagrams and the drawings
4. Control wiring shall be terminated in molded, screw-type terminal blocks approved by the manufacturer for the application and acceptable to the Engineer. Terminal blocks shall be provided with at least 10 percent spare positions after the final installation. Compression type terminal blocks shall not be acceptable.
5. Foreign circuits entering the switchgear on "pull-apart" terminal blocks shall be terminated to meet the requirements

of the State of California.

6. The manufacturer shall provide number wiring with shrink-type tag devices at both ends consistent with the manufacturer's detailed wiring diagrams. Duplication of wire numbers and terminal block number is not acceptable.

Instruments, Meters, Relays, and Control Devices

The Contractor shall install instruments, meters, relays, and control devices complete with devices and associated circuitry necessary to perform the required functions as shown on the plans and specified in these special provisions. The Contractor shall provide any material not specifically listed or shown on the plans but necessary to perform required functions.

The Contractor shall mount instruments and relays on hinged panels secured to the metal-clad unit. Devices shall have enclosing cases, dull black finish, mounted semi-flush and be provide with nameplates.

Indicating instruments shall be square or rectangular type with anti-parallax scales. Indicating instruments shall be provided with zero adjustment external to the case and include resistor, reactors, or other auxiliaries necessary for complete and functional instruments.

Panel mounted relays shall be the switchgear drawout type with built-in testing facilities and have fit relays with targets to indicate operations. The relays contacts shall be self-aligning and visible to permit ready inspection.

Control switches shall be the push/pull operation type with two normally open and two normally closed contacts. Pushing in the handle of the switch shall disable remote operation leaving only local and manual operation possible, allowing testing and service to be performed safely. Puling out the handle of the switch shall allow remote operation from SCADA and in addition local and remote operation. The red and green target flag of the switch shall indicate true status of the breaker whether in SCADA/LOCAL or LOCAL mode of operation. Electrical connections to the two normally open and two normally close auxiliary contacts can be made at the terminal block deck at the rear of the switch. These auxiliary contacts shall have a 15 A, 600 volt rating and shall be used to provide status indication.

The Contractor shall furnish wiring, potential bus, necessary fuses, and terminal blocks within each unit as required for proper operation. The Contractor shall shield secondary and control wiring within the high voltage compartment with a protective metal covering.

Items mounted on panels shall conform to the following requirements:

1. Mounted items shall be designed for semi-flush mounting on a 3.2 mm panels unless otherwise noted.
2. Instruments shall be in accordance with ANSI C39.1, one percent accuracy class, sized for a 115 mm nominal square, with 250 degree scale movement unless otherwise noted.
3. Items required to be installed on a drawout device shall be mounted on a removable-chassis construction which shall provide for removal of the relay from the case without disconnecting the leads or removing the case from the panel. The associated current-transformer secondary shall be automatically short-circuited at the case when a relay is removed from its case.

Under Voltage Relays

The under voltage relay shall trip for under voltage in the AC system and conform to the following:

1. The relay shall be a solid state design, draw-out construction, testable in its case, pass IEEE C37.90 for surge withstand ratings as defined for "Utility Grade."
2. The relay shall not require computerized software for setup and settings shall be via front panel controls.
3. The relay shall be capable of sensing 27 inputs that have adjustable trips set over the range from 55 V(ac) to 160 V(ac).
4. The time delay for the relay shall be adjustable over a settable range from 0 to 9.9 seconds (s), in 0.1 s increments or less.
5. The relay shall be set from the front panel and have internal switches and potentiometers.
6. The relay shall have front panel LEDs to indicate when unacceptable voltage conditions and settings have occurred.
7. The relay shall conform to the requirements in ANSI/IEEE C37.90, 90a, 90.1, and 90.2, and IEC 255 and 255-5 as specified for surge withstand, fast transient, and radio interference standards.
8. The relay shall be UL recognized under Standard 508.
9. The relay shall be externally powered by 125 V(dc).

Directional Power Relays

The directional power relay shall trip for real over power flow in the design direction. The relay shall comform to the following:

1. The relay shall be a solid state design, draw-out construction, testable in its case, pass IEEE C37.90 for surge

withstand ratings as defined for "Utility Grade," and have targets indicating that the relay has tripped.

2. The relay shall not require computerized software for setup and setting shall be via front panel controls.
3. The relay shall measure three phase power and real power flow.
4. The relay shall be designed for three current inputs and for three wire line-line voltage inputs.
5. Nominal potential input shall be 208 V line to line.
6. Current input shall be rated at 5 A nominal.
7. The time delay for the relay shall be adjustable over a settable range from 0 to 99 seconds (s), in 0.1 s increments or less.
8. The relay shall be set from the front panel and have internal switches and potentiometers.
9. The relay shall have front panel LEDs to indicate when unacceptable power flow conditions and settings have occurred.
10. The relay shall conform to the requirements in ANSI/IEEE C37.90, 90a, 90.1, and 90.2, and IEC 255 and 255-5 as specified for surge withstand, fast transient, and radio interference standards.
11. The relay shall be UL recognized under Standard 508.
12. The relay shall be externally powered by 125 V(dc).

Microprocessor Three-Phase Protective Relays

1. Microprocessor three-phase protective relays shall be incorporated into a single device providing protection, features and functions that conform to the following:

    A. Instantaneous over-current and ac-time over current relay ANSI 50/51
    B. Ground fault protection relay ANSI 50/51N
    C. Ac- reclosing relay ANSI 79
    D. Ac directional over-current relay ANSI 67/67N
    E. Carrier or pilot-wire transmitter and receiver relay ANSI 85
    F. Synchronism-check device ANSI 25
    G. Lock-out relay ANSI 86

2. The relay shall have four levels of instantaneous, definite-time and time over-current for phase, negative-sequence, neutral, and residual over-current elements for coordinated protection. The phase over-current element shall be capable of operating from either maximum-phase or single-phase current, and shall be capable of being controlled with load encroachment logic. The overcurrent elements shall be capable of non-directional or directional operation.
3. The relay shall support communication-assisted tripping for rapid fault clearing, including Permissive Overreaching Transfer Trip (POTT), Directional Comparison Unblocking (DCUB), Directional Comparison Blocking (DCB), Permissive Underreaching Transfer Trip), Direct Underreaching Transfer Trip (DUTT), and Direct Transfer Trip (DTT) schemes.
4. The relay shall have two EIA-232 ports and one EIA-485 port for remote communications capabilities. The rear EIA-232 port shall be capable of accepting an IRIG-B time signal.
5. The relay shall have a programmable four-spot recloser with synchronism-checking capabilities, including a separate single-phase voltage input for line-side potential indication.
6. The relay shall have phase and sequence under and overload elements for applications such as capacitor bank control, load-shedding schemes, and hot-bus/dead-line recloser control.
7. The relay shall have self-check diagnostics, and be equipped with an alarm contact which will assert in the event of a self-check failure. The relay shall provide accurate fault locating and event reporting for every event.
8. The relay shall have six steps of over or under frequency elements for trip and control logic.
9. The relay shall have the ability to program internal control equations. The equations shall be capable of operating front panel control switch operation to eliminate the need of external control switches, and internal elements and output contacts for developing custom logic. The equations shall use Boolean algebra to perform these tasks.
10. The relay shall have a substation battery monitor that monitors and record dc voltage levels. The relay shall have a breaker monitor which uses breaker manufacturer's published data.
11. The relay shall have six independent setting groups to cover multiple control and protection contingencies.
12. The relay shall have complete, revenue class accuracy (0.25 percent of reading) metering, capable of recording and displaying three-phase and per-phase quantities, power, power factor, sequence quantities, energy, frequency, and substation dc voltage.
13. The relay shall have the manufacturer's warranty.
14. No proprietary software shall be required to communicate with the relay. Standard IBM-compatible terminal emulation programs, such as Windows v3.1 Terminal or Windows 95 HyperTerminal, shall be sufficient to establish communications to enter settings or downloading data.

15. The relay shall meet the following hardware requirements and standards:

    A. The relay shall be provided with six optically isolated programmable inputs and 12 programmable output contacts. Four of the output contacts shall be jumper configurable as a-type or b-type contacts. Output contacts shall meet IEEE C37.90, and be capable of high current interruption (10 A for time constant (L/R) equals 40 ms at V(dc) of less than 150 V(dc).
    B. The relay shall be able to be powered by either 24 V(dc), 48 V(dc), 125 V(dc)/125 V(ac), or 250 V(dc).
    C. The relay shall have a operating temperature of -40°C to 85°C, and able to mount the relay in a standard 483 mm rack.

16. The relay shall conform to the following type tests and standards:

A. IEEE C37.90.1, IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems. (Logic inputs, contact outputs, and power supply).
    B. IEEE C37.90.2, IEEE Trial-Use Standard Capability of Relay System to Radiated Electromagnetic Interference from Transceivers.
    C. IEC 68-2-30, damp heat, cyclic (12 plus 12-hour cycle). Humidity, 95 percent between 25°C and 55°C.
    D. IEC 255-5, Impulse Voltage Test: 0.5 Joule, 500 Volts (Logic inputs, contact output, and power supply).
    E. IEC 255-21-1, Class 1 Vibration test (sinusoidal).
    F. IEC 255-21-2, Class 1 Shock and bump tests.
    G. IEC 255-22-1, Electrical disturbance tests for measuring relays and protection equipment, Part 1: 1 MHz burst disturbance tests. (Logic inputs, output contacts, and power supply).
    H. IEC 801-2, Electrical discharge requirements. (Logic inputs, contact outputs, time-code input, power supply, EIA-232 ports).
    I. IEC 801-4, Electrical fast transient/burst requirements. (Logic inputs, contact outputs, power supply).

Communication Processor

The communications processor shall be capable of communicating with a variety of microprocessor-based devices, including digital fault recorders, sequential recorders, digital meters, and digital relays. The communications processor shall support communications on all active ports simultaneously at baud rates up to 38 400. The device shall be equipped with at least 16 EIA-232 communication ports, with a front panel test port for local access. The communications processor shall be able to collect selected data from the intelgent electronic devices (IEDs) so that only essential information is collected. The communications processor shall have the ability to collect data based on time, period, day of week, or other programmable logic. The processor shall have the ability to scale the retrieved data. The processor shall be able to accept either a modulated or demodulated IRIG-B time signal, and distribute the demodulated time signal to all attached devices. Data collected from all attached devices shall be time-stamped in accordance with the time synchronization. In the absence of IRIG-B input, the processor shall generate the IRIG-B time signal from its battery backed clock.

The communications processor shall be equipped with an input/output (I/O) board with at least 16 contact inputs and 4 contact outputs. The processor should be able to accommodate an external modem for remote communication, and non-volatile flash RAM memory for long term data storage. The processor shall be of microprocessor-based design, having self-check diagnostics, and equipped with an alarm contact to assert in the event of a self-check failure.

The communications processor shall have front panel LED's to display port activity to allow a convenient check of the port status. The processor shall be able to receive, parse, store, and distribute data. It shall have several parsing options, including ASCII and binary, which allow it to receive and distribute data to a variety of devices, and as DNP slave with DNP3.0 level2 implementation. There shall be ability to program internal control equations. These equations shall have the ability to use the collected data to trigger additional communications, or operate an output contact. The equation shall use Boolean algebra to perform these tasks.

The communications processor shall have two plug-in slots that allow support of two high speed communications cards.

The processor shall have the manufacturer's warranty.

No proprietary software shall be allowed to communicate with the processor. Standard IBM-compatible terminal emulation programs, such as Windows v3.1 Terminal or Windows 95 Hyper Terminal, shall be sufficient to establish communications to enter settings or down loading data.

The communications processor shall conform to the following hardware requirements and standards:

1. Output contacts shall meet IEEE C37.90 Tripping Output Performance Requirements.
2. The processor shall be able to powered by either 24 V(dc), 48 V(dc), 125 V(dc)/125 V(ac), or 250 V(dc).
3. The processor shall have a operating Temperature range from -40°C to 85°C.
4. The processor shall be able to mount the processor in a standard 483-mm rack.

The communications processor shall conform to the following type tests and standards:

1. IEEE C37.90.1, IEEE Standard Surge Withstand Capability (SWC) Test for Protective Relays and Relay Systems.
2. IEEE C37.90.2, IEEE Trial-Use Standard Withstand Capability of Relay System to Radiated Electromagnetic Interference from Transceivers.
3. IEC 68-2-30, damp heat, cyclic (12 plus 12-hour cycle). Humidity, 95 percent between 25°C and 55°C.
4. IEC 255-5, Impulse Voltage Test.
5. IEC 255-21-1, Class 1 Vibration test (sinusoidal).
6. IEC 255-21-2, Shock and bump tests.
7. IEC 255-22-2, Electrical disturbance tests for measuring relays and protection equipment, Part 1: 1 MHz burst disturbance tests.
8. IEC 801-2, Electrical discharge requirements.
9. IEC 801-4, Electrical fast transient/burst requirements.

Fiber Optic Transceiver

The fiber optic transceiver shall be capable of sending serial data up to 15 km using multi-mode optical fiber with Standard ST connections. The fiber transceiver shall be capable of connecting directly onto a Standard 9-pin serial connector (DB-9). The fiber transceiver shall be powered directly from the host device via the 9-pin connector. The fiber transceiver shall be capable of operating at data rates from 300 to 40 000 baud.

The fiber transceiver shall have a selector switch to chose between data communication equipment (DCE) and data technical equipment (DTE) standard pin configurations and have a bit error rate of less than one in 10^{-8}. The transceiver shall have an operating temperature of -40°C to 85°C and conform to the following type tests and standards:

1. IEEE C37.90.2, IEEE Trial-Use Standard Withstand Capability of Relay System to Radiated Electromagnetic Interference from Transceivers.
2. IEC 60068-2-1, Fifth edition, 1990, Cold, -40°C.
3. IEC 60068-2-2, Fourth edition, 1974, Dry Heat, 85°C.
4. IEC 60068-2-30, Second edition, 1980, Damp Heat Cycle, 55°C, 6 cycles.
5. IEC 60055-22-2, Second edition, 1996, Electrostatic Discharge Immunity Level 4.
6. IEC 60255-21-1, First edition, 1988, Vibration Endurance Class 1, Vibration response Class 2.
7. IEC 60255-21-2, First edition, 1988, Bump and Shock Withstand Class 1, Shock response Class 2.
8. IEC 60255-21-3, First edition, 1993, Quake response Class 1.
9. ANSI Z136.2, 1993, Optical safety standard Class 1.
10. ANSI Z 136.2, 1988, Optical safety standard service Group 1.
11. CEI/IEC 6085-1, First edition, 1993, Optical safety standard Class 1.
12. 21 CFR 1040.10, Optical safety standard Class 1.

Nameplates

The Contractor shall provide engraved plastic nameplates to identify switchgear units, door mounted components, and interior mounted devices. The Contractor shall use black lamicoid with white letters fastened with round head stainless steel screws, engraved with the circuit number and circuit name as indicated on the plans.

Accessories

Switchgear accessories shall conform to the following:

1. Manual handles for operating circuit breakers shall be provided.
2. Switchgear shall have removable maintenance closing device.
3. One breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails shall be provided.
4. Portable lifting device for lifting breaker on or off the rails shall be provided.
5. Secondary couplers for operating a power circuit breaker in the DISCONNECTED position shall be provided.
6. Test plugs for drawout relays and meters shall be provided.
7. Test cabinet shall be provided for electrically operating circuit breaker outside its housing.

Warning Signs

The Contractor shall provide a minimum of 2 warning signs on the front of the switchgear lineup and 2 on the back of the switchgear that shall conform to the following:

1. The signs shall have red laminated plastic engraved with white letters approximately 12.7 mm high.

2. The signs shall read "WARNING-HIGH VOLTAGE-KEEP OUT".

Factory Testing

Standard factory tests shall be performed on the primary equipment provided. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

The secondary equipment (480 V) switchgear shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchgear shall be tested to assure the accuracy of the wiring and the functioning of all equipment. The main bus system shall be given a dielectric test of 2200 V for one minute between live parts and ground and between opposite polarities.

The Contractor shall furnish structural mounting channels in accordance with manufacture's recommendations to provide proper alignment of switchgear.

The Contractor shall provide three certified copies of factory test reports from the manufacturer. Factory tests, as outlined above, shall be witnessed by the Engineer. The Contractor shall notify the Engineer three weeks prior to the date the tests are to be performed by the manufacturer. The manufacturer shall include the cost of transportation and lodging for up to three State's representatives.

Installation

The Contractor shall supply the Engineer with three copies of the installation instructions from the manufacturer at least 10 working days in advance of the scheduled installation. The Contractor shall install all equipment in accordance with the manufacture's recommendations and as shown on plans.

Field Quality Control

The Contractor shall obtain the service of a qualified factory-trained manufacturer's representative to assist the Contractor in the installation and start-up of the equipment specified under this section. It is anticipated the manufacturer's representative shall be required by the Contractor for a period of 15 working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.

The Contractor shall provide three copies of the manufacturer's field start-up report from the equipment supplied.

Training

The Contractor shall provide a training session for 6 State's representatives for a period of 5 normal working days. The training session shall be conducted by a manufacturer's qualified representative at 111 Grand Avenue, Oakland, CA 94623. The training program shall include instructions on the assembly including primary equipment, transformer, and secondary equipment. All circuit breakers, protective devices and other major components shall be included.

The training shall also include a comprehensive overview of all manufacturer's literature as it relates to the final installation of equipment, its operation, troubleshooting, maintenance and repair. The Contractor shall provide the Engineer with 6 sets of the all training material to be provided during training session two weeks in advance of the scheduled training. The Engineer will provide feedback to the Engineer on the training material provided up to 48 hours before the scheduled training. The manufacturer's qualified representative should be prepared to address all questions presented in advance of the training session and during the training session.

10-3.31 SUBSTATION TRANSFORMERS

References

The substation transformers shall be fabricate in accordance with applicable ANSI, NEMA, IEEE standards and be UL listed. The substation transformers shall conform to the following:

1. ANSI/IEEE C57.96 - IEEE Guide for Loading Dry-Type Distribution and Power Transformers
2. IEEE C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers.
3. NEC Article 450 - Transformers.

Submittals

The Contractor shall submit the following to the Engineer for approval:

1. Shop drawings shall include as a minimum the following:

    A. Master drawing index.
    B. Front view elevation and weight.

C. Floor plan.
D. Schematic diagrams.
E. Nameplate diagram.
F. Component list.
G. Conduit entry/exit locations.
H. Cable termination sizes.
I. Transformers rating shall include as a minimum the following:

(1). kVA rating.
(2). Primary and secondary voltage.
(3). Taps.
(4). Primary and secondary continuos current.
(5). Basic impulse level.
(6). Impedance.
(7). Insulation class and temperature rise.
(8). Sound level.

2. Where applicable the following additional information shall be submitted to the Engineer:

A. Busway connection.
B. Connection details between close-coupled assemblies.
C. Composite floor plan of closed coupled assemblies.
D. Key interlock scheme drawing and sequence of operations.

3. Product Data.

Transformers

Transformers shall be individual mounted dry-type of the two winding type, self-cooled, suitable for indoor installations with ratings and voltage as indicated on the plans. The transformers shall be designed for continuous operation at its rated kVA value for 14 hours a day, 365 days a year, with normal life expectancy as defined in ANSI C57.96.

Rating

The substation transformers shall be 3-phase, 60 Hz and conform to the following:

1. Transformer design temperature rise shall be based on a 30°C average ambient over a 24-hour period with a maximum of 40°C. Transformers shall be rated for 115°C.
2. Transformers power rating, kVA, shall be shown on the plans.
3. Two primary taps for the rated kVA shall be provided in two 2-1/2 percent steps above and below the rated normal voltage.
4. Secondary voltages shall be as shown on the plans.
5. The transformer enclosure shall be ventilated, drip-proof and have lifting holes.
6. Basic Impulse Insulation Level (BIL) shall be rated for 95 kV.

Construction

The substation transformers shall be cooled by natural air convention and designed to meet the sound level standards for dry-type transformers as defined in NEMA TR1. The transformer shall be of explosion-resistant, fire-resistant, air insulated, dry type construction, and cooled by the natural circulation of air through the windings. The transformers shall be UL labeled.

The electrical insulation system shall utilize Class H material for a fully rated and continuos 220°C duty system. Solid insulation in the transformer shall consist of inorganic material such as porcelain, glass fiber, electrical grade glass polyester, or Nomex. The insulation between the high and low voltage coils shall be more than sufficient for the voltage stress without using varnish.

High-voltage and low-voltage windings of the transformers shall be copper with insulator paper or equal insulation between the layers of the windings. The high-voltage and low-voltage coil assemblies of the transformers shall be vacuum pressure encapsulated (VPE) with a silicon resin per MIL-1-4092. The total VPE process shall require applying a four cycle shield of silicon resin to the coils and a two cycle protective shield to the bus, core and support structure. The VPE process shall effectively encapsulate the entire core and coil assembly which result in a transformer which is virtually impermeable to moisture, dust, dirt, salt, air, and other industrial contaminants.

The high-voltage and low-voltage coil assemblies of the transformers shall be preheated to evaporate any moisture, then placed into a vacuum pressure tank. The air in the tank shall be evacuated; and at extremely low absolute pressure, all air bubbles are to be drawn out of the insulating materials. The resins shall be introduced to a level that submerge all parts while the vacuum is maintained for approximately one hour. Then the vacuum shall be released and pressure applied for approximately 1/2 hour, after which the coil shall be removed and placed in an oven for several hours in order for the resin to catalyze into a composite mass, completely sealing and binding the winding.

The transformer shall be supplied in a knock down case design, for ease in fitting through limited opening, and shall be of heavy gage sheet steel construction, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate ventilating grills.

Each transformer shall be painted utilizing an initial phosphatizing cleaning treatment, followed by manufacturer's standard paint process baked on to a total of 0.076 mm to 0.127 mm average thickness.

The transformers shall also include:

1. Diagram instruction plates.
2. Provision for lifting and jacking up.
3. Removable case panel(s) for access to high voltage strap-type connector taps for de-energized tap changing.
4. Two ground pads.

Factory Quality Control

All factory quality control testing shall be in accordance with the latest revision of ANSI and NEMA standards. The following factory tests shall be performed on all transformers:

1. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating on this project.
2. No-load loss at rated voltage on the rated connections.
3. Exciting current at rated voltage on the rated voltage connections.
4. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit only of a given rating on this projects.
5. Ratio test on the rated voltage connection and on tap connections.
6. Polarity and phase-relation tests on rated voltage connections.
7. Applied potential tests.
8. Included potential tests.
9. Basic impulse test on all windings.

The manufacturer shall provide test results certified by a registered Engineer to the Contractor to be submit .

Installation

The Contractor shall supply the Engineer with three copies of the installation instructions from the manufacturer at least 10 working days in advance of the scheduled installation. The Contractor shall install all equipment in accordance with the manufacture's recommendations and as shown on plans.

Field Quality Control

The Contractor shall obtain the service of a qualified factory-trained manufacturer's representative to assist the Contractor in the installation and start-up of the equipment specified under this section. It is anticipated the manufacturer's representative shall be required by the Contractor for a period of 15 working days. The manufacturer's representative shall provide technical directions and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.

The Contractor shall provide three copies of the manufacturer's field start-up report from the equipment supplied.

Field Testing

The Contractor shall perform insulation resistance tests at 500 V (dc) on the primary and secondary windings and referenced to ground. The insulation resistance test results shall be compared with the manufacturer's data and provided to the Engineer for approval. The insulation resistance shall not be less than 10 MΩ on all references to ground.

The Contractor shall measure the primary and secondary voltages for proper tap settings and adjust taps to deliver appropriate secondary voltage at the end of testing.

Manufacturer's Certification

A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. The Contractor shall provide three copies of the

manufacturer's representative's certification to the Engineer.

Training

The Contractor shall provide a training session for 5 State's representatives for a period of one normal working day. The training session shall be conducted by a manufacturer's qualified representative at 111 Grand Avenue, Oakland, CA 94623. The training program shall include instructions on the transformer, auxiliary devices and other major components.

The training shall also include a comprehensive overview of all manufacturer's literature as it relates to the final installation of equipment, its operation, troubleshooting, maintenance and repair. The Contractor shall provide the Engineer with 5 sets of the all training material to be provided during training session two weeks in advance of the scheduled training. The Engineer will provide feedback to the Engineer on the training material provided up to 48 hours before the scheduled training. The manufacturer's qualified representative should be prepared to address all questions presented in advance of the training session and during the training session.

Warranty

The Contractor shall submit manufacturer's standard warranty.

Maintenance

The Contractor shall submit to the Engineer 90 days before anticipated completion of the contract terms and conditions for a maintenance service agreement to begin upon completion of the contract and does not overlap the manufacturer's standard warranty. The Engineer will review the terms and conditions and provide written comments back to the Contractor. No maintenance service agreement will be funded or be contractually binding under this contract.

10-3.32 LOW VOLTAGE CONTROL CENTER

References

The low voltage control center shall include the 600 V(ac) low voltage control centers, completely engineered, assembled and ready to use. The low voltage control center shall conform to the following:

1. NEMA ICS-2 Industrial Control Devices, Controller, and Assemblies.
2. UL 845 - Motor Control Centers.

Submittals

The Contractor shall submit the following to the Engineer for approval:

1. Shop drawings shall include as a minimum the following:

    A. Plans shall include front and side view drawings, including overall dimensions of each control center. Identify shipping slips and show conduit stub-up area locations as indicated on the drawings.
    B. Plans shall include internal schematic and point-to-point wiring diagrams of each plug-in unit. Wiring diagrams shall include wire identification and terminal numbers. Plans shall indicate device regardless of their physical location on the diagrams. Indicated on diagrams the specific device location symbols and their respective legend as indicated on the plans.
    C. External connection diagram showing the wiring to the external controls and devices associated with low voltage center.
    D. Bill of material list for each low voltage control center.
    E. Nameplate schedule for each low voltage control center.

2. The Contractor shall submit manufacturer's installation instructions.

General

The low voltage control center shall be provided with UL label(s), where applicable, on each vertical section and individual unit as an evidence of compliance with UL 845. The low voltage control center shall be provide with lifting eyes on each section to facilitate handling.

Enclosure

The low voltage control center enclosure shall conform to the following:

1. NEMA 1 (with closed cell neoprene gasket)

2. Rigidly formed each vertical section that holds the units of minimum 1 gage, cold-rolled steel.
3. Wiring shall be NEMA Class II, Type B.

Unit Doors

Unit doors shall mount on the stationary structure and hinged on side away from vertical wireway, with slotted thump to hold in closed position. Unit doors shall provide positive action linkage with disconnect operating mechanism. Mechanism for the door shall be designed so that the unit door can be locked in the OFF position with up to 3 padlocks. When handle is not padlocked, door to open by release of door interlock with small tool.

When the unit door is closed, operating mechanism shall indicate an ON or OFF position, and the door interlock shall automatically become effective. When unit doors are open internal disconnect operating mechanism shall prevent against inadvertent operation of the unit.

The Contractor shall provide each plug-in unit door with nameplate, specified elsewhere, that indicates circuit number, load name and tag number, where applicable. Nameplate shall be attached to door with stainless steel screws.

Wiring Trough

The Contractor shall provide continuos horizontal wiring troughs at both top and bottom of each section. The troughs shall line up to form a continuous wireway for full length of center. The Contractor shall provide a large continuous, full height vertical wiring trough in the right side of each section.

Terminal Strips

Split-type terminal strips shall be provided that facilitate wiring connections for disconnecting factory or field conductors. The terminal strips shall be rated to accept conductor sizes and voltages as specified in these special provisions and as shown on the plans. The Contractor shall insure that the final configuration of the terminal strips are provided with a minimum of 25 percent spare terminals.

Bus Bars

Horizontal bus bars shall be silver plated insulated copper of the ampacity indicated on the plans. Unit bus bar stabs shall insure high contact pressure as recommended by manufacturer.

Vertical bus bars shall be silver plated copper effectively isolated from accidental contact by plastic insulating medium in units, including spaces.

Bus bar supports shall be high impact strength, noncarbonizing insulating material mounted on padded steel brackets to provide adequate dielectric strength and creepage distance.

Bus structure shall be capable of withstanding not less than 65,000 A rms short circuit current in accordance with NEMA standards. The Contractor shall do short circuit fault analysis and provide the written results to the Engineer for review. In the event the analysis indicate that a higher short circuit duty rating of the control center is required, the Contractor shall furnish the low voltage control center with the higher rating.

The Contractor shall provided tin-plated copper horizontal ground bus continuous across the full length of control center. The Contractor shall provide copper vertical ground bus, which is solidly connected to the horizontal ground bus, each vertical section containing feeder units. The Contractor shall provide vertical ground bus with provisions for connecting the equipment grounding conductor at the associated unit location.

Painting

Finish metal surface and structural parts shall be treated with a phosohatizing, or equal, treatment prior to painting. The Contractor shall paint the control centers with gray undercoat equal to zinc chromate.

The Contractor shall finish interior surface including bus support angles, control unit back plates, and top and bottom unit barrier plates with baked white enamel.

The finished exterior of enclosure shall be with ANSI 61 gray.

Future Spaces Requirements

The Contractor shall provide spaces for future loads in the control centers as shown on the plans. Furnish spaces with hardware to accommodate future plug-in control unit without modification of vertical sections shall be provided by the Contractor.

Installation

The Contractor shall install control centers to allow complete unit door swing required for unit removal. Complete unit door swing is specifically required where a vertical section of control center is set next to a wall and the left of the control center.

The Contractor shall protect the low voltage control center until accepted by the Engineer.

Warranty
The Contractor shall submit manufacturer's standard warranty.

10-3.33 MOLDED CASE CIRCUIT BREAKER SWITCHBOARD

The Contractor shall provide factory assembled, wired, and tested switchboards, with major components being products from a single manufacturer, including but not limited to, circuit breakers, instruments, control devices, and other equipment specified herein and indicated on the plans.

The molded case circuit breaker switchbord shall be divided into several sections: (1) 600 V(ac), (2) dead-front type, (3) metal-enclosed molded case circuit breaker switchboards and (4) molded case breakers.

References
The molded case circuit breaker switchboard shall conform to the following:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers (IEEE).
3. Insulate Cable Engineers' Association (ICEA).
4. National Electrical Code (NEC):

    A. Article 310 - Conductor for General Wiring.
    B. Article 384 - Switchboards and Panelboards.

5. NEMA PB-2 - Dead-front Distribution Switchboard.
6. UL 891 - Deadfront Switchboards and UL 489 - Molded Case Circuit Breakers.

Submittals
The Contractor shall submit the following to the Engineer for approval:

1. Shop drawings shall be submited as a minimum the following information:

    A. Plan, front, and side view drawing including overall dimensions of each switchboard line-up. Identify shipping splits and show conduit stub-up area locations.
    B. Internal wiring diagram of each compartment including wiring identification and terminal numbers.
    C. Internal compartment-to-compartment interconnection wiring diagrams including wiring identification and terminal numbers.
    D. Complete 3-line diagrams for each switchboard line-up. These drawings shall indicate devices comprising the switchboard assembly including, but not limited to, circuit breakers, and control devices.
    E. Complete bill of material list and equipment data sheets identifying appropriate information specific to the switchboard being supplied.
    F. Nameplate schedule.

2. Product Data.

Warranty
The Contractor shall submit manufacturer's standard warranty.

10-3.34 600 VOLTS AC SWITCHBOARDS

The 600 V(ac) switchboards shall conform to the following:

1. The switchboards shall have indoor dead-front type panel, low voltage metal-enclosed front and rear accessible switchboards.
2. Switchboard and equipment shall conform to current applicable standards of organizations listed under references elsewhere in these special provisions.
3. The complete assembly shall bear a UL label.
4. The complete switchboard assembly shall be rated to withstand mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current of 100,000 A symmetrical at rated voltage. The Contractor shall test the switchboards for conformance according to applicable NEMA and UL

standards.

5. The manufacturer of the assembly shall be the manufacturer of air circuit breakers contained therein.
6. Circuit breaker frame and trip rating shall be as indicated on the plans and shall be coordinated with the ratings of the equipment actually furnished. The Contractor shall modify ratings where necessary to suit the equipment and in accordance with the short circuit fault analysis and protective device coordination study.
7. Terminations shall be UL - listed, marked as suitable to accept conductors sized for 75°C operating temperature in accordance with NEC.

Voltage Rating

The switchboards shall be designed and constructed for use on a 480 V, 3-phase, 4-wire, 60 Hz system with entire assembly suitable for 600 V(ac) maximum service.

Main Bus

The main bus of the switchboard shall conform to the following:

1. The main bus shall be fabricated of high conductivity, flat, silver-plated copper bar having rounded edges suitably braced and supported on high dielectric strength insulators and arranged in the same vertical plane. Buses shall have a continuos current-carrying capacity of not less than that specified in these special provisions or indicated on the plans.
2. The main bus shall be insulate to protect against spread of arcing faults and accidental contact by people or foreign objects. The Contractor shall provide bus joints with Belleville spring type washers.
3. The Contractor shall mount buses on insulated supports with coordinated dielectric properties, and strength to withstand magnetic stresses developed by fault currents equal to 100,000 A symmetrical at rated voltage.
4. Bus supports shall be fabricate from insulation possessing flame-retardant and self-extinguishing, dielectric and anti-hydroscopic properties.

Ground Bus

Ground buses shall be manufactured from silver-plated copper bar, 6.35 mm by 25.4 mm to 51 mm maximum, extending through all cubicles. The Contractor shall provide bus joints with Belleville spring type washers. The Contractor shall ground each housing directly to the ground bus.

Stationary Structure

Switchboards shall be constructed as a stationary structure similar in construction to formation of houses in order to provide a rigid, self-supporting and self-contained enclosure. The Contractor shall fabricate each stationary structure of heavy, formed, specially smooth and level steel sheets and structural members.

The Contractor shall provide lugs including grounding lugs, suitable for copper cable, of quantity and size as indicated on the plans. Switchboards shall be provided with side and rear covers that are bolted and removable.

Source Quality Control

The Contractor shall furnish to the Engineer a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," for the 600 V(ac) switchboards to be provided. The certificate shall be signed by the manufacturer's quality control representative and shall state that all materials and workmanship comply with the approved shop plans and these special provisions.

The manufacturer shall completely assemble, wire and test the switchboard at the factory. Rigid inspections before and after assembly shall assure correctness of design and workmanship. The manufacturer shall provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips.

After assembly the manufacturer shall provide the switchboard with lifting channels having eyebolts for attachments of crane slings to facilitate and handling each shipping-assembly unit. The lifting channels shall be removable after equipment is placed on permanent foundations.

The manufacturing facility for the switchboard shall be third party certified to ISO 9002. Third party certifier shall be subjected to the Engineer's approval.

10-3.35 PANELBOARDS

Panelboards shall include dead-front panelboards, lighting distribution, control panelboards and conform to details shown on the plans and these special provisions.

References

The panelboards shall conform to the following:

1. NEMA 250 - Enclosure for Electrical Equipment.
2. UL 67 - Panelboards.

Performance Requirements

The minimum interrupting capacity of devices shall be equal to available short circuit current at line terminals as determined by the Contractor's short circuit fault analysis and approved by the Engineer.

The Contractor shall provide main bus rating of panelboards, number of poles, and provisions for number of circuits as indicated on the plans.

Submittals

Shop drawings shall include panelboard layout and manufacturer's specifications and description.

Interior

The Contractor shall size the main bus bars in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50°C above specified ambient maximum. Tin-plated copper buses shall be provided.

The Contractor shall number branch circuits and spares as indicated on the plans. Affixed to the panel under a transparent cover of the panelboards the Contractor shall furnish a completely typed circuit schedule in the directory cardholder.

Phase busing shall be full size with no reduction. The interior of the panelboards shall include full size neutral bars with suitable lugs for the maximum number of circuits which can be connected to the panel.

The Contractor shall provide panel with tin-plated copper ground bus separate from neutral bars. Ground bus shall have suitable lug for each circuit breaker installed including future circuits.

Enclosures

Panelboards enclosures shall be sufficiently sized to provide minimum of 10.6 mm of gutter space on all sides. Live parts shall not be exposed when circuit breakers or switches are put in service. Hinges and latches shall not required tools to operate.

Panelboards enclosures shall be furnished with a furnish lock and be provided with a minimum of 2 keys for each panelboard.

The outdoor enclosure type shall be a NEMA 4X and the indoor enclosure type shall be NEMA 12.

Enclosures mounting shall be as indicated on plans.

Finish of the stand alone panelboards enclosures shall have a primer coat, rust-resistant phosphate undercoat and 2 coats of oven-baked enamel with finish color ANSI 61 gray or a color to be selected by the Engineer.

Circuit Breakers

Molded-case circuit breakers shall be ambient compensating which provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element. Circuit breakers shall have accomplish compensation by a secondary bimetal that will allow the breaker to carry rated current from 25°C to 50°C with tripping characteristics which are approximately the same throughout the temperature range.

Warranty

The Contractor shall submit manufacturer's standard warranty.

10-3.36 WIREWAY

The Contractor shall install a complete indoor wireway system as shown on the plans, including, but not limited to straight lengths, elbows, tees, offsets, panel adapters, closing plates, wire retainers and supports required for a complete installation.

Wireways shall be constructed of minimum of 16 gage steel before finishes are applied. All straight lengths of wireway shall have hinged covers. Lengths shall be provided with cover latches, a minimum of every meter, which hold the cover securely in place when closed.

Wireways shall be furnished with knockouts. Wireways with knockouts shall have conduit knockout patterns arranged on the bottom and both sides of straight lengths.

The Contractor shall provide wire retainers for the wireways to hold cables in place after installation. Wire retainers shall be designed so as to be installed or removed without any tools.

Wireways shall be provided with an ANSI-49 gray epoxy paint finish over a corrosion resistant phosphate pretreatment.

Hangers shall be of two-piece construction and have provision for either clamps, rod or bolted mounting applications. The two-piece hanger should be able to hook together to permit preassembly of wireway and hanger bottom plates before hanging on preinstalled upper bracket.

All wireways lengths and accessories shall be Underwriter's Laboratories (UL) listed and labeled as prescribed in UL870 Standards for "Wireways, Auxiliary Gutters and Associated Fittings."

Wireway shall be installed in accordance with National Electrical code requirements. Wireway shall conform to a NEMA 1 rating.

10-3.37 PROGRAMMABLE LOGIC CONTROLLER

The programmable logic controller (PLC) shall conform to the following:

1. Manufacturer's Standards

The manufacturer shall have shown high commitment to product, manufacturing and design process quality and is currently ISO 9000 registration.

2. Design and Manufacture

The programmable controller and all of the corresponding components within the family of controller products shall be offered by a company who regularly manufactures and services this type of equipment.

All products shall be designed, manufactured, and tested in accordance with recognized UL, CSA, IEC and JIS industrial standards. The system shall be operational during and after testing. See tables below for standard requirements.

3. Vibration

Modules are to perform well where vibration is a factor. Designs are to be shock and vibration tested to meet the following specifications when installed on a panel-mounted Type DIN rail-using clamp supplied, and panel-mounted feet secured:

Vibration: IEC68-2-6: from 10 Hz to 57 Hz 0.305 mm displacement (peak to peak) from 57 Hz to 500 Hz at 2 G.
Shock: IEC68-2-27, Shock: 15 G, 11 ms, half sine wave.

4. Noise

Modules are to be resistant to noise levels found in most industrial applications when installed according to accepted practices, including proper separation of wiring by voltage and power levels, and mounting on a conductive (unpainted) Type DIN rail. Filtering and transient protection shall be coordinated with equipment, such as the unit substation feeder management relays, communicating with the RTU. The Type DIN rail is an integral part of the grounding system. Modules are to be tested to the following noise specification:

Emissions	FCC Part 15, Section J, Class A, Computing Devices CISPR11
Susceptibility	IEC 801 - 2,3,4,5,6, ANSI/IEEE C37.90 (Relay and relay system associated with Electrical Power Apparatus)

5. Temperature

Modules shall operate reliability in ambient air temperatures from 0°C up to 55°C.
Storage temperatures are to be -40°C to +85°C.

6. Humidity

5 percent to 95 percent, non-condensing.

7. Quality Assurance

The manufacturer shall have a fully operational quality assurance and quality control program in place.
Complete documentation describing the quality assurance and quality control plan shall be available.
Complete product documentation describing installation and simple field maintenance shall be available.
The product shall be designed and manufactured in the USA.

8. Support

The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, regional application centers, and local or headquarters technical assistance. A toll-free (800) number hot-line shall be available for emergency support.

An electronic Bulletin Board Service (BBS) shall be available to users for application support.

Product shall have a warranty period of at least 1-year from the date of purchase.

9. Product Hardware

The PLC system shall consist of rugged components designed specifically for industrial environments. A complete PLC system shall consist of one or more racks containing I/O modules, interconnected by signal cables.

10. Packaging

All components shall be housed in structurally secure enclosures. The controller CPU shall be one of two types, modular within the rack backplane. The modular type shall be fully enclosed within a durable plastic shroud. When mounted on the system base, the modular CPU shall not occupy more than one available slot. The I/O system shall be modular. Each module shall be fully enclosed within a durable plastic shroud. When mounted on the system base, each I/O module shall not occupy more than one available slot. There shall be at least two sizes of I/O bases available and shall hold up to 5 I/O modules. I/O modules shall be retained in their slot by a hinge on the upper rear edge and snap on the lower rear edge of the baseplate. Removing the module shall require no tools. I/O modules shall be installed in any available slot in the CPU or expansion baseplates, and shall require no tools for insertion and extraction. I/O modules shall connect electrically to the baseplate via a pin and socket connector. I/O modules shall be fully enclosed in a plastic covering protecting the electronic circuitry from exposure.

11. Durability

All components within the controller family, including switches and operator-controlled devices shall be manufactured for industrial applications in Seismic Zone 4.

All signal cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.

12. Parts Interchange

In order to minimize spare parts stocking requirements, the controller family shall have interchange capability. The power supply, battery, EEPROM chips, hand-held programmer should all operate equally well regardless of the CPU being used.

The system shall incorporate a modular design using plug-in assemblies with pin and socket connectors.

All assemblies and sub-assemblies performing similar functions shall be interchangeable.

The system design shall accommodate the replacement of assemblies without having to disconnect field wiring. Removable connectors shall be used to connect field wiring to the individual circuit board assemblies.

All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings each of which indicates the manufacturer's catalog number, product manufacturing date code, UL and CSA certifications.

13. Environmental Conditions

All components of the programmable logic controller system, except CRT terminals and programming workstations, shall meet the following environmental specifications**:**

Storage temperature	-40°C o 85°C
Operating temperature	0°C to 60°C
Humidity	5 to 95 percent relative humidity, non-condensing

14. Power Supply

The power supply shall be one of three types: High voltage AC/DC supply and low voltage DC supply. A wide range supply shall operate from voltage sources in the range from 83 V(ac) to 254 V(ac) and 100 V(dc) to 125 V(dc), providing 30 W of power. Available power shall be 30 W at a +5V(dc) output, 15 W at a 24 V(dc) relay power output, and 20 W at an isolated 24 V(dc) output.

The power supply shall contain an isolated, internal 24 V(dc) power source for input/output (I/O) modules requiring 24 V(dc) power. The power supply shall contain a built-in serial communication port which can be used to connect the programmer for PC compatible programming software, connect the hand-held programmer to the PLC, and connect to one of the wide variety of third-party operator interfaces utilizing an open architecture software protocol. This serial port shall provide RS-422 signals with RS-485 compatibility. The characteristics of this port shall be software configurable and shall be modem compatible. The power supply shall contain dual battery connectors in a battery compartment such that a battery may be installed to protect programming CMOS RAM memory. Dual connectors are required to provide smooth battery power transfer. The backup battery for RAM memory shall be a Lithium, long-life battery with a typical life of 6 months under load, and 8 to 10 years under no load. This battery shall be replaceable while power is applied to the PLC. The power

supply shall be modular separate from the CPU. The power supply shall have universal input and compatible with main CPU racks as well as accepting expansion racks. The power supply shall have a super capacitor that provides a minimum of one hour battery-less backup power for CPU RAM memory.

15. Central Processing Unit

The central processing unit (CPU) shall be capable to solve application logic, store the application program, store numerical values related to the application processes and logic, and interface to the I/O systems. The CPU shall handle: PID (Proportional Integral Deriative), Modulo, Math, Double Precision math, Logical functions, Subroutines, Data Array Move and Indirect Addressing.

16. Modular Central Processing Unit

The modular CPU shall conform to the following:

A. An Intel 80188 or Intel 80386EX microprocessor operating at a minimum of 10 MHz up to 25 MHz as the main processing element, memory mounted on the board or the latest version.
B. A dedicated VLSI Instruction Sequencer Co-Processor (ISCP-Boolean Co-Processor) for performing Boolean operations, and interfaces to a serial port and the system bus.
C. The modular CPU shall contain a real-time calendar and clock that can be accessed by the user program. The time of day clock and calendar shall be battery-backed and maintain seven time functions:

(1). Year (2 digits).
(2). Month.
(3). Day of Month.
(4). Hour.
(5). Minute.
(6). Second.
(7). Day of week.

D. The modular CPU shall execute Boolean functions at a rate of .3 µs per instruction or less.
E. The modular CPU shall be capable of controlling up to 49 I/O slots in the basic configuration and up to 79 I/O slots in the advanced.
F. The modular CPU shall be able to provide special functions such as: (1) High Speed Counter function, (2) Axis Positioning function, and (3) Local Area Networking function.
G. The modular CPU shall be able to provide two additional serial ports, one phone jack for RS-232 and one 15 pin RS-485 for communications. The serial ports shall be supported by an additional Hitachi H8 microprocessor.

17. System Diagnostics

Status of low or dead battery shall be indicated by a red battery LED on the power supply module. The diagnostic status of the fuses, for those discrete I/O modules containing fuses, shall be indicated by a red LED mounted on the top of the module. The red LED shall illuminate when a blown fuse condition is present.

18. Alarm Processor

The modular CPU shall contain an alarm processor that is special PLC feature designed to receive and process faults. The diagnostics shall provide information on the configuration and CPU, memory, communications and I/O status. The alarm processor shall log I/O and system faults in two tables that can be display on the PC compatible programming software screen or uploaded to a host computer or other co-processor. The alarm processor shall maintain the states of up to 128 discrete system diagnostic bits to be read by a host or incorporated as contacts into the ladder program for customized diagnostic routines. Each fault table shall have a total capacity of 32 faults. The last 16 entries shall maintain the latest 16 faults. The first 16 shall be kept unchanged. Faults may be cleared by a programmer. Access to clear the status of the fault tables shall be passwords protected.

The alarm processor shall report three types of fault action; (1) fatal, (2) diagnostic, or (3) informational. In response the CPU shall respond as follows:

Fault Action	Fatal	Diagnostic	Informative
CPU Enter Stop Mode	Yes	No	No
Set Diagnostic Bit	Yes	Yes	No
Logged	Yes	Yes	Yes

When an I/O fault occurs, the alarm processor shall report the rack and slot location of the fault, the condition, the address and the circuit number. When a modular CPU is used, this alarm processor function shall have the capability to time-stamp system faults for future references.

19. System Security, PLC Memory Protection

The PLC shall have 4 levels of security or password privilege levels to prevent unauthorized access to the PLC. These built-in privilege levels shall be set either by programming software or with the hand-held programmer and shall impose the following constraints:

Level	Constraint
1	Read PLC data only (except passwords)
2	Write to any data memory
3	No. 2 and write to all configuration or logic in stop mode
4	No. 3 and write to logic in Stop or Run mode (on-line change) and password level access

There shall be one password, up to four ASCII characters in length, for each privilege level in the PLC, and the same password can be used for more than one level. Any attempts to access or modify information in the PLC without the proper password privilege level shall be denied.

A. Subroutine Password**.—**The PLC shall have a software OEM key that allows users to control access to each subroutine in the relay ladder program.

B. OEM Program Protection**.—**The PLC shall have a software OEM key that allows users to protect the resident relay ladder program from unauthorized reads and writes.

C. CPU Memory and Memory Capacity**.—**The PLC shall supply a modular CPU that contains at least the following:

Either 16,384 (16 k), or 16-bit words for application programming.
Either 2048 (2 k) 16-bit registers for register and data usage.
1280 global references.
1024 (1 k) control relays.
512 bits for discrete inputs.
512 bits for discrete outputs.
Either 128, 16-bit registers for analog inputs.
Either 64, 16-bit registers for analog outputs.

All application memory shall be available to the user program. Executive level operations performed by the CPU shall not consume application memory.

20. Memory Storage

The register values and the application program shall be stored in battery back up, CMOS static RAM memory. The application program and system configuration shall also be stored in EEPROM memory. There shall be a long-life lithium battery used to maintain the contents of the CMOS RAM memory in the CPU. There shall be an easily accessible battery compartment in the power supply with dual battery connectors. The battery shall be replaceable with power applied to the PLC and without removing the CPU. An LED shall provide a visual indication of the battery condition. A low battery condition shall be alarmed with a system diagnostic bit. Both types of CPU shall allow resident user program to be maintained in the CPU without power applied. Two levels of maintainability shall be provided, short duration and long duration. For short duration, the program shall be maintained by a high-capacity capacitor for a period of no less than an hour. This allows adequate time for replacing the battery in the power supply module, should the external supply to the CPU be interrupted. For long duration, the CPU module shall maintain its contents by using the battery. This allows the CPU module to be shipped via surface mail where power supply to the module is not available. This method may be achieved by providing internally mounted battery. If the CPU module does not have an internal battery then an external battery board may be used. The CPU shall calculate the application program checksum at the end of every sweep. A complete checksum calculation for a program may take several sweeps. A fixed number of program memory checksum shall be calculated each sweep. This number is configurable by the user. If the calculated checksum does not equal the reference checksum, a fault shall be recorded, and the CPU mode will change to STOP.

21. Programming Environment and Programming Devices

At least two programming devices shall be available for development of application programs, a small hand-held device with back-lit LCD readout and a software programming package running on a PC compatible laptop or desktop computer. On-line and off-line, CPU and I/O configuration and application program development shall be achieved with a PC compatible and software and software documentation. A hand-held programmer shall be capable of on-line programming and configuration only. Both the PC compatible computer and the hand-held programmer shall be connectable to the PLC via a built-in serial communication port on the power supply or serial ports on the CPU. The serial communication port shall provide RS-422 signals with RS-485 compatibility. In addition to the serial communications, the PC compatible computer shall be connectable to the PLC via Ethernet TCP/IP supporting the SRTP application protocol. A separate module providing Ethernet communications through an AAUI connection shall plug into any system. The programming devices shall have access to the application program, the CPU and I/O system configurations, all registers, CPU and I/O status, system diagnostic relays, and I/O over-ride capabilities

22. Hand-Held Programmer

The hand-held programmer shall provide 4 modes of operations: program, data, configuration, and protect. The hand-held programmer shall require no external power supply. Power supply shall be provided by the connected PLC. The program mode shall provide the capability to enter an application program, monitor an existing program, or make element for element on-line changes. The data mode shall provide the capability to monitor all of the reference tables, and make word changes to this data. The configuration mode shall provide the capability to enter a new CPU or I/O configuration, or monitor existing configurations. The protect mode shall provide the capability to select password protection options. The hand-held programmer shall be capable of being remotely connected to the CPU while the CPU is running. The hand-held programmer shall provide the functionality to archive the data in a secondary device. The secondary storage device shall be either an EEPROM installed in the CPU, or a metal encased memory card (EEPROM) which can be inserted into the hand-held programmer. The hand-held programmer shall be capable of reading the contents of EEPROM from RAM, writing the contents of RAM to EEPROM, or comparing the contents of EEPROM with RAM. Secondary storage devices shall be interchangeable from one CPU to another. The only considerations for ability to interchange shall be the size of the application programs and the type of memory required.

23. MS-DOS/Windows Compatible Software

The MS-DOS/Windows compatible software shall provide the capability of reading, writing, and verifying the configuration and program with a diskette backup. The software shall execute on DOS operating system or in a DOS Window in a Windows operating system. The software shall provide on-screen help information throughout its execution paths. It shall have the capability of programming the relay ladder program, store the program to the PLC, monitor program and reference address status while the PLC is in Run or Stop mode. The software shall be capable of generating a printout of the relay ladder program for documentation purposes. The user shall be able to select any of the program documentation below:

a. Types of Documentation: Description
b. Print Program: This printout shall print the program logic with or without the equivalent Boolean instructions for each rung, the reference list, reference descriptions and/or users rung comments.
c. Cross reference tables: This printout shall show the use of references in the program.
d. Reference tables: This printout shall show the values of each reference in each selected table.
e. Configuration Printout: This printout shall allow the user to generate a rack hardware and its assigned reference addresses listing, and the CPU configuration listing.
f. The software shall provide the capability for programming using user-defined variables (nicknames).
g. The software shall have built-in modem connection capabilities.

24. Operator Interface

The programming port and its protocol shall be open architecture. The protocols of this communication port shall be published such that a user may develop his own operator interface device, software or hardware, to access Register, I/O status, I/O override and system diagnostic memory data. Through an open protocol, a wide variety of operator interface shall available. These may be manufacturer's own brand or they may be manufactured by third party vendors.

25. Instruction Set and Programming Language

The CPU shall be capable of solving an application program whose source format shall be relay ladder diagram. The language shall support relay, timers and counters, arithmetic, relational, bit operation, data move, data conversion, and control functions. The CPU shall be capable of solving an application program whose main program format is in sequential function chart (SFC) with underlying code in relay ladder diagram.

26. Relay Functions

Relay ladder operations shall consist of the following contacts and coils:

RELAY FUNCTIONS
Normally Open Contact
Normally Closed Contact
Coil
Negated Coil
Retentive Coil
Negated Retentive Coil
Positive Transition Coil
Negative Transition Coil
Set Coil (Latch)
Reset Coil (Unlatch)
Retentive Set Coil
Retentive Reset Coil

Positive transition coils and negative transition coils shall function as leading and trailing edge one-shot coils respectively. Contacts may be referenced any number of times within the application program. A single rung may contain more than one coil. There shall be a service that allows user programs to be checked for multiple coil use. This flag may be set to:

Disallow more than one coil in a single rung
Allow multiple coil use but generate warning messages
Allow multiple coil use without warnings

27. Timers and Counters

Timer and counter operations shall consist of the following types:

TIMERS AND COUNTER FUNCTIONS
Retentive On-Delay Timer (ONDTR)
Simple Off- Delay Timer (OFDT)
Simple On-Delay Timer (TMR)
Up Counter (UPCTR)
Down Counter (DNCTR)

The retentive on-delay timer shall behave as a stop-watch that increments time when enabled and holds the current timed value until receiving power flow to the reset input. The simple on-delay timer shall increment while it receives power flow and reset to zero when power flow stops. The simple off-delay timer shall increment while it power flow stops and reset to zero when power flow is present. There shall be at least 682 programmed timers and/or counters available for use in application programs. Each timer or counter requires the use of three 16-bit registers within memory for storage of the preset, the current value and a control word. These three registers shall be accessible to the user via a register reference. The timers and counters shall not require an output reference, the output of a timer or counter can be used to energize a coil, or enable another function, such as a math function, or another timer or counter. The time/count limit shall be either a programmed constant or shall be programmable via a register reference value. The time shall be counted in tenths of seconds or hundredths of seconds, and the range for the timers and counters is 0 to 32,767 time units.

28. Arithmetic

The arithmetic operations shall support two data types, Signed Integer (INT), and Double Precision Integer (DINT). Arithmetic functions shall consist of the following types:

ARITHMETIC FUNCTIONS:

Addition
Subtraction
Multiplication
Division (quotient)
Modulo (remainder)
Square Root

Signed Integers (INT) data shall be stored in 16 contiguous bits of memory, in 2's complement notation. The range for Signed Integer Data shall be -32,768 to +32,767. Double Precision Integer (DINT) data shall be stored in 32 contiguous bits of memory, double precision data is always signed. The range for Double Precision Integer Data shall be -2,147,483,648 to 2,147,483,647. The arithmetic function blocks shall consist of 3 inputs and 2 outputs. The enable input shall begin the execution. When the function is enabled, the two data inputs are operated upon and the result is output. There shall also be an OK output that is always true when the function is enabled, unless an overflow or other error exists. All of the Arithmetic functions shall be such that they can be cascaded together in a single rung.

29. Relational Functions

Relation Functions which are used to compare two numbers, shall operate on Signed Integer and Double Precision Integer data types, and shall consist of the following types:

Relational Functions
Equal To - Not Equal To
Greater Than - Greater Than or Equal to
Less Than - Less Than or Equal to

30. Bit Operation Functions

Bit Operation Functions shall perform comparison and movement operations on word data that is specified as a continuous string of data in 16-bit increments, with the first bit of the first word being the least significant bit, and the last bit of the last word being the most significant bit. Bit Operation Functions that are used to perform Boolean operations on corresponding bits of two bit strings of the same length shall consist of the following types:

BOOLEAN FUNCTIONS
Logical AND
Logical OR
Logical Exclusive OR

Bit Operation Functions used to create an output string that is a copy of an input bit string, but with its bits inverted, shifted, or rotated shall consist of the following types:

BIT FUNCTIONS
Logical Invert (NOT)
Shift Left
Shift Right
Rotate Left
Rotate Right

The shift functions shall allow for the user to specify the number of places that the array is to be shifted as an input, and provide the state of the last bit shifted out, and a copy of the shift register as outputs.

31. Data Move Functions

Basic data movement capabilities shall be provided by the following list of functions:

DATA MOVE FUNCTIONS:

Move
Block Move
Block Clear
Shift Register
Bit Sequencer
Range
Communications Request

The movement of data (16 bit integer or word), as individual bits, from one location to another shall be accomplished by the Move function. The user shall be able to specify the length of the move. The Block Move function shall provide the functionality to move a block of 7 constants (integer or word) to a specified location. The ability to fill a specified block of

data (word) with zeros shall be accomplished by the Block Clear function. The user shall be able to specify the length of the block. The Shift Register function shall provide the functionality to shift one or more data words from a reference location into a specified memory location. All of the data within the Shift Register shall be accessible throughout the program from logic addressed memory. A method of shifting a bit sequence through an array of bits shall be provided by a Bit Sequencer function. The function shall provide the ability to reset the sequence, change the direction of the bit pattern, or access the step location within the array. A method of checking for a value to be contained within a group of values shall be provided in a Range function. Provisions to initiate communications with a specialized communication module shall be made through the use of a Communication Request function. This function shall allow the PLC to behave as a master on a serial communication link, thus providing the ability to communicate master/slave or peer to peer with any controller or computer using the same serial communication protocol.

32. Table Operations

Table operations shall consist of moving data into or out of tables and searching for data of values equal to, not equal to, greater than, greater than or equal to, less than and less than or equal to a specified value.

TABLE FUNCTIONS:

Array moves
Search Equal
Search Not Equal
Search Greater Than
Search Greater Than or Equal to
Search Less Than
Search Less Than or Equal to

The array move feature shall be capable of implementing indirect addressing applications.

33. Conversion Functions

Two conversion functions shall be provided to convert a data item from a 4 digit Binary Coded Decimal (BCD-4) data type to a 16 bit signed integer and vice versa.

34. Control Functions

Control functions shall be provided to limit program execution, alter the way the CPU executes the application program, or provide special PLC services. The following control functions shall be provided:

CONTROL FUNCTIONS
CALL
Immediate I/O update (DO I/O)
Comment rung (COMMNT)
Master Control Relay (MCR, END MCR)
Jump to a label (JUMP, LABEL)
Special Service Requests (SVCREQ)

An immediate I/O update function shall be provided for the update of all or a portion of the inputs or outputs for one scan while the program is running, or to update I/O during the program in addition to the normal I/O scan. Additionally, the function shall provide a mean to read inputs into memory auxiliary to the true input table, and execute outputs from discrete memory alternate to the true output table. A comment rung function shall be provided to enter a rung explanation in the program. The rung explanation shall have the capacity to hold 2048 characters of text. The memory required for the comment shall be independent of the program storage memory. The comment shall have the ability to be edited via the PC compatible programming software. A master control relay function shall allow all rungs between the MCR and its subsequent END MCR function to be executed without power flow. A method for structuring the ladder program shall be provided with the use of a JUMP Function. This will cause the program execution to jump to a specified location in the logic targeted by the location of the LABEL function. Seven different special PLC service requests shall be accessible by the programmer by utilizing one of the Service Request Functions listed below:

SERVICE REQUEST FUNCTIONS
Change/Read Checksum Task State and
Logical Number of Words to Checksum
Change/Read Time of Day Clock.
Shut Down the PLC.
Clear Fault Tables.
Read Last Fault Table Entry.
Read Elapsed time Clock.
Read I/O Override Status.

The Data written by these service request functions shall be in BCD or Packed ASCII format, and written into user definable register locations.

35. PID Function

A single Proportional/Integral/Derivative (PID) function block instruction shall be provided by the CPU without any additional module. Two versions of this closed loop control algorithm PID shall be available: The standard ISA PID algorithm, which applies the proportional gain to each of the proportional, derivative, and integral terms; and the independent algorithm that applies the proportional gain only to the proportional gain term.

36. Subroutine Function

A single function block shall be available to allow repetitive call of a function. A password to protect the integrity of the subroutine shall also be available. A subroutine may be called from within another subroutine. The nesting shall be at least 8 deep. A Periodic Subroutine shall be available that is executed once a programmable interval. The interval shall be between 1 and 10 milliseconds. The accuracy of the subroutine execution shall be 50 nanoseconds. Discrete I/O shall be available to update during the execution of the subroutine.

37. Discrete I/O, MODULARITY

Interface between the PLC and user supplied input and output field devices shall be provided by rack type I/O modules.

CONFIGURATION

An expandable I/O system shall be supported by a single slot modular CPU, and shall accommodate up to 5 total racks or 49 I/O slots up to a total distance of 15 m with the standard expansion racks and 213 m with the remote expansion racks. Expansion I/O racks shall be connected to the CPU rack via a high speed serial interface cable. The receiver shall be contained within the expansion baseplates eliminating the requirement for additional communication modules.

I/O ADDRESSING

I/O reference addressing for each I/O module shall be assigned through the use of the PC compatible configuration and programming software or the hand held programmer. There shall be no jumpers or DIP switch settings required to address modules. The circuit status of each I/O point on a module shall be indicated by a green LED mounted at the top of the module. These LED's shall be visible through a clear plastic lens. Each LED shall illuminate a letter and number which corresponds to the energized I/O circuit. Addressing of all references including I/O shall be represented as a Decimal Based number.

CONSTRUCTION

Terminal blocks shall be easily removable, and common to all discrete and analog I/O to allow for convenient pre-wiring of field devices. Each I/O module shall contain a hinged, clear plastic, terminal block cover (door) with a removable label. The inside of the label shall have the module description, catalog number, and circuit wiring diagram for that module type, and the outside of the label shall have a user legend space to record circuit identification information. The label shall have color coding for quick identification of the module as high voltage (red), low voltage (blue), or signal level (gray) type.

Electrical Specifications: I/O modules shall be designed for 1500 volt isolation between the field wiring and the system backplane.

Input Specifications: The 120 V(ac) input module shall accommodate an input voltage range from 0 to 132 volts. The 24 V(dc) positive and negative logic input modules shall accommodate an input voltage range of -30 to +30 V(dc).

AVAILABILITY OF INPUT MODULES

The following discrete input modules shall be available for use:

Description	Points/Module
Input Simulator	8, 16
120 Vac Isolated Input	8
240 Vac Isolated Input	8
120 Vac Input	16
24 Vac/Vdc Negative Logic Input	16
24 Vdc, Positive/Negative Logic Input	8, 16, 32
24 Vdc Positive/Negative Logic Input (1ms response)	16
125 Vdc Positive/Negative Logic Input	8
5/12 Vdc Positive/Negative Logic Input (TTL)	32

OUTPUT MODULES

Discrete AC output modules shall have separate and independent commons allowing each group to be used on different phases of AC supply. Each discrete AC output shall be provided with an RC snubber to protect against transient electrical noise on the power line. Discrete AC outputs shall be suitable for controlling a wide range of inductive and incandescent loads by providing a high degree of inrush current (10 times the rated current). Discrete DC output modules shall be available with positive and negative logic characteristics in compliance with the IEC industry standard. Discrete DC output modules shall be provided with at least eight output points in a group with a common power input terminal per group. Discrete DC output modules shall be compatible with a wide range of user-supplied load devices, such as: motor starters, solenoids, and indicators. A 2 A relay output module shall be capable of supplying 2 A resistive maximum load per output and 4 A resistive maximum load per group of 4 outputs. A 4 A relay output module shall have 8 isolated outputs per module and shall be capable of supplying 4 A resistive maximum load per output and 32 A resistive maximum load per module.

AVAILABILITY OF OUTPUT MODULES

The following discrete output modules shall be available for use:

Description	Points/Module	Fuse Rating	No. Fuses/Module
120 Vac, 0.5 A(2 group)	12, 16	3 A	2
120/240 Vac, 1 A (2 group)	8	3 A	2
120/240 Vac Isolated, 2 A	5	3 A	5
12/24 Vdc Positive Logic, 2 A	8	5 A	2
12/24 Vdc Positive Logic , .5 A	8, 16, 32	N/A	0
12/24 Vdc Negative Logic , 2 A	8	5 A	2
12/24 Vdc Negative Logic, .5 A	8, 16	N/A	0
125 Vdc Positive/Negative Logic, 1 A	6	N/A	0
5/12/24 Vdc Negative Logic, .5 A	32	N/A	0
Relay, Normally Open, 2 A (4 groups)	16	N/A	0
Relay, Normally Open 4 A Isolated	8	N/A	0
Relay, Isolated, 4 Normally Closed	8	N/A	0
4 Normally Open (Form B & C) 8 A	8	N/A	0

AVAILABILITY OF MIXED I/O MODULES

The following discrete output modules shall be available:

Description	Point/Module
24 Vdc Input, Relay Output	8 in, 8 out
120 Vac Input, Relay Output	8 in, 8 out

ANALOG I/O, GENERAL SPECIFICATIONS

For the conversion of analog to digital and digital to analog conversion required by an application, the following shall be available:

Analog Voltage Input.—The analog voltage input module shall be capable of converting 4 or 16 channels of inputs in the range from -10 V to +10 V. Resolution of the converted analog voltage input signal shall be 12 bits binary or 1 part in 4096. All of the channels of converted analog voltage input signals shall be updated each scan into a dedicated area of data registers in a 16-bit 2's complement format. The conversion speed for all of the analog voltage input channels shall be no less than 2 ms and no greater than 13 ms . The analog voltage input module shall be configurable for a range from 4 mA to 20 mA analog current input via an external resistor.

Analog Current Input.—The analog current input module shall be capable of converting 4 or 16 channels of inputs in the range from 4 mA to 20 mA or from 0 mA to 20 mA. Resolution of the converted analog current input signal shall be 12 bits binary or 1 part in 4096. All of the channels of converted analog current put signals shall be updated each scan into a dedicated area of data registers in a 16-bit 2's complement format. The conversion speed for all analog current input channels shall be a minimum of 2 ms and no greater than 13 ms .

Analog Voltage Output.—The analog voltage output module shall be capable of converting 2 or 8 channels of digital data to analog outputs in the range from -10 V to +10 V. Resolution of the converted output signal shall be 13 bits or 16 bits. All channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format. The analog voltage outputs shall be configurable to default to 0 mA, 4 mA or hold-last-state in the event of a CPU failure.

Analog Current Output.—The analog current output module shall be capable of converting 2 or 8 channels of digital data to analog outputs in the range from 0 mA to 20 mA. Resolution of the converted output signal shall be 12 bits or 16 bits. All channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format. The analog current outputs shall be configurable to default to 0 V or hold-last-state in the event of a CPU failure.

Analog Combination.—The analog combo module shall be capable of converting 4 channels of analog inputs to digital data and 2 channels of digital data to analog outputs. All channels are configurable for 0 mA to 20 mA, 4 mA to 20 mA, 0 - +10V, and -10 - +10V. Resolution of the converted input signals shall be 12 bits and output signals shall be 16 bits. All channels of analog data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format. The analog outputs shall be configurable to default to 0 volts or hold-last-state in the event of a CPU failure.

MODULE AVAILABILITY

The following analog modules shall be available for use:

Description	Channels/Module
Input	4, 16
Voltage Analog Input	4, 16
Current Analog Output	2, 8
Voltage Analog Output	2, 8
Combo Analog Inputs/Outputs	4/2

SPECIALTY MODULES

HIGH SPEED COUNTER

A specialized high speed counter option module shall be available to accommodate applications where pulse input rates exceed the input capability of the PLC. The high speed counter module shall provide direct processing of rapid pulse signals up to 80 kHz in frequency. The high speed counter module shall be configurable as four independent counters counting either up or down, two independent bi-directional counters, or one counter that can calculate the difference between two changing count values.

PROGRAMMABLE CO-PROCESSOR MODULE

A specialized high-performance programmable microcomputer module having up to 640 Kbytes of on-board CMOS battery-backed user memory shall be available to perform co-processor functions. The specialized co-processor module shall be programmable with a powerful BASIC language interpreter or 'C' Language to perform data acquisition, data storage and retrieval, real time computing, and operator interface functions. The specialized co-processor module shall be capable of performing master/slave or peer-to-peer serial communication tasks in point to point or multidrop configurations utilizing a serial communication protocol. The configurable module shall have two serial communication ports, one RS-232 and the other a selectable RS-232 or RS-485. The specialized co-processor module shall have dual tasking capabilities, and shall be software configurable to behave as:

One serial communication port,
Two independent serial communication ports,
One serial communication port and one ASCII/BASIC application using one port, or
One ASCII/BASIC application using one or both ports.

OPERATOR INTERFACE MODULE

An embedded module shall support a high performance, character-based operator interface. This intelligent module shall communicate with the CPU over the backplane. The operator interface shall support the use of a single remote terminal up to 1220 m from the PLC. The module should support any VT-100 standard compatible terminal in order to provide maximum flexibility in terminal selection.

The operator interface shall require no programming to create graphic screens.

The operator interface shall provide configurable alarm messages.

The operator interface shall support trending functions.

The operator interface shall provide a standard screen for monitoring and tuning the standard PID functions provided by the PLC.

The operator interface shall allow direct control of PLC functions through the use of fifteen user-defined function keys per graphic screen.

The operator interface shall supply a standard screen to display diagnostic information available in the PLC CPU and I/O fault tables. In addition, the operator shall be able to clear these faults from the operator interface.

COMMUNICATIONS (Bus Controller)

Peer-to-Peer Communications: A specialized option (bus controller) module shall be available that will allow the PLC to communicate on a token passing peer-to-peer, noise immune network providing high-speed transfer of control data. The specialized communication (bus controller) module shall be configurable to broadcast data to and receive data from up to 31 other devices on a network automatically and repeatedly from a shared and dedicated database in RAM memory. The communication medium for this specialized network shall be a high energy and noise immune single shielded twisted pair cable transmitting data at an adjustable rate of up to 153.6 kbaud. The distance of the communication shall be up to 2287 m at a lower baud rate.

10-3.38 FIELD CONTROL STATION

The field control station (FCS) shall function as a standalone programmable logic controller, distributed programmable logic controller, or as industrial I/O for a user-specified controller. The controller shall receive discrete and analog inputs and controls discrete and analog outputs in a manner dictated by the user-specified logic called relay ladder logic or instruction list. The controller shall also perform data handling operations and communicate with external devices.

Manufacturer's Standards.—The manufacturer shall have attained ISO 9000 registration.

Design and Manufacture.—The controller or I/O system and all of the corresponding components shall be offered by a company who regularly manufactures and services this type of equipment. All products shall be designed, manufactured, and tested in accordance with recognized UL, CSA, IEC and JIS industrial standards. The system shall be operational during and after testing.

Agency Approvals Overview.—The field control station shall conform to the following agency requirements:

A. Quality Assurance in Design and Development, Production, Installation and Servicing ISO 9001 Certification by Underwriters Laboratories.
B. Industrial Control Equipment [Safety] UL508 Certification by Underwriters Laboratories.
C. Process Control Equipment [Safety] CSA22.2, 142-M1987 or C-UL Certification by Canadian Standards Association or Underwriters Laboratories UL 1604 with C-UL Certification by Underwriters Laboratory.
D. European electro-magnetic-comptability (EMC) Directive CE Mark Certification by Competent Body for EMC Directive for selected modules.

Environmental.—The field control station shall conform to the following environmental requirements:

A. Vibration: IEC68-2-6, JISC0911 at 1G from 40 Hz to 150 Hz, 0.30 mm p-p from 10 Hz to 40 Hz.
B. Shock: IEC68-2-27, JISC0912 at 15G for 11 ms.
C. Operating Temperature: From 0_C to 60_C.
D. Storage Temperature: From -40_C to +85_C.
E. Humidity: From 5 percent to 95 percent, non-condensing.

Enclosure Protection.—The field control station shall be housed in an enclosure that conforms to the requirements in IEC529 Steel Cabinet per IP54, "Protection From Dust and Splashing Water."

Electro-Magnetic-Comptability Emissions.—The EMC emissions for the field control station shall conform to the requirements listed in CISPR11, EN55011 and FCC Class A [applies to CE Marked modules] Part 15, Sub-part J, Class A.

Electro-Magnetic-Comptability Immunity.—The EMC immunity for the field control station shall conform to the following requirements:

A. Electrostatic Discharge IEC801-2 for 8 kV Air Discharge.
B. 4 kV Contact Discharge Radiated RF IEC801-3, 10 Vrms/m, 80 MHz to 1000 MHz modulated.
C. Fast Transient Burst: IEC801-4, 2 kV (power supplies), 1 kV (I/O communications).
D. Conducted RF: IEC801-6, 10 V, from 150 kHz to 80 MHz injection for communication cables greater than 30 m
E. Surge Withstand: ANSI/IEEE C37.90a Damped Oscillatory Wave at 2.5 kV [cmn,diff mode]: power supplies, I/O from 12 V to 240 V.
F. IEC255-4 Damped Oscillatory Wave, Class II: power supplies, I/O from 12 V to 240 V.

Isolation.—The field control station shall meet the dielectric requirements listed under: UL508, UL840 and IEC664 for 1.5 kV rating for modules operating from 51 Vto 250 V.

Power Supply.—The power supply used for the field control station shall conform to the requirements in IEC1000-4-11 for variations in AC input ranging from 30 percent to 100 percent producing a variation for AC outputs of up to 10 percent and a variation for DC outputs of up to 20 percent.

The manufacturer shall have a fully operational quality assurance and quality control program in place. Complete documentation describing the quality assurance and quality plan shall be available to the Engineer upon request. The Contractor shall provide the Engineer complete product documentation describing installation and simple field maintenance.

The power supply shall be modular in design, separate from the CPU or Network Interface Unit (NIU), for easy replacement in the unlikely event of failure. The power supply shall be compatible with main CPU or NIU stations, as well as with expansion stations and booster power supply carriers. The AC power supply shall provide from 85 V(ac) to 132 V(ac) and from 176 V(ac) to 264 V(ac) at 27 VA of input power. The DC power supply shall provide from 18 V(dc) to 30 V(dc) voltage source requiring up to 11 watts of input power (depending on module loading).

Support.—The Contractor shall submit manufacturer's standard warranty. The manufacturer or its authorized representative shall provide complete technical support for all of the products supplied under this contract for the field control station. A toll-free (800) number hot-line shall be available for emergency support.

General Product Information.—The FCS system shall consist of rugged components designed specifically for industrial environments. A complete system shall consist of one or more stations containing DIN-rail-mounted I/O modules, I/O field wiring carriers, CPU or Network Interface Unit (NIU), and power supply interconnected by signal and power cables.

Packaging.—All FCS components shall be housed in structurally secure modules that are fully enclosed within a durable plastic shroud. The system shall be modular and DIN rail mounted with additional provisions for panel mounting. When mounted on the system base, each I/O module shall not occupy more than one available slot. The electronic components of each I/O module shall be separate from the I/O wiring carrier termination. The depth of the system shall not exceed 70 mm when mounted on a DIN rail with a power supply. I/O modules shall be retained with a lock down mechanism. The I/O modules shall have a color plastic insert for quick identification of the module as high voltage (red), low voltage (blue), signal level (gray), or mixed (gold) type. I/O modules shall require no tools for insertion or extraction. Module insertion or removal shall not disturb field wiring. Modules shall connect electrically via a pin and socket connector. All products shall be marked using a laser etching process which leaves all plastic housings recyclable. The markings shall be placed on the front of each product and include the manufacturer's catalog number, product manufacturing date code, and certifications.

Durability.—All components of the FCS shall be manufactured with a high degree of durability. All switches and other operator-controlled devices shall be of the size and durability for the intended use as is normally offered for industrial applications. All signal cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.

Parts Interchangeability.—The I/O system shall have a keying system to prevent modules from being installed into the wrong field wiring carrier. Wherever possible, all assemblies and sub-assemblies performing similar functions shall be interchangeable.

Central Processing Unit (CPU).—The CPU shall be modular, having the capability to solve application logic, store the application program, and store numerical values related to the application processes and logic, and interface to the I/O system. The CPU shall provide at least the following advanced programming features:

PID.
Modulo.
Math.
Floating Point Math.
Double Precision Math.
Logical Functions.
Subroutines.
Data Array Move.
Indirect Addressing.

The CPU shall contain a real-time calendar and clock that can be accessed by the user program. The time of day clock and calendar shall be battery-backed and maintain seven time functions:

Year (4 digits)
Month, Day of Month
Hour
Minute
Second
Day of week and be year 2000 compliant.

The CPU shall execute Boolean instructions at a rate of 1.8 ms per instruction or faster. The CPU shall be capable of controlling up to 8 local I/O carriers in the basic configuration and up to 56 additional I/O carriers remotely. The CPU shall support a total of 256 local I/O and a total of 4096 I/O in a local and remote configuration. The CPU shall provide two serial ports, one 9 pin RS 232 and one 15 pin RS 485 for communications. Both ports shall support CPU programming. Both ports are configurable for SNP slave or RTU slave operation. Both ports shall support 4-wire and 2-wire Modbus_ RTU. Both ports on the CPU shall support configurable baud rates from 1.2 kbps to 38.4 kbps. The CPU shall support serial ASCII read and write. Application programs, configurations, and data are maintained in non-volatile RAM and protected by a super-capacitor or optional battery. This data shall be saved if power is cycled to the CPU. Using the programmer, all data can be saved to flash memory, which does not require battery backup. The CPU can be configured to automatically restore data each time it powers up. With a battery, data shall be retained for 3 months in storage or approximately 7 months with the CPU powered up for 50 percent of the time. The battery shall be easily removed and readily available through commercial outlets. There shall also be a super capacitor that provides a minimum of 1 to 2 hours battery-less backup power for CPU RAM memory. The CPU shall provide LEDs, visible through the module's door, which indicate the presence of power and show the operating mode and diagnostic status of the CPU. The following LEDs shall be provided on the CPU:

Power
OK
Run
Fault
Force
Port 1
Port 2

Alarm Processor.—The CPU shall contain an alarm processor that is a special CPU feature designed to receive and process faults. The diagnostics shall provide information on the configuration and CPU, memory, communications and I/O status. The alarm processor function shall log I/O and system faults in two fault tables that shall be accessible for display on the Windows_ compatible programming software screen or uploaded to a host computer or other co-processor. The alarm processor shall maintain the states of up to 128 discrete system diagnostic bits to be read by a host or incorporated as contacts into the ladder program for customized diagnostic routines. Each fault table shall have a total capacity of 32 faults. The last 16 entries shall maintain the latest 16 faults. The first 16 entries shall be kept unchanged. Faults may be cleared by the user by way of a programmer. Provision shall be made by way of passwords to protect these faults from unauthorized clearing. Faults may also be cleared by a key switch.

Alarm Features.—The alarm processor shall report three types of fault action: fatal, diagnostic, or informational, and the CPU shall respond as follows:

Fault Action	Fatal	Diagnostic	Informational
CPU Enters Stop Mode	Yes	No	No
Set Diagnostic Bit	Yes	Yes	No
Logged In Fault Table	Yes	Yes	Yes

When an I/O fault occurs, the alarm processor shall report the station and slot location of the fault, the condition, the address and the circuit number if appropriate. The alarm processor function shall have the capability to time-stamp system faults for future reference.

System Security and CPU Memory Protection.—The CPU shall have four levels of security or password privilege levels to prevent unauthorized changes to the contents of the CPU. These built-in privilege levels shall be set in the programming software and shall impose the following constraints:

Level	Constraint
1	Read CPU data only (except passwords)
2	Write to any data memory
3	No. 2 and write to all configuration or logic in Stop mode
4	No. 3 and write to logic in Stop or Run mode (on-line change) and password level access

There shall be one password, up to four ASCII characters in length, for each privilege level in the CPU, and the same password can be used for more than one level. Any attempts to access or modify information in the CPU without the proper password privilege level shall be denied.

Subroutine Password.—The CPU shall have a software OEM key that allows users to control access to each subroutine in the relay ladder program.

OEM Program Protection.—The CPU shall have a software OEM key that allows users to protect the resident relay ladder program from unauthorized reads and writes.

CPU memory and Memory Capacity.—The CPU shall support at least the following resources:

12,288 (12 k), bytes for application programming memory.
2048 (2 k) 16-bit registers for register and data usage.
1280 bits for global references.
2048 (2 k) bits for control relays.
2048 (2 k) bits for discrete inputs.
2048 (2 k) bits for discrete outputs.
128 each 16-bit registers for analog inputs.
128 each 16-bit registers for analog outputs.
256 bits for discrete temporary.
1024 bits for discrete internal with memory retention.

Executive level operations performed by the CPU shall not consume application memory.

Memory Retention and Diagnostics.—The register values and the application program shall be stored in battery backed RAM. The application program and system configuration shall also be stored in FLASH memory. There shall be a long-life lithium battery used to maintain the contents of the RAM in the CPU. There shall be an easily accessible battery compartment in the CPU. The battery shall be replaceable with power applied to the CPU and without removing the CPU. A low battery condition shall be alarmed with a system diagnostic bit. The CPU shall update the application program checksum at the end of every sweep. A complete checksum calculation for a program may take multiple sweeps. A configurable number of program memory words shall be calculated each sweep. If the calculated checksum does not equal the reference checksum, a fault shall be recorded, and the CPU mode will change to STOP/FAULT.

CPU Master and Slave Communications.—The CPU or equivalent shall have the capability to communicate with external devices through Network Communications Modules (NCM) supporting different networks. One module shall allow the CPU to communicate as a slave on Profibus-DP. One module shall allow the CPU to communicate as a master on DeviceNet_.

Distributed I/O Communications.—As an I/O system a networked master shall communicate with the I/O through a Network Interface Unit (NIU). The following networks shall be supported as Network Interface Units:

Genius_
Profibus- DP
DeviceNet

The Profibus-DP Network Interface Unit shall support a minimum of 125 nodes per bus. The DeviceNet NIU shall support a minimum of 63 nodes per bus. The Genius NIU shall support a minimum of 31 nodes per bus.

I/O and Field Wiring Interface.—The I/O modules shall be supported by individual field wiring carriers that connect the I/O electronics to the I/O bus. Each CPU and NIU shall support eight I/O carriers locally. The carriers shall be capable of accepting modules with up to 32 points. There shall be at least four styles of I/O carrier wiring terminations – IEC box style, barrier style, spring clamp style, and connector style. The I/O carriers shall be universal and accept any discrete or analog I/O modules. The I/O modules and carriers shall be the same for either direct connection to the CPU or connection to the NIU as distributed I/O. Each I/O carrier shall have a clear plastic door that covers the wiring terminals. Each I/O carrier shall include a label with the module description, catalog number, and wiring diagram for that module type. The outside of the label shall have user legend space to record wiring information.

I/O Addressing.—The I/O modules connected to a NIU shall have reference addressing assigned automatically upon power up. The I/O reference addressing for modules connected to a CPU shall be assigned automatically upon power up or may be assigned through the use of the Windows compatible configuration and programming software. There shall be no DIP switch settings required to address the I/O modules.

Visual Diagnostics.—Each I/O module shall have an OK LED to indicate when backplane power is present to the module. Output modules shall have a field power LED to indicate when field power is applied to the module. Each discrete I/O module shall have individual LEDs to indicate the on/off state of the I/O points. The diagnostic status of the Electronic Short Circuit Protection (ESCP), for those discrete output modules containing ESCP, shall be indicated by a green LED during normal operation per point and amber during a fault. The fault should be auto-corrective without the need to cycle power.

Discrete I/O and Discrete Input Module.—
The 120 V(ac) input module shall accommodate an input voltage in the range from 85 V(ac) to 132 V(ac). The 24 V(dc) positive logic input modules shall accommodate an input voltage range of +15 V(dc) to +30 V(dc) and nominal 24 V(dc).

Availability of Discrete Input Modules.—The following discrete input modules shall be available for usage:

Description	Points/Module
120 Vac Input	8 and 16
240 Vac Input	8 and 16
24 Vdc, Positive Logic Input	16 and 32

Discrete Output Module.—Grouped discrete AC output modules shall have separate and independent commons allowing each group to be used on different phases of AC supply. Each discrete AC output shall be provided with an RC snubber to protect against transient electrical noise on the power line. Discrete AC outputs shall be suitable for controlling a wide range of inductive and incandescent loads by providing a high degree of inrush current (10 times the maximum rated current). Discrete DC output modules shall be available with positive logic characteristics in compliance with IEC industry standards. Discrete DC output modules shall provide at least eight output points in a group with a common power input terminal per group. DC outputs shall also be available with Electronic Short Circuit Protection (ESCP). Discrete DC output modules shall be compatible with a wide range of user-supplied load devices, such as: (1) motor starters, (2) solenoids, and (3) indicators. A relay isolated output module rated for 2 A shall be capable of supplying a maximum resistive load per output of 2 A.

Availability of Discrete Output Modules.—The following mixed discrete I/O modules shall be available for usage:

Description	Points/Module
120 Vac, 0.5 A, Isolated	8 and 16
120 Vac, 2 A Isolated	8
24 Vdc Positive Logic, 0.5 A	16 and 32
24 Vdc Positive Logic, 0.5 A with Electronic Short Circuit Protection	16 and 32
24 Vdc Positive Logic, 2 A with Electronic Short Circuit Protection	8
Relay, Normally Open, 2 A Isolated	8 and 16

Availability of Discrete Mixed I/O Modules.—The following mixed discrete I/O modules shall be available for usage:

Description	Points/Module
24 V(dc) Input, Relay Output	20 Inputs and 12 Outputs
24 V(dc) Input, Relay Output	16 Inputs and 8 Outputs
24 V(dc) Input, Relay Output	10 Inputs and 6 Outputs
24 V(dc) Input, 24 V(dc) Output with High Speed Counters and Pulse Width Modulation or Pulse Train Outputs	20 Inputs and 12 Outputs
24 V(dc) Input, 24 V(dc) Output	16 Inputs and 16 Outputs
24 V(dc) Input, 24 V(dc) Output with Electronic Short Circuit Protection	16 Inputs and 16 Outputs
120 V(ac) Input, 120 V(ac) Output	8 Inputs and 8 Outputs
120 V(ac) Input, Relay Output	8 Inputs and 8 Outputs
240 V(ac) Input, Relay Output	8 Inputs and 8 Outputs

Analog I/O-Analog Input Voltage and Current Modules.—The analog voltage and current input module shall be capable of converting 4 channels of inputs in the ranges from -10 to +10 V, from 0 V to 10 V, and from 4 mA to 20 mA. Resolution of the converted analog voltage and current input signal shall be available in 12 bit and 16 bit versions. All of the channels of converted analog voltage and current input signals shall be updated each scan into a dedicated area of data registers in a 16-bit 2's complement format. The conversion speed for all of the analog voltage and current input channels shall be no less than 2 ms and no greater than 13 ms.

Analog Output Voltage Modules.—One analog voltage output module shall be capable of converting 4 channels of digital data to analog outputs in the range from -10 V to +10 V. One analog voltage output module shall be capable of converting 4 channels of digital data to analog outputs in the range from 0 V to +10 V. Resolution of the converted output signal shall be 12 bits. All channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format. The analog voltage outputs default to hold-last-state in the event of a CPU failure according to the following table:

Module	Default	Configurable Power Loss State
0-10 V	Hold Last State	0 V
-10 V to +10 V	Hold Last State	0 V

Analog Output Current Modules.—An analog current output module shall be capable of converting 4 channels of digital data to analog outputs in the range from 4 mA to 20 mA. Resolution of the converted output signal shall be 12 bits. All channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format. The analog current outputs shall be configurable to default to 0.0 mA current or hold-last-state in the event of a CPU failure.

Analog Mixed Modules.—Analog mixed modules shall be capable of converting 4 channels of analog inputs to digital data and 2 channels of digital data to analog outputs. There shall be one analog mixed module that supports 4 channels from 4 mA to 20 mA inputs and 2 channels from 4 mA to 20 mA outputs. Another module shall be available that supports 4 channels from 0.0 V(dc) to 10 V(dc) inputs and 2 channels from 0 to 10 V(dc) outputs. All channels of analog data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format. The analog outputs shall be configurable to default to 0.0 V at 4 mA or hold-last-state in the event of a CPU or network failure.

Analog I/O Module Availability.—The following analog modules shall be available for usage:

Description	Channels/Module
Analog Input Voltage/Current	4 and 8
Analog Input RTD	4
Analog Input Thermocouple	7
Analog Output Current	4
Analog Output Voltage	4
Analog Inputs/Outputs Current	4 Inputs and 2 Outputs
Analog Inputs/Outputs Voltage	4 Inputs and 2 Outputs

Specialty Modules, High Speed Counter/PWM/PT Module.—A specialized high speed counter/PWM/PT option module shall be provided to accommodate applications where pulse input rates exceed the input capability of the CPU or where high speed pulsed outputs are required. The high speed counter module shall have 20 DC inputs and 12 DC outputs. Up to 4 of the 20 inputs shall be configurable as high speed counter inputs. The other inputs are available for use as discrete inputs. Up to 4 of the 12 discrete outputs may be configured as pulse width modulated outputs or pulse train outputs. The module may be configured as a high speed counter or high speed output module. As a high speed counter, the module shall be configurable as four independent counters counting either up or down (uni-directional), one independent bi-directional counter and two uni-directional counters, or one bi-directional counter that can perform a homing sequence. As a high speed output module the module shall produce up to four PWM or PT outputs up to 5 kHz.

Programming.—A software programming package running on a PC compatible laptop or desktop computer shall be used to program the CPU. The software shall be Windows 95, Windows 98, and Windows NT_ compatible. On-line and off-line, CPU and I/O configuration and application program development shall be achieved with the PC compatible and programming and documentation software. The PC compatible shall be connectable to the CPU via a built-in serial communication port on the CPU. The programming software shall have access to the application program, the CPU and I/O system configurations, all registers, CPU and I/O status, system diagnostic relays, and I/O over-ride capabilities

MS-Windows Compatible Software.—The MS-Windows compatible software shall provide the capability of reading, writing, and verifying the configuration and program with a diskette backup. The software shall execute on a latest version of operating software, or Windows NT platform. The software shall provide on-screen help information throughout its execution paths. The software shall have the capability of programming the relay ladder program, store the program to the CPU, monitor program and reference address status while the CPU is in Run or Stop mode. The software shall support complete Windows functionality, including:

Drag and drop within the application
Drag and drop to external applications, such as Microsoft_ Excel and Word

The programming software shall support bumpless run mode storage of the program to the CPU. The software shall be capable of generating a printout of the relay ladder program for documentation purposes. The user shall be able to select any of the program documentation below:

Types of Documentation	Description
Print Program	This printout shall print the program logic with or without the equivalent Boolean instructions for each rung, the reference list, reference description and/or users rung comments.
Cross Reference Tables	This printout shall show the use of references in program.
Reference Tables	This printout shall show the values of each reference in each selected table.
Configuration Printout	This printout shall allow the user to generate a rack hardware and its assigned reference addresses listing, and the CPU configuration listing.

The software shall support the creation of an electronic representation of the ladder, as a bit map, to display in other documentation tools. The software shall provide the capability for programming using user-defined variables (nicknames). The software shall have built-in modem connection capabilities. The software shall be IEC 1131 compliant. The software shall have provisions for importing and exporting tag names, comments and descriptions in an Excel spread sheet format. The software shall support toggle and override capability and mixed reference tables.

Programming Languages.—The CPU shall be capable of solving an application program whose source format shall be relay ladder diagram (LD) or instruction list (IL). Programs created in LD shall be displayable in IL and vice-versa (certain restrictions may apply).

Relay Ladder Diagram Functions.—Relay ladder operations shall consist of the following contacts and coils:

Normally Open Contact.
Normally Closed Contact.
Coil.
Negated Coil.
Retentive Coil.
Negated Retentive Coil.
Positive Transition Coil.
Negative Transition Coil.
Set Coil (Latch).
Reset Coil (Unlatch).
Retentive Set Coil.
Retentive Reset Coil.

Positive transition coils and negative transition coils shall function as leading and trailing edge one-shot coils respectively. Contacts may be referenced any number of times within the application program. A single rung shall be capable of containing more than one coil. There shall be a service that allows user programs to be checked for multiple coil use. The flag for the service shall be set to one of the following:

Disallow more than one coil in a single rung.
Allow multiple coil use but generate warning messages.
Allow multiple coil use without warnings.

Timers and Counters.—Timer and counter operations shall consist of the following types:

Retentive On-Delay Timer (ONDTR).
Simple Off- Delay Timer (OFDT).
Simple On-Delay Timer (TMR).
Up Counter (UPCTR).
Down Counter (DNCTR).

The retentive on-delay timer shall behave as a stop-watch that increments time when enabled and holds the current timed value until receiving power flow to the reset input. The simple on-delay timer shall increment while it receives power flow and reset to zero when power flow stops. The simple off-delay timer shall increment while it power flow stops and reset to zero when power flow is present. There shall be at least 682 programmed timers or counters available for use in application programs. Each timer or counter requires the use of three 16-bit registers within memory for storage of the preset, the current value and a control word. These three registers shall be accessible to the user via a register reference. The timers and counters shall not require an output reference, the output of a timer or counter can be used to energize a coil, or enable another function, such as a math function, or another timer or counter. The time and count limit shall be either a programmed constant or shall be programmable via a register reference value. The time shall be counted in tenths of seconds or hundredths of seconds, and the range for the timers and counters is 0 to 32,767 time units.

Arithmetic.—The arithmetic operations shall support two data types; (1) signed integer (INT), and (2) double precision integer (DINT). The arithmetic functions shall consist of the following types:

Addition.
Subtraction.
Multiplication.
Division (quotient).
Modulo (remainder).
Square root.
Floating point math.
Trigonometric functions.

Signed integers (INT) data shall be stored in 16 contiguous bits of memory, in 2's complement notation. The range for signed integer data shall be -32,768 to +32,767. Double precision integer (DINT) data shall be stored in 32 contiguous bits of memory, double precision data is always signed. The range for double precision integer data shall be -2,147,483,648 to 2,147,483,647. The arithmetic function blocks shall consist of 3 inputs and 2 outputs. The enable input shall begin the execution. When the function is enabled, the two data inputs are operated upon and the result is output. There shall also be an OK output that is always true when the function is enabled, unless an overflow or other error exists. All of the arithmetic functions shall be such that they can be cascaded together in a single rung.

Relational Functions.—Relation functions which are used to compare two numbers, shall operate on signed integer and double precision integer data types, and shall consist of the following types:

Equal To, Not Equal To.
Greater Than, Greater Than or Equal to.
Less Than, Less Than or Equal to.

Bit Operation Functions.—Bit operation functions shall perform comparison and movement operations on word data that is specified as a continuous string of data in 16-bit increments. The first bit of the first word being the least significant bit, and the last bit of the last word being the most significant bit. Bit operation functions that are used to perform Boolean operations on corresponding bits of two bit strings of the same length shall consist of the following types:

Logical AND.
Logical OR.
Logical Exclusive OR.

Bit operation functions used to create an output string that is a copy of an input bit string, but with its bits inverted, shifted, or rotated shall consist of the following types:

Logical Invert (NOT).
Shift Left.
Shift Right.
Rotate Left.
Rotate Right.

The shift functions shall allow for the user to specify the number of places that the array is to be shifted as an input, and provide the state of the last bit shifted out, and a copy of the shift register as outputs.

Data Move Functions.—
Basic data movement capabilities shall be provided by the following list of functions:

Move.
Block Move.
Block Clear.
Shift Register.
Bit Sequencer.
Range.
Communications Request.

The movement of data (16 bit integer or word), as individual bits, from one location to another shall be accomplished by the Move function. The user shall be able to specify the length of the move. The Block Move function shall provide the functionality to move a block of 7 constants (integer or word) to a specified location. The ability to fill a specified block of data (word) with zeros shall be accomplished by the Block Clear function. The user shall be able to specify the length of the block. The Shift Register function shall provide the functionality to shift one or more data words from a reference location into a specified memory location. All of the data within the Shift Register shall be accessible throughout the program from logic addressed memory. A method of shifting a bit sequence through an array of bits shall be provided by a Bit Sequencer function. The function shall provide the ability to reset the sequence, change the direction of the bit pattern, or access the step location within the array. A method of checking for a value to be contained within a group of values shall be provided in a Range function. Provisions to initiate communications with a specialized communication module shall be made through the use of a Communication Request function. The Communication Request function shall allow the CPU to behave as a master on a serial communication link, thus providing the ability to communicate master/slave or peer to peer with any controller or computer using the same serial communication protocol.

Table Functions.—Table operations shall consist of moving data into or out of tables and searching for data of values equal to, not equal to, greater than, greater than or equal to, less than and less than or equal to a specified value. Basic table functions shall be provided by the following list of functions:

Array moves.
Search Equal.
Search Not Equal.
Search Greater Than.
Search Greater Than or Equal to.
Search Less Than.
Search Less Than or Equal to.

The array move feature shall be capable of implementing indirect addressing applications.

Conversion Functions.—Two conversion functions shall be provided to convert a data item from a 4 digit Binary Coded Decimal (BCD-4) data type to a 16 bit signed integer and vice versa.

Control Functions.—Control functions shall be provided to limit program execution, alter the way the CPU executes the application program, or provide special CPU services. The following control functions shall be provided:

CALL.
Immediate I/O update (DO I/O).
Comment rung (COMMNT).
Master Control Relay (MCR, END MCR).
Jump to a label (JUMP, LABEL).
Special Service Requests (SVCREQ).

An immediate I/O update function shall be provided for the update of all or a portion of the inputs or outputs for one scan while the program is running, or to update I/O during the program in addition to the normal I/O scan. Additionally, the function shall provide a mean to read inputs into memory auxiliary to the true input table, and execute outputs from discrete memory alternate to the true output table. A comment rung function shall be provided to enter a rung explanation in the program. The rung explanation shall have the capacity to hold 2048 characters of text. The memory required for the comment shall be independent of the program storage memory. The comment shall have the ability to be edited via the PC compatible programming software. A master control relay function shall allow all rungs between the MCR and its subsequent END MCR function to be executed without power flow. A method for structuring the ladder program shall be provided with the use of a JUMP Function. This will cause the program execution to jump to a specified location in the logic targeted by the location of the LABEL function. Seven different special CPU service requests shall be accessible by the programmer by utilizing one of the service request functions listed below:

Change/Read Checksum Task State and Logical Number of Words to Checksum.
Change/Read Time of Day Clock.
Shut Down the CPU.
Clear Fault Tables.
Read Last Fault Table Entry.
Read Elapsed time Clock.
Read I/O Override Status.

The data written by these service request functions shall be in BCD or Packed ASCII format, and written into user definable register locations.

PID Function.—A single PID function block instruction shall be provided by the CPU without any additional module. Two versions of this closed loop control algorithm (Proportional/Integral/Derivative) shall be available: (1) the standard ISA PID algorithm, which applies the proportional gain to each of the proportional, derivative, and integral terms; and (2) the independent algorithm that applies the proportional gain only to the proportional gain term.

Sub-Routine Function.—A single function block shall be available to allow repetitive call of a function. A password to protect the integrity of the subroutine shall also be available. A sub-routine may be called from within another sub-routine. The nesting shall be at least 8 deep. A periodic sub-routine shall be available that is executed once a programmable interval. The interval shall be between 1 ms and 10 ms. The accuracy of the sub-routine execution shall be 50 ns. Discrete I/O shall be available to update during the execution of the subroutine. The user may create up to 64 sub-routine.

10-3.39 SUPERVISORY CONTROL AND DATA ACQUISITION SOFTWARE PACKAGE

The Supervisory Control and Data Acquisition (SCADA) software package shall include, but not limited to, the following:

1. Human Machine Interface (HMI) Software.
2. PLC Programming Software.
3. Microsoft Office (latest version).
4. Symantec Norton Antivirus (latest version) for Window NT.
5. Symantec Pcanywhere (latest version).
6. Diskeeper (latest version).

GENERAL

This specification covers the technical requirements for a Microsoft Windows NT®, Windows® 95, or Windows® 98 based Monitoring and Control system. A monitoring and control system exchanges data in the form of discrete and analog values from I/O devices or control devices such as programmable, motion or computer numerical controllers. A monitoring and control system also typically performs graphical display, alarming, logical functions, analysis, data handling operations and can communicate with external systems over a network.

DEFINITIONS

1. HMI: Human Machine Interface. Used to provide a graphic representation of data from a process and to accept user commands to be fed back to the process.
2. Ethernet: A very high performance local area network standard providing the two lower levels of the ISO/OSI seven layer reference model, the physical layer and the data link layer.
3. TCP/IP: a protocol widely used across Ethernet networks for connecting computers and programmable controllers.
4. Data Concentrator: A physical device that translates analog and digital information from attached I/O devices to a protocol that can be used with an HMI.
5. Communications Protocol: A formal set of conventions governing the control of inputs and outputs between the two communicating processes.
6. Network: An interconnected group of nodes, a series of devices, nodes or stations connected by communications channels.
7. Operating System: A program that controls the entire overall operation of the computer system hardware and software.

WARRANTY

The Contractor shall submit manufacturer's standard warranty. Manufacturer shall warrant the product for a minimum of 90 days. Post warranty support shall be available as a separately purchasable item.

SUPPORT

The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, application technical support, and local or headquarters technical assistance. A telephone help desk shall be available for emergency support. In North America there shall be a toll-free (800) number available to access this support. An electronic Bulletin Board Service (BBS) and World Wide Web pages shall be available to users for application support.

PRODUCT UPGRADES

The manufacturer shall make product upgrades available for purchase. These upgrades shall include both functional upgrades to add features or product options and version upgrades to take the product up to the currently offered product version or revision level.

MANUFACTURER'S STANDARDS

The manufacturer shall have shown high commitment to product, manufacturing and design process quality. It shall have attained ISO 9000 registration. If the manufacturer provides both hardware and software products, each of these shall have separately attained ISO 9000 certification.

DESIGN AND MANUFACTURE

The supplier shall be a company who regularly designs, manufactures and services monitoring and control systems and components. The manufacturer shall have a fully operational quality assurance and quality control program in place. Complete documentation describing the quality assurance and quality plan shall be available. Complete product documentation describing installation and simple field maintenance shall be available.

INDUSTRY STANDARDS

The monitoring and control system shall conform to and take advantage of industry standard and de-facto standards. These shall include, but not be limited to:

ODBC
OLE
ActiveX
DDE
C programming language
Visual Basic®
Microsoft Windows 95
Microsoft Windows 98
Microsoft Windows NT
TCP/IP
OPC

OVERALL DESIGN

The software system shall be designed to operate on a variety of computer platforms and operating systems. It shall support industry standards, be modular in design, and provide application program interfaces to allow easy customization.

CLIENT AND SERVER

In order to reduce the overhead of multiple independent systems, the monitoring and control system shall support a distributed architecture including human machine interfaces, data servers, and viewers (clients). Each of these components shall work in conjunction with the others using industry standard Ethernet networks. The HMI shall support a true client server architecture. HMI servers shall poll and collect data from devices. This data is to be seamlessly shared among other HMI servers and to viewers without requiring the duplication of data values in another node. HMI viewers shall act as clients to the HMI servers, seamlessly receiving their data. In a true client server environment, data is to be configured once. The HMI shall support one time configuration of data points. For example, points to be polled from a device shall be configured once on that server and other servers or viewers need only reference that data item to use it for their applications. Alarms shall be configured once and served across multiple HMI servers and viewers. HMI viewers shall be able to simultaneously access data from one or more HMI servers. Data from multiple servers may be used within the same graphic screen. Viewers shall require only a valid TCP/IP connection to the server to obtain this data. This TCP/IP link may typically be across a local area Ethernet network (LAN) although it may be across a wide area network (WAN) and make use of telephone lines, radio, or satellite links.

HUMAN MACHINE INTERFACE SERVERS (HMI)

The HMI server software shall be configurable to provide for the monitoring and control of all points, loops, and systems through graphic display screens and hard copy (printer output) reports. The HMI server software shall include but not be limited to:

a. Parameter displays for signal control.
b. Control loop status displays.
c. Real time and historical data trend displays.
d. Event displays and log reports.
e. Alarm displays and log reports.
f. Equipment diagnostic displays and reports.
g. HMI servers shall be capable of operating independently but shall be configurable to share data with other HMI servers or enterprise server systems.

ENTERPRISE SERVER

Enterprise servers system shall be capable of consolidating data from HMI servers without the need for reconfiguring point values. Servers shall provide a broad view of information within a facility and shall be capable of supporting host or database applications such as SPC and production tracking. In addition, enterprise servers shall be capable of supplying data services to networked viewers.

VIEWERS

Viewer systems shall provide occasional system users with easy access to plant floor data using the same graphical user interface as enterprise and HMI servers. Viewers shall be capable of both displaying and modifying data.

COMPUTER PLATFORMS

The computer platform for HMI servers shall be a PC compatible personal computer running Windows NT, Windows 95, Windows 98 or a Digital Equipment Alpha computer running Microsoft Windows NT. The HMI shall be capable of running on Symmetric Multi-Processor Windows NT operating systems.

REAL TIME DATA MANAGEMENT

The software shall provide a real time, distributed, memory resident database of current process data values. These data ("point" or "tag") values may be from definable device points representing the value of a physical data collection item on a resource, or virtual points representing values calculated from one or more device point values used in a mathematical expression.

MATH AND FUNCTION SUPPORT

The following math and logic capabilities, as a minimum, shall consist of:

Event driven math and logic.
Visual Basic compliant scripting language support.

Logical operators (and, or, compares).
Alarm status.
Timers.
Four function math (+, -, /, *).
Exponential and logarithmic.
Statistics (average, mean, min, max, median).
Trigonometric (sine, cosine).
Bit manipulation.
String functions.
Conversions (BCD, ASCII).

Expressions using the above math functions shall be supported in the point configurator.

DATA SHARING

Point values shall be stored, retrieved and manipulated across one or more computers using the software's distributed architecture. Data integrity shall be automatically and continuously ensured. Writing of custom software shall not be required to provide simple data sharing among HMI servers, enterprise servers and viewers. Viewers shall simply "connect" to servers to obtain data. Enterprise servers shall have configurable support for collecting data from HMI servers. Application program interfaces shall be published and available to permit users to write custom software to support interfacing the HMI and enterprise servers to other computer systems and applications. To ensure that these "API's" provide adequate support for device data collection, it is required that the HMI supplier shall use these API's in the implementation of the HMI itself. The HMI shall also support data sharing using DDE. In this mode, the HMI acts as the "server" and applications such as Microsoft Excel act as the "client."

DATA COLLECTION METHODS

Data collection methods shall including scheduled polling, on-change, unsolicited, timed interval, "on demand", triggered reads, and array support, among others. Engineering unit conversions on collected data and reverse engineering units conversions for set points are required. HMI servers shall have configurable support for obtaining data from supported plant floor devices. Application program interfaces shall be published and available to permit users to write custom software to support additional devices for data collection. To ensure that these "API's" provide adequate support for device data collection, it is recommended that the HMI supplier shall use these API's in the implementation of the HMI itself. The HMI shall also support data collection from DDE servers using both the DDE and AdvanceDDE protocol standards. In this mode, the HMI operates as a client. This capability permits the use of third party software to extended data collection support. The HMI shall also support data collection from OPC servers. In this mode, the HMI operates as a client. This capability permits the use of third party OPC servers to extended data collection support.

REQUIRED DATA TYPES

The following data types, as a minimum, shall be supported:

Global.
Floating point.
Analog (Signed and Unsigned).
Discrete.
String.
Arrays.
Structures.

DEVICE COMMUNICATIONS

The HMI shall be capable of supporting hundreds of different models, makes, manufacturers, and protocols of programmable and industrial control devices. Support for the following shall be included as a minimum: GE Fanuc, Allen-Bradley, Modicon, Siemens and TI. To permit integration of computer numerical controllers (CNC's), the HMI shall include a communications driver and alternately support open architecture standards and application programming interfaces to allow the development of such a driver as required. As described earlier, the HMI shall also support use of DDE and OPC servers to provide device communications.

SYSTEM POINTS

The HMI shall provide a wide range of pre-defined system points that include a wide variety of topics including alarms, date and time, project, and computer information. System points shall be available to be used by the standard HMI components such as graphics and scripting. The HMI shall accommodate for system points in a client and server architecture with the ability to access system points from the server ($Project) and system points from the client viewer ($Local). The HMI shall provide points for:

Point	Description
$USER	Logged on user
$ROLE	Role of the logged on user
$LOCAL.COMPUTER	Computer Name
$LOCAL.WINUSER	Windows User Name
$PROJECT.COMPUTER	Server Computer Name
$PROJECT	Project Name
$PROJECT.AVAILABLE	Project availability
$PROJECT.LOGGEDIN	Logged In status
$PROJECT.DEVICES	Number of devices online
$PROJECT.USERS	Number of users
$PROJECT.DATETIME	Server Date and Time in seconds from 1/1/1970
$PROJECT.DATE.YEAR	Current Year (1970-2039)
$PROJECT.DATE.MONTH	Current Month (1-12)
$PROJECT.DATE.DAY	Current day in month (1-31)
$PROJECT.DATE.WEEKDAY	Current day in the week (1-7)
$PROJECT.DATE.DAYOFYEAR	Current day in the year (1-356)
$PROJECT.DATE.WEEK	Current week in the year (1-52)
$PROJECT.DATE.HOUR	Current hour in the day (0-23)
$PROJECT.DATE.HOUR12	Current hour on a 12-hour clock (1-12)
$PROJECT.DATE.MINUTE	Minutes past the hour (0-59)
$PROJECT.DATE.SECOND	Seconds past the minute (0-59)
$PROJECT.DATESECOFDAY	Seconds past midnight (0-59)
$PROJECT.DATE.AMPM	0 for AM, 1 for PM
$LOCAL.DATETIME	Local Date and Time in seconds from 1/1/1970
$LOCAL.DATE.YEAR	Current Year (1970-2039)
$LOCAL.DATE.MONTH	Current Month (1-12)
$LOCAL.DATE.DAY	Current day in month (1-31)
$LOCAL.DATE.WEEKDAY	Current day in the week (1-7)
$LOCAL.DATE.DAYOFYEAR	Current day in the year (1-356)
$LOCAL.DATE.WEEK	Current week in the year (1-52)
$LOCAL.DATE.HOUR	Current hour in the day (0-23)
$LOCAL.DATE.HOUR12	Current hour on a 12-hour clock (1-12)
$LOCAL.DATE.MINUTE	Minutes past the hour (0-59)
$LOCAL.DATE.SECOND	Seconds past the minute (0-59)
$LOCAL.DATE.SECOFDAY	Seconds past midnight (0-59)
$LOCAL.DATE.AMPM	0 for AM, 1 for PM
$USER.ALARMS	Alarm count by user
$ALARM.TOTAL	Alarm count
$ALARM.ACKED	Alarms acknowledged
$ALARM.UNACKED	Alarms unacknowledged
$ALARM.DELETED	Alarms deleted
$ALARM.RESET	Alarms reset
$ALARM.GENERATED	Alarms generated
$ALARM.GENPERSEC	Alarms generated per second
$CLASS<Alarm class name>.ALARMS	Alarm count by class
$CLASS<Alarm class name>.UNACKED	Unacknowledged alarm count by class

DYNAMIC MEASUREMENT SYSTEMS

The HMI shall have the capability to dynamically switch between measurement systems such as US and metric. The HMI shall also support the ability for the user to define their own measurement systems as well.

REAL TIME VALUE AND ALARM DISPLAY TABLE

The HMI shall have the ability to select and display a table of points in a separate window without the need for configuring graphic screens. The values of the points shall update dynamically along with a time stamp that indicates when the value changed. In addition, points that meet their alarm criteria shall be displayed in a different color. Double clicking on a displayed point shall bring up configuration information on the point including its description and alarm information. Points with Read/Write capabilities shall be able to be set from this table. By using Microsoft standard user interface guidelines, the HMI shall allow the user to highlight a point and right mouse click. A pop-up menu shall allow the user to open a window and trend the point without the need of a pre-configured a graphics screen.

POINT CROSS REFERENCE

The HMI shall provide the ability to cross reference where points are used within the HMI. The cross reference listing shall include areas such as:

Point Configuration
Events and Actions
Database Logging
Scripts

The ability to print out the point cross reference information shall be provided to assist in documenting the configuration of the system.

APPLICATION MODULES

The monitoring and control system shall be implemented in a modular fashion with a "base" module and one or more "option" modules. Use of option modules shall require the use of the base module. Multiple option modules may be combined with the base module to provide additional functionality.

GRAPHICAL USER INTERFACE AND STATUS MONITORING

The graphical user interface shall provide a set of tools for graphically representing process status. A graphic editor shall be provided to enable creation of graphic screens to represent current process information. For ease of use, the editor shall include cut and paste as well as drag and drop support within a single window and among multiple windows and shall include undo and redo support. Support for grouping and un-grouping sets of objects and for readily editing them while grouped are to be included. Object alignment and spacing tools are required so those objects can be properly arranged on the screen. The editor shall include a utility or tool for determining which points are referenced in a screen, which objects reference them, and which points are not currently defined or known to the software. This tool shall also include provision to search and replace point names for both single objects and groups of objects. A test animation capability shall display the screen currently being developed in the run time environment for rapid prototyping and testing. The editor software shall include the ability to create and edit points from within the editor. It shall also be possible to browse the network to locate computers and projects for available points. The editing package shall include a wizard and symbol and object library to permit the inclusion of pre-developed or third party graphic objects. The editing package shall allow objects and wizards to be created with the native graphics and scripting language and added to the library. A procedure editor shall be included to control setpoints and to perform window management. The graphic editor shall include a scripting expression editor to develop application logic. Graphic objects on these screens can be linked by name to actual device and virtual data through the distributed point database. Objects on the graphics screens can be configured with animation features, causing them to change color or position. Text information can be printed to the screen alerting personnel to current point status. Objects shall be dynamically scalable in both horizontally and vertically directions. The software, as a minimum, shall support the following dynamic attributes:

Annunciation, movement, blink, rotation, and fill (uni-directional and bi-directional).
Gradient fill.
Object border animation.
Object visibility.
Transfer tags for screen transfer or popup windows.
Procedure tags to invoke user defined scripts/programs.
Object and or application help screens.
Alarm information.

Trends charts.
Setpoint tags for point value changes.
Animated frames that can include other graphic objects.
Zoom to best fit, resize window to zoom.
Automatic font scaling when changing window sizes.
1.5 million colors.

Graphic objects, as a minimum, shall include:

Imported metafile objects.
Embedded OLE, including ActiveX objects, sound, video, clip art, spreadsheets.
SPC charts.
Trend charts.
Historical data displays.
Alarm displays.
Arcs.
Lines.
Circles.
Ellipses.
Lines.
Polylines.
Polygons.
Rectangles.
Text strings.
Buttons.

Tag types, as a minimum, shall include:

constant - downloads constants to a point.
variable - allows operator input of desired value.
ramp - downloads values in configured increments.
slide - increment and decrement of point values.
toggle - sets digital points to opposite state.

Graphics screens shall support a Visual Basic compliant scripting language. Data items and variables can be manipulated by the screen scripting to provide additional functionality in dynamically controlling screen characteristics. The graphical editor and viewer shall be capable of being an ActiveX container. It shall be capable of using ActiveX objects provided with the HMI package or third party ActiveX controls supplied by others. The graphical user interface shall support ActiveX "methods" to allow the user to interact with ActiveX control objects. Interaction may be through the association of a method to a button or object, which the operator initiates, or methods may be used by the Visual Basic compliant scripting language for advanced functionality and additional control of the ActiveX components.

ALARMING

The software shall provide alarm annunciation and routing capabilities. The alarm text associated with each alarm shall be user configurable. Alarms are to be applied as follows:

a. Digital Points - The alarm generating condition (0 or 1) shall be selectable.
b. Analog Points - The alarm generating conditions shall be evaluated based on alarm criteria selected.
c. Absolute - There shall be two levels of high alarming, HI-2 and HI-1, and two levels of low alarming, LO-1 and LO-2. HI-1 and LO-1 are also known as warning alarms. For high alarming, an alarm shall be generated when the point value reaches or exceeds the value specified for HI-1 or HI-2. For low alarming, an alarm shall be generated when the point value reaches or falls below the value specified for LO-1 or LO-2.
d. Deviation - Alarm limits for deviation alarms shall be given in positive values. The HI-2 and HI-1 alarms shall be generated when the difference between the current point value and the deviation point value is positive and reaches or exceeds the specified limits. The LO-1 and LO-2 alarms shall be generated when the difference between the current point value and the deviation point value is negative and the absolute value of the difference reaches or exceeds the specified limits.

e. Rate of Change - Rate of change alarms shall be provided to detect either a faster or slower than expected change in the value of a point.
f. Duration - The alarm display shall include total time in alarm state.

Alarms shall be configurable to be filtered and asynchronously sent to users based on user role and scope of responsibilities. Alarms shall be configurable with respective priorities, divided into classes, and color-coded for display. There shall be user-defined logging criteria, user-defined acknowledgment and deletion criteria, user-specific textual messages and operator help text. The alarm list can be toggled between dynamic and static display and quickly filtered to limit the current view to a particular alarm set of interest. The system shall support "alarm blocking". Users shall be able to define an alarm hierarchy and block the generation of "lower level" alarms if a "higher level" alarm is present. This allows for operators to concentrate on primary causes rather than receive all the resulting secondary problems. For example, if a conveyor stops then all machines feeding it would also stop. The operator needs to determine why the conveyor stopped, yet the operator does not need to see the other alarms. In this example, fixing the conveyor will fix those alarms as well. The system shall provide for an automatic routing of configured alarm messages to display type pagers. The routing shall be configurable as to personnel or pager ID receiving the message. It shall be possible to upgrade the paging system to support dual outputs, thereby allowing messages to be sent to local pagers, or to a dial-up paging system.

DATA LOGGING

Data collected by the monitoring and control system shall be logged into a relational database to support historical reporting and analysis. The system shall support multiple SQL compatible databases and formats. Configurable logging of points, alarms, and events shall be supported without forcing the application developer to understanding database internals. Custom application software shall not be required to log data. Configuration of the logging characteristics of a point shall automatically configure the database that shall store the data. A variety of database management systems shall be available for use. Point and alarm data is to be logged upon a "trigger" event. The following triggers for logging point and alarm data are required.

Point Data	Alarm Data
At Time of Day	On Generation
On Time Interval	On Reset
On Point Update	On Acknowledgment
On Event	On Deletion
Gated Based On Logical Expression	

Point attributes, which shall be available for logging, shall include the following:

a. Point value.
b. Previous value.
c. Raw value.
d. Alarm state.
e. Resource.
f. Time last logged.
g. Engineering units.

The logging module shall support the logging of multiple point attributes into a single record based on a single trigger. The logging module shall also support logging multiple points and their attributes to a single. The logging module shall support the simultaneous logging of multiple tables of data consisting of combinations of single points, multiple points, alarms, and events. This supports the creation of custom database tables unique to an application. Through configuration alone, the logging utility shall support "store and forward" to selected database management products. Data shall be buffered on the node collecting it and automatically forwarded to the node where it is to be logged. During a communications outage between the two nodes, the data collection node shall continue to buffer data. Upon restoration of communications, the data collection node shall automatically forward the buffered data to the logging node for storage. User configurable database maintenance actions, which are executed automatically, based on database size or number of records shall be supported. Examples of these actions include exporting data to a CSV file then purging the records from the database. No custom software shall be required to implement this support. Reports using the logged data may be generated using standard third party database management tools such as spreadsheets and report writers.

DDE CLIENT AND SERVER INTERFACE

The HMI shall support a DDE interface in both client and server modes. In the server mode, DDE aware applications (clients) such as Microsoft Excel shall be able to access data managed by the monitoring and control system. The DDE client interface support the use of third party applications to monitor, analyze, report, and modify point data. Required services for the HMI server support include:

a. Request Point Configuration Data (e.g. alarm limits, engineering units labels).
b. Request Point On-Change (DDE Peek).
c. Request Point Update (DDE Poke).

In the client mode, DDE server applications such as device communications drivers shall be able to act as a source of data to the HMI, for both reading and writing of data down to factory floor devices or external systems. For maximum flexibility in selecting third party servers and for maximum software performance, the HMI shall support both the DDE and AdvanceDDE protocols.

OPC CLIENT AND SERVER INTERFACE

The HMI shall support an OPC interface in both client and server modes. In the server mode, OPC aware applications (clients) shall be able to access data managed by the HMI. The OPC client interface shall support the use of third party OPC device communication servers. The OPC server interface shall allow for point information collected and maintained by the HMI to be sent to OPC applications requesting the data.

APPLICATION DEVELOPMENT

Application development should be done in the context of a "project". A given system shall support concurrent application development and execution of multiple projects. All the data related to a project including communication ports, field devices, alarms, users, and graphic screens is stored in a project folder. Project folders shall be easily transportable from system to system. Configuration of a project shall be fully dynamic so that objects may be added to or modified within the project without requiring a system restart. System shall be furnished with application development tools for configuring projects. Utility should provide for interactive fill-in-the-blank transactions for configuring individual items as well as a configuration wizard which guides a developer through the entire process. To support rapid configuration of large systems, an import and export utility should be provided to allow for external management and replication of configuration data. This external file format shall be CSV format to facilitate the use of standard tools such as MS Excel and MS Access. An interactive graphics editor package is required to develop screen layouts and to animate a given application (see earlier section). In cases where standard software functions do not support a given requirement, a set of documented application programming interfaces (API) shall be available for developers. APIs shall be C language or Visual Basic (see earlier section).

DATA TRENDING

The trending module shall be capable of supporting one or more embedded trends within the runtime graphics user interface. The following types of trends shall be supported:

a. Trends with multiple Y axes.
b. Trends with multiple X axes.
c. Trends with multiple time periods.
d. Reference curves.
e. XY plots.

The trending option shall support display of an unlimited number of pens on a single trend chart. Each pen shall display either dynamically updating data or provide seamless access to historical values based on user request. In addition, user shall be able to compare data from different time periods. Trending shall support the creation and re-display of files with reference data from the currently displayed trend. This export capability shall produce "CSV" format files so as to be compatible with standard office automation tools such as spreadsheets and databases. Users shall be able to analyze trend data by scrolling through time, changing the range for point displays, zooming into an area of the trend and selecting a new time period to display. Printing of trend charts is required. The trending module shall support reading data from "CSV" files for the display of data collected or generated by other applications within the HMI framework. Trend layout shall be highly configurable including colors, tick marks, legends, title, and fonts. The update rate for data being displayed from log files shall be configurable. The data being trended shall be configurable. This configuration shall be modifiable at runtime without requiring a development system or license. Trend data can be supplied from multiple sources including current point data, data from .CSV files, and data logged to a database. Data displayed by the trend manager shall support time-based or on-

change based sampling. Trending shall support the display of array points. Arrays can be interpreted as independent variables or as a time series of a single variable. The latter case supports buffering of data in high speed sampling applications. The ability to select any numeric value or values being displayed on a graphic screen and quick trending the values shall be provided. There shall be no need to have pre-configured graphic screens created to display the quick trends.

STATISTICAL PROCESS CONTROL

Data collected though the monitoring and control system shall be accessible by a statistical process control module. This includes data from plant floor devices, manual data entry, custom applications, and flat files. SPC charts and reports shall be provided as ActiveX objects which can be dropped into graphic screens. The software shall support an unlimited number of quality characteristics or sub-groups. The quantity of data displayed in SPC charts shall be user configurable and shall be updated dynamically as new data is collected. SPC ActiveX objects shall allow the user to dynamically switch between a chart and report view of the data without the need to reconfigure screens. Users shall be able to scroll through data that is not initially displayed on a chart. Standard charts and reports shall include:

a. Xbar and range.
b. Xbar and sigma.
c. X individual.
d. Histograms.
e. Pareto.

Software shall support the following control checks where "N" is configurable. Each may be separately enabled or disabled.

a. Any one subgroup beyond upper or lower limits.
b. N subgroups on the same side of the center line.
c. Trend of N consecutive subgroups in a row up or down.
d. N subgroups in a row alternating up and down.
e. Sets of subgroups in a row within one, two or three standard deviation.

All SPC out of control (OOC) conditions shall be capable of being processed by the monitoring and control system to:

a. Change the color of a graphic object to red or flashing.
b. Sounding an audio alarm.
c. Logging the OOC condition to a device or file.
d. Send an alarm message to a user or another process.

Individual quality characteristics are configurable based on the following parameters:

a. Enable or disabled.
b. Subgroup size and interval.
c. Center line, upper and lower control limits.
d. Control limit recalculation type (manual or automatic).
e. Control checks and alarming.

Configuration information shall be centralized on a server node and support SPC charts operating on viewer nodes. All nodes displaying an SPC chart shall have the same control limits. Users shall be able to dynamically modify control chart configuration parameters through the user interface. In addition, they shall be able to delete outliners (points that are out of reasonable range) prior to recalculation of control limits. SPC charts may be embedded in graphic display screens as ActiveX objects to provide seamless integration among applications.

PRODUCTION TRACKING

The HMI shall provide a configurable production tracking application that monitors point values and maintains an accurate image of work-in-process inventory. The production tracking module shall be configurable with respect to the layout of plant conveyor systems, the type of items being tracked (serialized verse non-serialized), and the type of plant floor inputs available for tracking. Example inputs include radio frequency (RF) tags, bar codes, type detectors, and limit switches. The tracking system shall be auto correcting based on collected data. Each item shall have a set of attributes including location, status, and user-definable fields. Attributes such "product build" options and inspection status shall be displayable and modifiable through point values. The production tracking application shall support manual transactions to

add, delete, modify, move, re-sequence, and scrap items. The production tracking module shall include a comprehensive set of routing and control functions. These functions shall interface to the HMI's data collection subsystems to exchange data with factory floor devices. The routing and control functions shall be support user programming and configuration. The functions shall operate based upon the work in process image maintained by the production tracking module. The primary function of the tracking system is to provide tracking data to plant floor users and applications. As such the data maintained by the production tracking module shall be accessible through the graphical user interfaces and through a complete set of application interfaces. Additional applications such as dynamic scheduling, material delivery, and assembly broadcast depend on tracking data. The production tracking module shall support operation in a distributed system environment consisting of multiple HMI servers, enterprise servers, and viewers.

EQUIPMENT CONTROL

The HMI shall provide an equipment control module which includes the capability configure logic and schedule events based on the following criteria:

a. Time of day.
b. Time interval.
c. Production event.
d. Point change.
e. Alarm generation.

In response to configured events, the system shall invoke configurable actions that include:

a. Log event.
b. Acknowledge alarms.
c. Enable and disable an alarm.
d. Recipe upload and download.
e. Execute a script.
f. Set a point value.
g. Copy a point value.
h. Execute a procedure.

Scripts shall be modular and re-usable. Scripts shall be in a Visual Basic compliant language. An event editor shall be included to permits users to configure, monitor and debug applications. Users shall be able to monitor the progress of control programs and dynamically modify their operating characteristics. The event editor shall, as a minimum, support these debug tools:

a. Run in single step mode.
b. Start and stop scripts.
c. Set break points.
d. Step into or over sub-scripts.
e. Watch variables change.

Control programs shall have access to all of the application programming interfaces (API's) within other monitoring and control applications such as DDE interfaces, equipment/device interfaces, production tracking, and system alarming and logging.

RECIPE MANAGEMENT

A module that is capable of monitoring and managing equipment recipes shall be available. The recipe module shall support both batch and discrete part processing requirements. The recipe module shall support dynamic configuration of recipe information. The recipe management module shall support the creation and management of device independent recipe data for production processes. Configuration data shall be stored in recipe groups to simplify information management. Within a group, recipe parameters should only have to be entered one time to minimize duplicate data entry. Parameter values shall be supported for each recipe. The module shall support the concept of device independence. This shall permit the configuration of a recipe a single time yet also permit downloading that same recipe to different devices, for example, different programmable controller models or manufacturers. This device independent support no longer requires the maintenance of separate recipes for the various pieces of production equipment in the facility. There shall be a dedicated user interface utility. The utility shall support the display of recipes, parameters and the mapping of parameters to devices. Ideally, this display shall support a spreadsheet-like interface for ease of use and to help minimize user training. Like a

spreadsheet, the information display formatting shall be user configurable. The interface shall follow the Microsoft Windows look and feel and include tools such as copy, cut and paste. Overall, the user interface shall support the ability to:

a. Create and manage recipe parameters, recipes, and maps side-by-side in a spreadsheet format.
b. Import and export recipe groups from and to CSV format files.
c. Archive recipe groups.
d. Automatically reconcile recipe groups to accommodate changes in the group's structure and layout.
e. Compare recipes.
f. Validate recipe information.
g. Manually upload recipes.
h. Manually review and modify parameters and download recipes.
i. Create recipe parameter files, to support automatic upload and download of recipes.
j. Identify a batch ID for recipe downloads.

For maximum flexibility, the recipe management module shall also support a graphic user interface. Recipe objects should be implemented as OCX controls that may be embedded in graphic screens. These objects shall let a run-time user:

a. Manually upload recipes.
b. Manually review and modify parameters then download recipes.

To support the development of sophisticated applications, the recipe management module shall support an interface to the HMI's scripting capabilities. This scripting interface support shall include the ability to:

a. Automatically upload and download recipes based on system events, such as point changes from a shop floor device.
b. Import and export recipe groups from and to CSV format files.

The module shall support a wide range of data types including:

a. Signed integers.
b. Unsigned integers.
c. Digital and boolean values.
d. Real numbers.
e. Text strings.

CALENDAR BASED CONTROL

The HMI shall provide for calendar based control operations through a self-contained graphic users interface. The HMI shall allow you to dynamically create, maintain, and execute a calendar schedule of manufacturing events and corresponding actions. For example, a system shall allow the user to perform such actions as turn on lights, heat, and equipment based on a schedule which they configure and maintain through simple point and click actions.

Configuration of the calendar-based control shall allow the user to define different types of days, such as production, weekend, holidays, to conform to 4 day or 5 day work weeks. Users shall then be able to configure manufacturing control events they want to occur on a particular type of day and the time they should occur. Association of days on the calendar with a particular type of day shall be through a point and click interface. The graphic user interface for the calendar-based control shall allow the user to dynamically change or override the established schedule. The graphics interface for the calendar-based control shall be available on both servers and viewers.

HISTORICAL DATA DISPLAY

The HMI option shall provide for the examination of data through enhanced database logging functions, historical data viewing, data summarization, and modification and recalculation of data. It shall be possible to summarize data over configured time intervals and then these summarizations in a graphics screen through an ActiveX control. It shall be possible to edit and modify the historical data trough the ActiveX control embedded in the graphics screen. The user shall also be able to enter comments to further document the data. After modifying data, it shall be possible to initiate the recalculation of the historical data to update summarizations. Summarization values shall be able to be sent to an HMI point.

INTEGRATION APPLICATION PROGRAM INTERFACES

The HMI shall have a set of open interface, Application Program Interfaces (APIs). The APIs shall include :

a. Point Management API shall allows third party programs to be interfaced to the HMI and pass point data to and from the HMI in real time fashion.

b. Alarm Management API shall allow alarm information to be passed to and from the API.
c. Logon API shall allow the user to create their own custom logon dialog boxes.
d. Device Communication Toolkit shall allow the user to construct communication modules to third party devices with published protocols.

MARQUEE DRIVER

The HMI shall have the ability to send alarm information and messages to multi-line marquee display devices. The marquee driver shall be fully configurable. No custom coding shall be required to retrieve alarm or message information. It shall be possible to determine which set of HMI alarms you want to send to the actual marquee device. Marquee configuration shall include:

a. Marquee types shall be all marquee devices that use the same header, footer, message wrap, empty message, and attributes belong to the same Marquee Type.
b. Marquee ports shall be the PC communication port or the network communication port to which one or more serial marquee devices are connected. If more than one device is on a port, the header and footer information (from the marquee type) shall indicate which device on which the message is to be displayed.
c. Marquee devices shall provide the ability to assign a marquee ID, marquee type, marquee port, header, footer, empty message, and display time for each marquee device within a project. The option of associating sets of marquees into marquee groups shall be provided.
d. Marquee messages shall make it possible to assign a message ID, alarm ID, alarm state, message header, message footer, message text, the marquees on which to display the message, the attributes associated with the message, and any HMI point values to be displayed with the message.

ALPHA-NUMERIC ALARM PAGING

The HMI shall provide the ability to send process alarms to standard alphanumeric or numeric pagers carried by a mobile workforce. The paging capabilities shall be designed on a client and server architecture of to avoid duplication of configuration information. Paging capabilities shall support standard IXO/TAP protocols used by common paging systems. Paging features shall include:

a. On line configuration of users and paging numbers.
b. Enable or disable users from receiving pages.
c. Escalation of pages.
d. Filtering of pages based on point groupings, alarm classes, or alarm IDs.
e. Dynamic on-line configuration changes.
f. A scripting interface for automatically sending pages, changing a user's pager number, or disabling a page.
g. Customizable pager messages.
h. Configuration templates for fast setups.
i. Support of distribution lists.

REPORT MANAGER

The HMI shall provide ASCII based reporting without the need for a relational database. The user shall be able to pre-configure the reports they want produced on a timed or event basis. Design of reports shall be performed through a dedicated report editor. The editor shall have intuitive point and click features and the ability to browse the HMI's point database for inclusion in the report templates. It shall be possible before final installation for reports to be tested in accelerated time mode to verify your design. This shall be accomplished through a design validator and report previewer. The user shall be able to simulate the events causing values to recorded and use the report previewer to view the resulting reports. Report generation shall be possible based off a timed schedule or process events. The report manager shall provide a dedicated scheduler that allows users record values on a timed basis. In addition, the scheduler shall monitor process conditions and prevent unnecessary reports from being produced. User's reports shall be automatically archived and printed without operator intervention. A dedicated report viewer shall be provided to allow users to retrieve electronically stored reports easily by using simple queries. The report viewer shall allow the user to display multiple reports simultaneously for accurate comparison. Report manager features shall include:

a. Unattended background reporting is provided by a built-in scheduler. This shall provide for the execution of periodic, daily, weekly, monthly, and yearly reports. In addition, the report manager shall monitor events and trigger a report based on an event.
b. Report manager shall maintain its own historical database within the reports being generated. For example, minimum, maximum, average, standard deviation, and total values are stored as the reports are generated.

c. The report designer shall use point and click methods for easy report template generation. An integrated point browser shall display all HMI points for quick and easy inclusion.
d. A report sectioning feature shall enable the creation of complex reports in an easy fashion. Summary reports which require data from previous reports shall be built by standard functions.
e. Calculation functions, for example add, subtract, divide and multiply shall be performed within the report.
f. The duration between events shall be tracked and calculations performed on the duration.
g. Page numbering with footer and header section shall be provided.
h. Individual printer selection per report shall be provided. Single line printing shall be provided.
i. An integrated report viewer shall be provided. The integrated report viewer shall provide quick access to archived report files. Reports can be compared easily inside the report viewer.
j. The report manager shall allow values to be entered after the report has been generated, for example laboratory data or values that were (I/O) off-line when the report was made.
k. The report manager shall provide a synchronization flag that can be set to signify report completion. This flag can be used to reset totalizers.
l. The report files shall be stored in ASCII text files for easy access by any third party package.
m. Date, time and decimal separator shall be internationalized.
n. Support for the graphical character set shall be provided.

REDUNDANCY

The principle of redundancy in automated systems provides for switchover of functionality to a backup component in case of failure of a primary component. The switchover is considered automatic if no operator intervention is required. Redundancy applies to both hardware and software, and implies minimal loss of continuity during the transfer of control between primary (active) and redundant (backup) components. Redundant systems reduce single points of failure, preventing loss of functionality. For cell control systems, the major levels of redundancy include:

PLC
PLC LAN or serial connections to server
Computer networks
Computer

Each level of redundancy provides a failover system that allows continuous system activity with minimal loss of data. The following sections briefly describe each level.

PLC Redundancy

The HMI shall support PLC redundancy. PLC redundancy lets control transfer from a primary programmable controller to a redundant one in case of failure. When the primary PLC comes back on line, control can be transferred from the redundant PLC back to the primary with minimal loss of data. The redundancy can be synchronous or independent. Synchronous systems coordinate control and handling of data between CPUs of the active and backup units, while in independent systems each PLC acts like an active unit and is not constrained by the others.

Cabling Redundancy

The HMI shall support cabling redundancy. Cabling redundancy involves separate physical connections to the same device. The devices can be on a LAN or may require serial connections. Redundant cabling provides an alternate communication path to the device if the association with the host computer is lost due to failure of the primary path. The implementation of cable redundancy with respect to host monitoring and control systems differs with the device protocol involved.

Server Redundancy

The HMI shall support server redundancy. Server redundancy involves a primary factory monitoring server and a redundant "Hot Standby" server. The redundant server is essentially a mirror image of the primary server, running alternate monitoring and control processes and applications. Data collection is performed via independent or shared network paths to the same devices, depending on the protocol. The characteristics of the selected communications protocol(s) determine the details of the configuration. Upon detection of failure of the primary server, the secondary server can assume control of data collection, alarm functions, applications, and allow user access with minimal loss of continuity. When the primary server comes back on line, control can be transferred back, and the secondary server will resume its backup role.

Computer Network Redundancy

The HMI shall support computer network redundancy. Computer network redundancy is similar to cabling redundancy, except it covers computer to computer communications rather than computer to programmable controller. Computer network redundancy provides an alternate network path in case of failure of the primary network.

SYSTEM MONITORING

The HMI shall provide system monitoring to allow the user to monitor the most important part of the system, the computer. System monitoring shall monitor both the HMI processes as well as key Windows NT operating system and network parameters. System monitoring shall be able to monitor the status of the computer the HMI is running on as well as other NT computers on the network. System monitoring shall allow for key HMI parameters and statistics such as alarm frequency, device communications, data collection and throughput, inter-process communications, data logging, point management, and user registration to be monitored and recorded. System monitored information can be alarmed on.

WEB CAPABILITIES

The HMI shall have the capabilities of sending and receiving point based information from standard HTML pages. In addition, point information shall be capable of driving animated ActiveX graphic objects within the HTML web pages. The HMI shall also support thin client technology to enable graphic screens to be sent to standard web browsers without the need for the user to create HTML pages. The resulting web based graphic viewers shall be capable of viewing the graphic screens of the HMI. The web viewers shall support the ability to perform setpoints back to the supporting server. Web capabilities shall conform to the following technical specifications:

Cable: Glass 50/125 µm recommended.
Data Rate: From 0 kbps to 115.2 kbps.
Range: 1.6 km. Note that modems can be used back to back to extend range.
Optical Power: -15.2 dBm.
Receiver Sensitivity: -34.4 dBm.
Mating Connectors: ST type fiber optic connectors.
Power: From 8 V(dc) to 18 V(dc) with 24 V(dc) option is available.
Dimensions: Length 228.6 mm, Width 124.5 mm, and Height 36.3 mm
Data Format: RS232C with RS485/422 as optional.

FREQUENCY SHIFT KEY MODEM

The frequency shift key (FSK) modem shall operate full duplex over non-switched private and non-loaded leased telephone lines or any dedicated four conductor wire, twisted or untwisted, shielded or unshielded.

The FSK modem shall have the capability of operating at an uncompressed data rate of 9600 baud in full duplex mode, transmitting and receiving at a range of up to 8 km to 16 km on 22 gage or larger four conductor wire (smaller gage wire may be used but will reduce the range capability).

The FSK modem shall utilize pure FSK technology to provide immunity from electromagnetic interference, surge and noise problems as well as providing transformer and capacitor isolation between the data transmission line and ground, thereby eliminating any possibility of ground loop or ground plane shift problems.

The FSK modems and connecting cables shall be factory configured to provide simple installation (custom factory preconfigured, no modem field settings, programming or adapters required).

The FSK modem shall meet or exceed industrial operating specifications of from 0°C to +60°C and from 0 to 95 percent non-condensing humidity.

The FSK modems will operate with a 120 V(ac) to 24 V(dc) wall mount transformer and draw no more than 180 mA.

The FSK modem shall be able to transparently accept any asynchronous serial data stream and interface to RS-232/422/485 or CMOS/TTL signals. Mating connectors shall be two position pluggable terminal blocks to FSK data transmission line as well as DB25 or DB9 for digital interface.

For maximum EMI/RFI immunity, the FSK modem shall be housed in a metal enclosure and provide mounting flanges for ease of installation. Indicator LEDs' shall include at a minimum: Power, Carrier, Data In and Data Out.

The FSK modem modulation shall be in the 100 kHz band range.

The FSK modem shall also be optionally capable of, if desired, superimposing data on in-plant AC/DC power lines, PBX telephone wires or instrumentation lines providing the simultaneous transmission of data with existing power, voice or instrument loop transmissions, thereby eliminating the time and expense of separate data cable installation.

The FSK modem shall support point-to-point, multi-point, multi-drop addressing and polling operation as well as data rate and protocol transparency. Turn around delay shall be 20 ms or less in multi-drop, carrier control mode.

The FSK modem shall also optionally permit the reliable transmission of data over sliding contacts including slip rings and rolling wheels, as well as brushes and shoes, on conductor bars.

10-3.40 SUPERVISORY CONTROL AND DATA ACQUISITION COMPUTER HARDWARE

The computer, as a minimum, shall conform to the following specifications:

1. Intel Pentium III, 500 MHz.
2. CD ROM.
3. 1.44 MB floppy drive.
4. 6.0 GB hard drive.
5. 533 mm multi-sync color monitor (1024 x 768 minimum resolution).
6. Serial ports (2 each).
7. Parallel port.
8. Windows NT operating system.
9. Printer compatible with tractor feed (216 mm x 280 mm) paper with contronics parallel interface.

10-3.41 FIBER-OPTIC CABLE FOR RELAY PROTECTION

Fiber optic cable shall be multi-mode fiber, 200 µm, with heavy duty PVC jacketed round cable consisting of two fibers in each jacket both with ST connectors.

Fiber optic cable for relay protection, as a minimum, shall conform to the following:

Channels	2
Operating Temperature	-40°C to +85°C
Core Diameter	200 µm
Weigh/Unit length	45 kg/km
Max. Long-Term Tension	200 N
Max. Cable Pull Tension	445 N
Break Strength	1112 N
Min. Long-Term Bend Radius	75 mm
Cable Attenuation at 650 nm (-40°C to +85°C)	12 dB/km
Cable Attenuation at 650 nm (0°C to +70°C)	10 dB/km
Cable Attenuation at 650 nm (typical)	7.4 dB/km
Cable Attenuation at 850 nm (-40°C to +85°C)	10.6 dB/km
Cable Attenuation at 850 nm (0°C to +70°C)	8.8 dB/km
Cable Attenuation at 850 nm (typical)	6.5 dB/km
UL Rating	Riser Rated

Connectors, as a minimum, shall conform to the following:

Cable Crimp Retention Force (Min.)	53 N
Splice Bushing Loss (Max.)	2.0 dB
Splice Bushing Loss (typical)	1.5 dB

10-3.42 MARINE NAVIGATIONAL AIDS SYSTEM

Marine navigational aids system including radar beacon, lanterns for lighting on piers and clearance channels, and fog audible signal shall conform to the latest requirements of the U.S. Coast Guard and as specified in these special provisions.

RADAR BEACON

The beacon shall provide a precise position indication to mark a safe water channel under the new Benicia-Martinez Bridge. The beacon shall be triggered by vessels' radar pulses and respond by producing a distinctive trace on the radar display of the interrogating vessel.

The beacon shall respond to all radars in its service area, where X- or S-band (X-band: from 9320 MHz to 9500 MHz), but shall respond only in the interrogated band. The beacon response to interrogation shall be the transmission of a preselected Morse-coded microwave signal. The code for this signal and the trace length shall be settable as determined by the U.S. Coast Guard. The beacon shall be omnidirectional. The beacon shall provide a range of 27.8 km (15 nautical miles), minimum for line of sight transmission. The beacon shall respond to the main lobe of the interrogating radar beam. The beacon shall sample the interrogating radar signal based on impulse width and frequency in order to provide side lobe suppression while servicing and responding to all interrogations. The beacon shall incorporate circuitry which shall provide

the equivalent of a closure of a normally open contact to indicate when the beacon is not operating. The beacon, as a minimum, shall be equipped with the following remote control capabilities:

1. Changing reply codes.
2. Turning itself on and off.
3. Providing detailed self-test reports on demand.
4. Altering marine radar band service intervals for emergencies on special situations.

The input voltage to beacon shall be 12 V(dc) nominal. The beacon shall be operable throughout the range of DC input voltage from a minimum of 10 V to a maximum value of 18 V. The beacon shall be mounted in a pressurized gas tight, weatherproof enclosure. The beacon shall have lighting, surge, and reverse polarity protection. The connection of conductors to the beacon and functional testing of the beacon shall be done under the supervision of the beacon manufacturer. The Contractor shall submit a certificate of compliance in accordance to Section 6-1.07 of the Standard Specifications which shall indicate that the beacon was approved by the FCC and the U.S. Coast Guard.

TRAINING FOR RADAR BEACON SYSTEM

Prior to acceptance of the contract, a trained representative of the beacon manufacturer shall demonstrate the proper operation of the beacon.

After the radar beacon system is in operation, the Contractor shall provide an instructional video tape, complete written instruction, and a demonstration for the State Maintenance personnel for radar beacon system. The instruction shall include the general theory of the operation, and equipment maintenance, including troubleshooting procedures with complete wiring diagrams and circuit schematics.

BATTERY

The batteries shall be 12 V(dc) nominal, maintenance free, lead-calcium, photovotaic, and rechargeable units with low self-discharge rate. The amp-hour ratings for each particular navigational aids system shall be as shown on plans. The battery of each particular system shall be housed in a weatherproof fiberglass enclosure with a hinged lid and stainless steel hardware and sized as shown on plans.

CHARGER

The charger shall be a pulse-width modulated voltage regulator that automatically maintain full charge on the 12 volts or 14 volts battery without overcharging according to the battery manufacturer's specifications. In addition, the charger shall have the following features:

1. Rated operating temperature between -40°C and +85°C.
2. Electronic interrupt functions to protect against short-circuits, and reverse polarity.
3. Transient voltage suppressor rated for 1500 W.

LANTERNS

Each lantern shall have 12 degree vertical divergence of the light beam with a single piece lens of Acrylic Fresnel with a bird spike. Lens colors shall be as specified on plans. The lens shall be secured to the base through a hinge and with a minimum of three point fasteners. The base shall be corrosion resistant, ultra-violet radiation resistant and waterproof. The base shall be made of either reinforced polyester compression molded fiberglass or polycarbonated plastic. Each lantern shall be fitted with a four place automatic lamp changer. Each lantern shall have a visibility range of at least 1829 meters for 90 percent of the nights of the year. Pier lanterns and channel clearance lanterns shall be modified by method as recommended by the manufacture to emit light at an angle of 180 and 360 degrees respectively.

FLASHING BEACONS

Flashing beacons shall conform to the same specifications as the lanterns except for the following:

1. They shall be fitted with a four place automatic lamp flashchanger.
2. The flash rate shall be set at 2 seconds on and 1 second off with 10 percent margin of error.

The flash changer controls programmable flashing rates, and shall be capable of self-monitoring for "on" or "off" state by providing a normally close and open dry contacts interconnected to field PLC's.

FOG SIGNAL

The siren shall be heard omnidirectional. The sound pressure level measured at one meter shall be linearly tunable between the range of 126 decibels at 65 W and 132 decibels at 500 W. The siren frequency shall be 500 Hz of

electromechanical sound wave. The programmable sound pattern shall meet the requirement of the U.S. Coast Guard for such marine warning device on the new bridge. The siren shall be automatically controlled by the fog detector, a single station, backscatter device using modulated infrared light to monitor visibility over three thresholds in the range from 0.8 km to 6.4 km.

DETECTOR SPECIFICATIONS

The detector for the marine navigational aids system, as a minimum, shall conform to the following:

1. Approximate 2 to 12 meter sampling zones.
2. Sampling time of 12 seconds every 2 minutes.
3. 0.94 µm light wavelength.
4. 16 kHz pulse frequency.
5. -25°C to +70°C operating temperature.
6. 11 to 30 V(dc) supply voltage.
7. No volt-output contact.
8. Dimension: 312 mm X 480 mm X 633 mm.
9. Net weight: 12 kg.

CABLES

The following specified cables shall not be spliced unless otherwise shown on plans.

The SOW cable shall be 4 No. 12 of flexible stranded, insulated copper conductors rated at 600 V. The thermoset CPE jacket compound shall provide resistance to oils, ozone, abrasion, and withstand a wide temperature range from -35°C to +90°C. The cable, UL listed as weather resistance for outdoor applications, shall meet MSHA (Mine Safety and Health Act) flame test requirements. Its nominal outside diameter shall be between 16.6 mm and 17.0 mm.

The 3 pairs No. 19 data and control cable for radar beacon shall consist of color-coded, twisted, polyolefin-insulated pairs of solid annealed copper. The interstices between the pairs are filled with an 80°C filling compound to prevent the entrance of water. The cable shall be protected by a polyethelene inner jacket completely covered by an overlap of 0.2 mm polymer coated aluminum tape, and a black polyethelene outer jacket. The nominal outside diameter of the cable shall be from 10.6 mm to 11.2 mm. The cable shall have the manufacture's identification, pair count, conductor size, and year of manufacture clearly marked on the surface of the outside jacket at an alternate 610 mm intervals.

The 4 pairs No. 18 control or control status cables shall consist of color-coded, twisted, PVC insulated pairs of stranded copper conductors. Each insulated pair shall have a nylon overcoat. An overall, aluminum, foil shield with drain wire shall provide total coverage of shield effectiveness. The cable assembly is protected by an outer PVC jacket of 1.3 mm thick minimum. The nominal outside diameter of the cable shall be from 12.0 mm to 12.6 mm. The cable shall be rated for 600 V, 90°C, and suitable for installation in wet and dry locations.

The three-conductor cable (3CSC) for fog detector control cable shall conform to signal cable requirements in Section 86-2.08D of the Standard Specifications.

10-3.43 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT

Salvaged electrical materials shall be hauled to Caltrans Electrical Maintenance Station, 30 Rickard Street, San Francisco, CA 94134, (415) 330-6509 and stockpiled.

The Contractor shall provide the equipment, as necessary, to safely unload and stockpile the material. A minimum of 2 working days' notice shall be given prior to delivery.

10-3.44 PAYMENT

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.

Quantities of programmable logic control cabinets, video transmitter duplex data units, fiber optic data modems, wireless microwave vehicle detection systems, hard-wire microwave vehicle detection sensor systems, fiber optic cable terminations, camera units, pan and tilt units, camera control units and service boxes to be paid for by the unit will be determined from actual count in place.

The contract unit price paid for each of the following items shall include full compensation for furnishing all materials, tools, equipment, and incidentals, as shown on the plans, as specified in these special provisions, and as directed by the Engineer:

1. Programmable Logic Control Cabinet
2. Video Transmitter Duplex Data
3. Fiber Optic Data Modem

4. Microwave Vehicle Detection System, Wireless
5. Microwave Vehicle Detection System, Hard-wired
6. Fiber Optic Cable Termination
7. Camera Unit
8. Pan and Tilt Unit
9. Camera Control Unit
10. Service Box

Quantities of communication conduit (bridge) to be paid for by the meter will be determined from the length designated by the Engineer. Communication conduit (bridge) placed in excess of the lengths designated will not be paid for.

The contract price paid per meter for communication conduit (bridge) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in communication conduit (bridge) 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 the following items shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing said item, complete in place, including all the foundations (except State-furnished materials and labor), poles, manuals, training and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer:

Traffic Operations System
Call Box System
Traffic operations system hub
Interconnection between Pier 3 and new toll plaza
Electrical Facilities (Girder Conduit Layout-780, Bent 18 thru 22)
Electrical Facilities (Girder Conduit Layout-680, Bent 18 thru 19)
Electrical Facilities (Girder Conduit Layout-680, Bent 20 thru 23)
Electrical Facilities (Conductor Layout, Abutment 1 thru Pier 5)
Electrical Facilities (Conductor Layout, Pier 5 thru Pier 8)
Electrical Facilities (Conductor Layout, Pier 8 thru Pier 12)
Electrical Facilities (Conductor Layout, Pier 12 thru Pier 17)
Electrical Facilities (Conductor Layout 680, Pier 17 thru Abutment 23)
Electrical Facilities (Conductor Layout 780, Pier 17 thru Abutment 22)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 1 and 2)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 3 and 4)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 4 and 5)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 5 and 6)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 6)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 6 and 7)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 7 and 8)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 8 and 9)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 9 and 10)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 10 and 11)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 11 and 12)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 12 and 13)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 13 and 14)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 14 and 15)
Electrical Facilities (Girder Lighting and Receptacle Layout Span 15, 16 and 17)
Electrical Facilities (680 Bent 18) Bent Lighting and Receptacle Layout
Electrical Facilities (680 Bent 19) Bent Lighting and Receptacle Layout
Electrical Facilities (680 Bent 20 and 21) Bent Lighting and Receptacle Layout
Electrical Facilities (680 Bent 21 and 22) Bent Lighting and Receptacle Layout
Electrical Facilities (780 Bent 18 and 19) Bent Lighting and Receptacle Layout
Electrical Facilities (780 Bent 20 and 21) Bent Lighting and Receptacle Layout
Pier Stairway Lighting (Pier 6)
Pier Stairway Lighting (Pier 7 thru 9)
Pier Stairway Lighting (Pier 10 thru 12)
Pier Stairway Lighting (Pier 13 thru 15)
Marine Navigational Aids System

North Approach Substation
Cable Tray Layout
Pier 3 Substation
New Toll Plaza Substation
Supervisory Control and Data Acquisition System

SECTION 10-4. SEISMIC MONITORING ELECTRICAL SYSTEM

10-4.01 GENERAL

Scope.--This work shall consist of installing the seismic monitoring system electrical work in accordance with the details shown on the plans, the provisions in Section 86, “Signals, Lighting and Electrical Systems” of the Standard Specifications, the provisions in Chapter 6, “Specifications for Cabinet Models 332, 334 and 336”, of the Traffic Signal Control Equipment Specifications, the Standard Plans, and these special provisions.

Electrical work shall include furnishing all labor, materials, equipment and services required to construct and install the complete seismic monitoring electrical system as shown on the plans.

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. Placement of sersmic steel pipes and embedment of conduits shall be coordinated with the Engineer and California Division of Mines and Geology (CDMG) personnel.

Related work.—Earthwork, foundations, mechanical, seismic monitoring casing, piling and such other work incidental to and necessary for the proper installation and operation of the seismic monitoring system and health monitoring system electrical work shall be done in accordance with the requirements specified for similar work elsewhere in these special provisions.

Attention is directed to "Order of Work" of these special provisions.

State-Furnished Materials.—Attention is directed to Section 8-1.01, “State-Furnished Materials”, of these special provisions.

The following seismic monitoring system materials will be furnished by the State for installation by the Contractor (after pre-job meeting with Caltrans Electrical Engineer, California Division of Mines and Geology (CDMG) personnel and Earthquake engineering personnel):

Force balance accelerometer (FBA) pigtails
Seismic sensor mounting plates
“Bishops Hat” Downhole Specially formed sealed cap

The Contractor shall notify the Engineer in writing not less than 20 working days in advance when the Contractor wants CDMG personnel to deliver the State-furnished material to the Contractor.

State-Furnished and Installed Material.—The Contractor shall notify the Engineer in writing at least 30 working days in advance when the Contractor wants CDMG personnel to install and test the seismic equipment as specified elsewhere in these special provisions.

The following seismic monitoring system materials will be furnished and installed by the State personnel:

Downhole seismic sensors and cable to surface
Seismic sensors
Seismic recorders

Access and Contractor assistance (Seismic Monitoring System).—After all Contractor and State supplied equipment, conduit and cable has been installed, the Contractor shall provide CDMG and associated Caltrans personnel, total of 4 personnel each day as described below and the means and equipment to safely access and perform work at all the recorder, sensor, and antenna locations. This is to include the transportation of equipment to and from the job site, traffic control, movement of stored materials, and vehicle parking where necessary. Access is for the purpose of installation, operational testing and performing necessary system troubleshooting and repair. The estimates below are for actual work at the locations and exclude transit time to the work locations and the set-up times of any lifts, scaffolds, etc. Some of the work can be

accomplished simultaneously and the CDMG personnel will meet with the Engineer and the Contractor at the job site to work out a detailed, mutually agreeable schedule, including equipment and workplace access requirement.

1. At the Seismic recorders location:

   a. Approximately 4 days access per recorder cabinet to install and wire the recorders.
   b. Approximately 2 days access to each recorder during the installation and testing of the seismic sensors wired to that specific recorder location.
   c. Approximately 3 days access per recorder during the final system testing and any necessary troubleshooting and repair.

2. At the seismic sensor enclosure locations approximately 30 minutes access time at each enclosure on a minimum of two occasions for installation and operational testing of each sensor.

3. At the down hole and free field locations approximately 1/2 day access time for each down hole and free field location plus two additional days for wiring and testing.

TESTING.—

After the complete installation of the seismic monitoring system by both the Contractor and CDMG personnel, the complete system will be tested by CDMG personnel in the presence of the Engineer to demonstrate that it is working properly. Any problems associated with the equipment installed by the Contractor (State or Contractor supplied) shall be, adjusted, replaced, or repaired as required at the Contractors expense, and the complete system shall be retested. If problems occur with State installed equipment, it will be replaced, or repaired as required, and retested all at the States expense. The Contractor shall provide 120 V(ac), single phase, 60 Hz power for each recorder location for the duration of the testing if main power is not yet available.

SUBMITTALS.—

Product data.—A list of materials and equipment to be installed, manufacturer's descriptive data, and such other data as may be requested by the Engineer shall be submitted for approval.

Manufacturer's descriptive data shall include complete description, performance data and installation instructions for the materials and equipment specified herein. Control and wiring diagrams, rough-in dimensions for recessed junction and pull boxes, and component layout shall be included where applicable. All control and power conductors on the shop drawings shall be identified with wire numbers.

Manufacturer's descriptive data shall be submitted for the following:

Seismic cable.
Telephone (ISDN) cable.
Interconnect cable.
Manhole (for Freefield).
Junction boxes.
Seismic sensor enclosures (Cast and NEMA 4X SST).
Pull boxes.
Downhole box.
Receptacles.
Pile cap pull box.
Disconnect switches.
Switch.
Lighting fixture.

10-4.02 CONDUIT AND FITTINGS

Conduit, general.—Conduit shall conform to Section 86-2.05 “Conduit” in the Standard Specifications and as specified in these special provisions.

Rigid steel conduit shall be used unless otherwise shown on the plans or specified in these special provisions.

Rigid non-metallic conduit shall be used at the locations shown on the plans for direct underground burial outside the building foundation.

Unless otherwise specified or shown on the plans, liquid-tight flexible metal conduit shall be used on the bridge at the locations shown on the plans.

PVC coated rigid steel conduit shall be used on the pile caps and piers to a height 6.1 m above the pile cap. This conduit shall be installed with “clamp backs” to space conduit off the concrete surface.

Conduit trade sizes are shown on the plans. No deviation from the conduit size shown on the plans will be permitted without written permission from the Engineer.

Conduits shall be tightly covered and well protected during construction using metallic bushings and bushing "pennies" to seal open ends.

Rigid non-metallic conduit bends of 30 degrees or greater shall be factory-made long radius sweeps. Bends less than 30 degrees shall be made using an approved heat box.

A pull rope shall be installed in all empty conduits. At least one meter of pull rope shall be doubled back into the conduit at each termination.

Locations of conduit runs shall be planned in advance of the installation and coordinated with the electrical work shown on "Roadway Electrical Plans" in the same areas and shall not unnecessarily cross other conduits or pipe, nor prevent removal of ceiling tiles or panels, nor block access to mechanical or electrical equipment.

Where practical, conduits shall be installed in groups in parallel, vertical or horizontal runs and at elevations that avoid unnecessary offsets.

Exposed conduit shall be installed parallel and at right angles to the building lines or bridge line.

All raceway systems shall be secured to the structures using specified fasteners, clamps and hangers. Mechanical wedge anchors for mounting conduits to the concrete structure shall have a 32 mm embedding maximum. The drilled holes for embedding shall be a maximum of 35 mm deep. The only exception to these drilled hole and embedding depths will be as approved by the engineer.

Single conduit runs shall be supported by using one hole pipe clamps. Where run horizontally on walls in damp or wet locations, conduit shall be installed with "clamp backs" to space conduit off the surface.

Multiple conduit runs shall be supported with construction channel secured to the building structure. Conduits shall be fastened to construction channel with channel compatible pipe clamps.

Raceways of different types shall be joined using approved couplings or transition fittings.

Expansion couplings shall be installed where conduit crosses a building separation or bridge expansion joint.

All conduit across regions of movement (hinges and abutments) shall be liquid-tight flexible metal conduit with slack to accommodate the movement expected.

Expansion deflection fittings shall conform to Section 86-2.05D in the Standard Specifications and shall be used for expansion joint of 38 mm movement rating or less.

Conduit terminations.—Rigid steel conduits shall be securely fastened to cabinets, boxes and gutters using 2 locknuts and specified insulating metallic bushing. Electrical metallic tubing shall be securely fastened to cabinets, boxes and gutters using specified connectors. Conduit terminations at exposed weatherproof enclosures and cast outlet boxes shall be made watertight using specified hubs.

Grounding bushings with bonding jumpers shall be installed on all type of conduits terminating at concentric knockouts and on all conduits containing service conductors, grounding electrode conductor, and conductors feeding separate buildings.

10-4.03 CONDUCTORS AND WIRING

Seismic cable.— Seismic cable, SSC, shall be eight tinned copper insulated conductors (4 twisted pairs with individual drain wires), AWG No. 22 (7 x 30 stranded), insulation 0.18 mm thick, individually shielded pairs with an aluminum-polyester shield and a AWG No. 22 stranded tinned copper drain wire, overall nominal outside diameter of 8 mm or less and outer jacket 0.23 mm thick. Cable shall be instrument cable, NEC rated CL2P plenum cable rated for 150°C. Cable shall be similar to Belden plenum cable, Catalog No. 87778 but with only four pairs and having a color code as specified below:

Color Code: 1st pair - red, black;
2nd pair - white, brown;
3rd pair - blue, violet;
4th pair - yellow, orange.

Seismic cable shall be United Wire and Cable Co., Inc.; Consolidated Wire and Cable; or equal.

Cable spools shall be of sufficient length to allow cables to be installed without splices from the sensor enclosures to the recorder locations as shown on the plans. Only by permission from the Engineer will splices in these continuous runs be allowed.

Seismic cable identification.—Each seismic cable shall be tagged with the channel number as shown on the plans at each termination. Additionally, at each junction box or pull box, recorder cabinet location, and pull box that contains more than one seismic cable, the cables shall be identified. Identification shall be made with one of the methods specified under "Conductor Identification".

Telephone cable.—Telephone cable shall be Integrated Signal Digital Network (ISDN) rated cable with 2 twisted shielded conductor pairs, minimum No. 20 AWG tinned copper, polyethylene insulated, with a foil aluminum-polyester shield, drain wire and chrome PVC jacket rated for 300 V and underground installation.

Interconnect cable.—Interconnect cable, IC, shall be EIA RS-485 Applications cable, Plenum type, NEC rated CL2P for temperature of 150°C. Cable shall be similar to Belden cable No. 9844 but plenum rated. The cable shall have 8 tinned copper, insulated conductors (4 twisted pairs). Overall aluminum-polyester shield and No. 24 AWG stranded tinned copper drain wire. Overall tinned copper braid shield (90 percent coverage). Overall nominal O.D. of 9 mm or less, with outer jacket of 0.23 mm thick. Color Code shall conform to the following:

1st pair—White/Blue Stripe, Blue/White Stripe;
2nd pair—White/Orange Stripe, Orange/White Stripe;
3rd pair—White/Green Stripe, Green/White Stripe,
4th pair—White/Brown Stripe, Brown/White Stripe.

Interconnect cable shall be United Wire and Cable Co., Inc.; Consolidated Wire and Cable; or equal.
Cable spools shall be of sufficient length to allow cables to be installed without splices.

Conductors.—Conductors shall conform to Section 86-2.08 “Conductors” in the Standard Specifications.
The minimum insulation thickness, at any point, for Type THW and TW wires shall be 0.69 mm for conductor sizes No. 14 to No. 10, inclusive, 1.02 mm for No. 8, and 1.37 mm for No. 6 to No. 2, inclusive.

Conductor and cable installation.—Conductors shall not be installed in conduit until all work of any nature that may cause injury is completed. Care shall be taken in pulling conductors and cables that insulation is not damaged. An approved non-petroleum base and insulating type pulling compound shall be used as needed.
Seismic, health and interconnect cables shall be installed continuous without any splices. Only by permission from the Engineer will splices in these continuous runs be allowed.
Splices and joints shall be insulated with insulation equivalent to that of the conductor.
Provide 155 mm of slack at each outlet and device connection. If the outlet or device is not at the end of a run of wire, connection shall be made with correctly colored pigtails tapped to the runs with splices as specified herein.
Branch circuit conductors in panelboards and load centers shall be neatly trained along a path from the breaker terminals to their exit point. The conductors shall have ample length to transverse the path without strain, but shall not be so long as to require coiling, doubling back, or cramming. The path shall transverse the panelboard gutter spaces without entering a gutter containing service conductors and, unless otherwise shown on the plans, without entering the gutter space of any panelboard feeder.
All pressure type connectors and lugs shall be retightened after the initial set.
Splices in underground pull boxes and similar locations shall be made watertight.

Wire connections and devices.—Wire connections and devices shall be pressure or compression type, except that connectors for No. 10 AWG and smaller conductors in dry locations may be preinsulated spring-pressure type.

Conductor identification.—The neutral and equipment grounding conductors shall be identified as follows:
Neutral conductor shall have a white or natural gray insulation except that conductors No. 4 and larger may be identified by distinctive white marker such as paint or white tape at each termination.
Equipment grounding conductor shall be bare or insulated. If insulated, equipment grounding conductors shall have green or green with one or more yellow stripes insulation over its entire length except that conductors No. 4 and larger may be permanently identified by distinctive green markers such as paint or green tape over its entire exposed insulation.
Feeder and branch circuit ungrounded conductors shall be color coded by continuously colored insulation, except conductors No. 6 AWG or larger may be color coded by colored tape at each connection and where accessible. Ungrounded conductor color coding shall be as follows:

SYSTEM	COLOR CODE
120/240 V-Single phase	Black, blue

Seismic cable identification.—Each seismic cable shall be tagged with the channel number as shown on the plans at each termination. Additionally, at each junction box, recorder cabinet location, and pull box that contains more than one seismic cable, the cables shall be tagged. Identification shall be made with one of the methods specified under "Conductor Identification".

10-4.04 ELECTRICAL BOXES

Outlet, device and junction boxes.—Unless otherwise shown or specified, boxes shall be cast metal boxes and shall be the size and configuration best suited to the application indicated on the plans.

Cast metal boxes shall be cast iron boxes with threaded hubs and shall be of the size and configuration best suited to the application shown on the plans.

Cast metal boxes shall have cast metal covers with gaskets.

Seismic junction boxes.—Unless otherwise shown or specified, all seismic junction boxes shall be NEMA Type 4X SST junction boxes. Seismic cast metal junction boxes shall be installed at the locations shown on the plans Both type of boxes shall be as specified in these special provisions. The cover of both type of boxes shall have the inscription "SEISMIC JUNCTION BOX" in 25 mm high letters.

Seismic cast metal junction boxes.—Seismic cast metal junction boxes shall be a cast ferrous metal, NEMA Type 6, gasketed screw cover box complete with external mounting lugs, weatherproof conduit hubs and size as shown on the plans.

Seismic NEMA Type 4X SST junction boxes.—Seismic NEMA Type 4X SST junction box shall be a Type 316 or Type 316L stainless steel, NEMA Type 4X, hinged, gasketed cover box with weatherproof conduit hubs and size as shown on the plans.

Seismic Sensor Enclosures.—All seismic sensor enclosures, except sensor enclosure Type 5, shall be stainless steel Types 316 or 316L, NEMA Type 4X, hinged cover box of dimensions shown on the plans. A nameplate with the inscription "SEISMIC ENCLOSURE #" in 25 mm high letters shall be installed on the front cover (the # shall correspond to the number of the enclosure shown on the plans).

The backside of the enclosure shall be a flush and smooth surface. The enclosure shall be Hoffman, Catalog No. A-1412CHNFSS6; Circle AW, Catalog No. 14126-4XSCHC (without upper and lower mounting flanges and with padlock hasp similar to Catalog No. APLKJIC; or equal.

A nameplate with the inscription "SEISMIC ENCLOSURE #" shall be installed on the front cover (the # shall correspond to the number of the enclosure shown on the plans). The backside of the enclosure shall have a flush smooth surface.

Seismic sensor enclosure Type 5.—Seismic sensor enclosure Type 5, shall be a cast ferrous metal NEMA Type 6, box with gasketed screw cover box, 150 mm deep and of dimensions shown on the plans. Seismic sensor enclosure cover shall have raised cast inscription "SEISMIC ENCLOSURE #" in 25 mm high letters (the # shall correspond to the number of the enclosure shown on the plans).

The box shall be able to withstand submersion in water up to 2 meters depth for extended periods. A minimum of two cast mounting lugs shall be attached on two opposing sides of the enclosure. The enclosure shall have a bossed, drilled and tapped (NPT) hole to accept a 27 mm conduit connector, centered between the mounting lugs on one side only. The enclosure shall also have a mounting button drilled and tapped for 6 mm x 20 located in the center (+/-3 mm) of the inside bottom of the enclosure.

The enclosure shall be O-Z Gedney, Catalog No. YF-121206-SUB, with raised cast lettering, “SEISMIC ENCLOSURE”, in the cover, mounting button P/N 1 MBT (installed in the center inside the bottom of the box), mounting lugs P/N 4ML1816 attached to each side, and one P/N BDT100 conduit connector hole centered between mounting lugs on one side; Crouse Hinds, Catalog No. WCB121208-1000G (except box shall be 150 mm deep), with mounting straps and raised cast lettering, “SEISMIC ENCLOSURE”, in the cover, mounting pad blind tapped for 6 mm x 20 installed in the center of the inside bottom of the enclosure, and one drilled and tapped (NPT) 27 mm conduit hole centered between the mounting straps on one side only; or equal.

Manholes.—Manholes shall be 1220 mm x 1220 mm (inside dimensions) x 610 mm deep with 155 mm thick walls, bottom and top. The manhole shall be precast or cast-in-place concrete designed for H-20-44 bridge loading. A 915 mm square hole shall be cut out or formed within the bottom of the manhole. The frame and cover shall be cast iron and cover

shall have provisions for hold down bolts. Bolts shall be included. Conduits terminating inside the manhole shall end with bushings specified elsewhere in these special provisions. A cable pulling iron shall be installed in the wall opposite each conduit entrance. Manhole cover shall be engraved “SEISMIC” in 25 mm high letters.

The top of the manhole shall be installed 15 mm above the finished grade in unpaved areas and flush with grade in paved areas. Where conduits enter the manhole, the space around the conduits shall be grouted tightly or cast through the bottom.

Downhole Box.—Downhole box shall be high density reinforced concrete box having an inside diameter of 356 mm minimum. The box shall be designed for installation in heavy truck traffic areas. Box cover shall be cast iron with provisions for hold down bolts. Bolts shall be included. Box cover shall be marked “SEISMIC”.

Downhole box installation shall be installed 15 mm above the finished grade in unpaved areas and flush with grade in paved areas. Where conduits enter the manhole, the space around the conduits shall be grouted tightly or cast through the bottom.

Down hole junction box.—Down hole junction box shall be the same as seismic sensor enclosure (Type 5) except the box size shall be 355 mm x 205 mm x 155 mm deep. Cast mounting lugs shall be attached on 205 mm, minimum of two lugs each side. One each bossed, drilled and tapped (NPT) hole to accept a 53 mm conduit connector centered between mounting lugs on one side only. One each bossed, drilled and tapped (NPT) hole to accept a 27 mm water tight strain relief connector per down hole cable as required. These holes are to be centered between the lid and the bottom along a 355 mm side of the box. The box shall be O-Z Gedney, Catalog No. YF-140806-SUB with mounting lugs, Catalog No. 4ML1816, one hole, Catalog No. BDT200, and appropriate number of holes for down hole cables, Catalog No. BDT100; Crouse-Hinds, Catalog No. WCB120806-3-0000G0(****)00 (except box shall be 355 mm long); or equal. In the Crouse Hinds box catalog number the ****’s represent the appropriate number of conduits required for a given box.

Down hole junction box installation shall be as shown on the plans.

Pile cap pull box.—Pile cap pull box shall be a fiberlyte pull box with a flanged bottom rim suitable for bolting to a horizontal surface. The pull box shall have nominal dimensions of 435 mm x 765 mm x 460 mm deep for shallow downholes and 330 mm x 610 mm 460 mm deep for deep downholes. The lid shall be a bolt down type.

Pile cap pull box installation shall be as shown on the plans.

Underground Pull Box.—Pull boxes shall be high density reinforced concrete box with ultraviolet inhibitor polyethylene etched face anchored in concrete and fiberglass cover with hold down bolts. The polyethylene and fiberglass material shall be fire resistant and show no appreciable change in physical properties with exposure to the weather.

Traffic rated pull boxes shall be high density reinforced concrete box with steel cover with hold down bolts and bonding strap. Pull box and cover shall be designed for H20 loading. No. 3 1/2 pull box shall have inside dimensions of 270 mm by 440 mm and No. 5 pull box shall have inside dimensions of 335 mm by 610 mm.

Electrical pull box covers or lids shall be marked "ELECTRICAL." Telephone service pull box covers or lids shall have plain, unmarked covers.

Seismic underground pull box covers or lids shall be marked "SEISMIC."

The bottom of pull boxes shall be bedded in 155 mm of clean, crushed rock or gravel and shall be grouted with 40 mm thick grout prior to installation of conductors. Grout shall be sloped to a 25 mm PVC pipe drain hole. Conduit shall be sealed in place with grout.

Top of pull boxes shall be flush with surrounding grade or top of curb. In unpaved areas where pull box is not immediately adjacent to and protected by a concrete foundation, pole or other protective construction, the top of pull box shall be set at plus 30 mm above surrounding grade. Pull boxes shown on the plans in the vicinity of curbs shall be placed adjacent to the back of curb. Pull boxes shown on the plans adjacent to lighting standards shall be placed on the side of foundation facing away from traffic.

10-4.05 RECEPTACLES AND SWITCHES

Duplex receptacles.—Duplex receptacles shall be NEMA Type 5-20R, 3-wire, 20-ampere, 125-volt AC, safety grounding, ivory color, specification grade receptacle suitable for wiring with stranded conductors.

Ground fault circuit interrupter receptacles, (GFCI).—Ground fault circuit interrupter receptacles shall be NEMA Type 5-20R, feed-through type, ivory color, 3-wire, 20-ampere, 125-volt AC, grounding type, specification grade, duplex receptacle with ground fault interruption. Receptacle shall detect and trip at current leakage of 5 mA and shall have front mounted test and reset buttons.

Snap switches.—Snap switches shall be 20-ampere, 120/277-volt AC, quiet type, specification grade, ivory color switch with silver cadmium alloy contacts. Switch shall be suitable for wiring with stranded conductors.

10-4.06 MISCELLANEOUS MATERIALS

Warning Tape.—Warning tape shall be 100 mm wide and contain the printed warning "CAUTION ELECTRICAL CONDUIT" in bold 19 mm black letters at 760 mm intervals on bright orange or yellow background. The printed warning shall be non-erasable when submerged under water and resistant to insects, acids, alkali, and other corrosive elements in the soil. The tape shall have a tensile strength of not less than 70 kg per 100 mm wide strip and shall have a minimum elongation of 700 percent before breaking.

Pull ropes.—Pull ropes shall be nylon or polypropylene with a minimum tensile strength of 8000 N.

Watertight conduit plugs.—Watertight conduit plugs shall be a hollow or solid stem expansion plugs complete with inner and outer white polypropylene compression plates and red thermoplastic rubber seal. Seal material shall be non-stick type rubber resistant to oils, salt, and alkaline substances normally available at the construction sites.

Anchorage devices.—Anchorage devices shall be corrosion resistant, toggle bolts, wood screws, bolts, machine screws, studs, expansion shields, and expansion anchors and inserts. Mechanical wedge anchors for mounting conduits to the concrete structure shall have a 32 mm embedding maximum. The drilled holes for embedding shall be a maximum of 35 mm deep. The only exception to these drilled hole and embedding depths will be as approved by the Engineer.

Electrical supporting devices.—Electrical supporting devices shall be one hole conduit clamps with clamp backs, hot-dipped galvanized, malleable cast iron.

Construction channel shall be 41 mm x 41 mm, 2.66 mm (12-gage) galvanized steel channel with 13 mm diameter bolt holes, 40 mm on center in the base of the channel.

10.4.07 ELECTRICAL EQUIPMENT

Disconnect switch (DS1, DS2, DS3).—Disconnect switch shall be 1-pole, 120-volt, AC, 20-ampere, circuit breaker switch in a NEMA-3R enclosure. The load side of the circuit breaker shall have 4 lugs for conductor connections. The enclosure shall be sized to accommodate a (neutral) terminal block and ground (bus) terminal block. Both terminal blocks shall be able to terminate 5 conductors (4 of No. 12 AWG size, and one of the size shown on the plans of the incoming ground or neutral). Disconnect switch(es) shall be installed as shown on the plans.

F1.—Ceiling-mounted fluorescent fixture with two F40 lamps, electronic ballast and one-piece, clear acrylic, wrap-around diffuser. The fixture shall be Day Brite, Catalog No. AWN 240; Keystone Lighting, Catalog No. PRN 240-A; Lithonia, Catalog No. LB 240; or equal. The fixture shall be installed as shown on the plans.

10-4.08 SERVICE AND DISTRIBUTION

The Contractor shall make all arrangements and obtain all permits and licenses required for the extension of and connection to an ISDN telephone service applicable to this project, shall furnish all labor and materials necessary for such extensions which are not performed or provided by the utility, and shall furnish and install any intermediate equipment required by the serving utilities.

Upon written request by the Contractor, the State will pay all utility permits, licenses, connection charges, and excess length charges directly to the utility. Such a request shall be submitted not less then 15 days before the service connections are required.

The costs incurred by the Contractor for the extension of utilities beyond the limits shown on the plans, and in furnishing and installing any intermediate equipment required by the serving utilities, will be paid for as an ordered change as provided for elsewhere in these special provisions.

Installation details.—The Contractor shall submit complete service installation details to the serving utilities for approval. Prior to submitting installation details to the serving utility, the Contractor shall submit said drawings as specified elsewhere in these special provisions to be reviewed and stamped "APPROVED" by the Engineer. Submittals shall be approved by the serving utility prior to commencing work.

Installation of service equipment shall be in accordance with the requirements of the serving utilities as shown on the approved installation details.

10-4.09 SEISMIC SENSOR STEEL PIPES

Seismic Sensor Steel Pipes.—Seismic sensor steel pipes shall be furnished and installed in the pile as shown on the plans. The pipes shall be Schedule 40, 4-inch diameter galvanized steel pipe of commercial quality (Section 20-2.15A from the Standard Specifications). The Contractor shall notify the Engineer at least 2 weeks prior to installation of the seismic sensor steel pipes, within the drilled shafts and permanent steel casing. Specially formed sealed caps (Bishops Hats) will be installed at the bottom of the seismic sensor steel pipes, with instrumentation cables extending up through the casing. Bishops Hats and instrumentation cables will be furnished by the State and will be installed by personnel of the California Division of Mines and Geology (CDMG). The Contractor shall assist CDMG personnel with transferring Bishops Hat orientation marks to the tops of the seismic sensor steel pipes after said pipes are assembled and joints are secured. The seismic sensor steel pipes shall be installed in straight alignment and shall be plumb within ±1 degree. The seismic sensor steel pipes shall be securely fastened in place to prevent misalignment during installation of the reinforcement and placing concrete.

10-4.10 MEASUREMENT AND PAYMENT

Seismic monitoring electrical system shall be paid for on a lump sum price.

The contract lump sum price paid for seismic monitoring electrical system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals (except state furnished materials and labor), and for doing all the work involved in furnishing and installing the seismic monitoring electrical system, complete in place, including transportation and storage of state furnished materials, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

SECTION 10-5. CITY OF BENICIA WATER LINE AND SANITARY SEWER WORK

10-5.01 DESCRIPTION

This work shall consist of abandoning, removing and relocating City of Benicia water lines, fire hydrant and sanitary sewer in accordance with the details shown on the plans, the Standard Specifications and these special provisions.

10-5.02 WATER LINE WORK

EXISTING SERVICES

Existing services shall be kept in service during the main installation. Known services and meter locations are shown on the plans. Should service be interrupted for any reason due to the pipe laying operation, the contractor shall repair and reinstate the service the same work day. Only temporary service interruptions during installation will be allowed. Residences and businesses shall be notified 24 hours in advance of any temporary interruptions and/or shut-downs during new water hookups.

ABANDON WATER LINES

Existing water pipelines, where shown on the plans to be abandoned, shall be abandoned in place or, at the option of the Contractor, the pipelines shall be removed and disposed of.

Abandoning pipelines in place shall conform to the following:

A. Pipelines that intersect the side slopes shall be removed to a depth of not less than one meter measured normal to the plane of the finished side slope, before being abandoned.
B. The ends of pipelines shall be securely closed by a 150 mm thick tight fitting plug of commercial quality concrete.

Water pipelines shall not be abandoned until their use is no longer required. The Contractor shall notify the Engineer in advance of any intended pipeline abandonment.

RELOCATE FIRE HYDRANT

Relocated fire hydrants shall be reconnected with new risers, buries, and thrust blocks, to the new mains. Fire hydrant buries may be Tyler, Clow, Longbeach Iron, or approved equivalent. Relocated fire hydrants shall be installed at the location and to the details as shown on the plans. A 1.8m x 1.2m concrete pad shall be installed outside of sidewalk area and if in the sidewalk area, the sidewalk replacement shall be included. This work will be done after new main is installed, pressure

tested, chlorinated, flushed, and activated. The concrete shall be minor concrete and conform to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications.

RELOCATE WATER METER

Relocating water meter shall consist of removing and relocating the existing water meter as shown on the plans.

WATER LINE, VALVES, FITTINGS

All water line construction shall conform to the City of Benicia Standards, and shall be the sizes and materials and in trench sections as shown on the plans and on the bid schedule.

Waterlines--Water lines shall be Ductile Iron Pipe, Class 50 Minimum, for municipal waterlines. All the main, the 150mm leads to the fire hydrant, and existing main tie-ins shall be ductile iron. All ductile iron pipe shall be wrapped with minimum 8 mil thickness polyethylene sheets or tubes. All water line pipe shall be AWWA approved.

Valves--The valves shall be the sizes as shown on the plans and shall be standard AWWA Mueller Resilient Seat Gate Valves and Mueller Butterfly Valves and shall conform to City Standards. The Contractor shall have the option to use ring-tite or mechanical joint valves. The valve boxes and lids shall be Christy, the lids C-275, marked "water". All valves shall be AWWA approved.

Tees, Fittings, Retainer Glands, and Transition Couplings--All tees and fittings shall be manufactured by Tyler, Union Foundry, or approved equivalent. Retainer glands at various waterline tie-ins shall be EBAA Iron MJ retainer glands, Series 1100, or approved equivalent.

All transition couplings shall be Smith/Blair 441 or approved equivalent and of the proper size as shown on the plans. All couplings shall be wrapped with a minimum 8 mil thickness polyethylene sheets or tube.

All tees, fittings, retainer glands and transition couplings shall be AWWA approved. The Contractor shall have the option to use ring-tite or mechanical joint valves and fittings. All retainer glands are mechanical joint.

EXCAVATION AND BACKFILL

The trench sizes and backfill requirements will be per City of Benicia details as shown in the plans. All backfill will be crushed aggregate base 100% imported in street areas.

All trenches in the street area will be saw-cut to provide a straight smooth edge. The pavement section removed is to be 300mm wider than the excavated trench. Care must be given to maintain a 150mm ledge on each side of the trench to allow a "T" patch paving. Any uneven or jagged edge will be resaw-cut and patched at Contractor's expense.

No ponding or jetting of trench backfill will be allowed. Trench backfill materials compaction shall be by mechanical means with sufficient water added to insure compaction and consolidation. Trench compaction requirements are as follows:

A. The top 450mm– 95% compaction.
B. Remaining portions, including bedding – 92% compaction

Only that length of trench that the Contractor can excavate, install pipe, backfill, and compact per working day shall be opened up. All trench cuts shall be backfilled daily, and shall be covered with temporary paving (cold or hot mix) or proper steel plating, and shall be appropriately flagged and marked fore evenings and weekends.

PIPE LAYING

Each section of Water Pipe shall be carefully inspected for damage that may have occurred in transit. Any damaged or rejected pipe shall be marked appropriately and removed from project area.

Each section of pipe and each fitting shall be thoroughly cleaned out before it is lowered into the trench. Cleaning of each pipe or fitting shall be accomplished by swabbing, brushing, blowing out with compressed air, washing out with water, or by any combination of these methods necessary to remove all foreign matter. The most effective method of cleaning out pipe and fittings will be determined on the job by the Engineer.

If clean pipe sections and fittings cannot be placed in the trench without getting dirt into the open ends, the Engineer may require that a piece of tightly woven canvas be tied over the ends of the pipe or fitting until it has been lowered into position in the trench. After the pipe or fitting has been lowered into the trench, all foreign matter shall be completely brushed from the bell and spigot ends before assembly.

No pipe or fitting shall be lowered into a trench containing water. The trench bottom shall be free from pieces of rock or other material that would tend to damage the pipe. Water shall be pumped from wet trenches and the trenches shall be kept dry until the joints have been completed and the open ends of the main have been closed with water-tight plugs or bulkheads.

Whenever pipe laying is discontinued on any job for short periods, or whenever work is stopped at the end of the day, the open ends of the main shall be closed with approved water-tight plugs or bulkheads. The plug or bulkhead shall not be removed unless the trench is dry. Every effort shall be made to keep the trench dry at all times.

Mechanical or ring-tite joint fittings can be used with mechanical or ring-tite joint pipe. The plain end of the pipe usually is provided with 1 or 2 painted gauge lines which show whether it has been properly positioned in the bell socket after assembly. The pipe manufacturer's instructions as to the location of these lines should be followed.

When installing mechanical joint pipe, the assembly of the joint requires use of a torque wrench for the proper amount of pressure. The suggested torque is:

Bolt Size	Kg-M
16 mm	6-8
19 mm	10-12
25 mm	12-14
32 mm	15-17

PRESSURE AND LEAKAGE TEST

The following test shall be performed by the Contractor after the water system is installed, backfilled, and street base is in place, compacted and ready for paving:

a. Pressure/Leakage Test — per AWWA C600-82 Section 4. Filling the line with water and pressurizing the system to 1380 MPa for a minimum of 2 hours. Allowable leakage shall be calculated using the formula:

L = (SD/P)/133200
L is the allowable leakage in gallons per hour
S is the length of pipe
D is the nominal pipe diameter in inches
P is the test pressure in psi.

The pressure test shall not be made until at least thirty-six (36) hours after the last concrete thrust block has been poured when Type III cement is used, or at least seven (7) days after the last thrust block has been poured when Type II cement is used. The test pressure shall be held at specified pressure for a period of two (2) hours without loss. During the filling of the line and before applying the specified test pressure, all air shall be expelled from the pipe.

If necessary, taps shall be made as directed at the points of highest elevation and plugged upon completion of the test. Each section of pipe line shall be slowly filled with water and the specified test pressure applied at the point of lowest elevation by means of a pump connected to the pipe by a corporation cock. During the test, all exposed pipe, fittings, valves, hydrants, and joints will be carefully examined. Any cracked or defective material shall be removed and replaced by the Contractor to the satisfaction of the Engineer and no additional payment will be made thereof. The test shall be repeated until no defects remain.

Contractor is required to conduct pressure and bacteriological testing on his isolated system; i.e., he is not allowed to connect into the City's system until the tests are passed. This will usually require that plugs and thrust blocks be used, which may not appear on the plans. Closing pieces will be laid after testing is complete. No testing against-closed valves is allowed.

FLUSHING AND CHLORINATING

The Contractor shall disinfect the newly installed pipe line by use of HTH tablets, supplied by the Contractor. Tablets shall be attached to the crown of the pipe at each 5.5 meter length of pipe at each joint with pipe lubricant, or equal, as follows:

A. 150mm line — 1 tablet
B. 200mm line — 2 tablets
C. 300mm line — 4 tablets
D. 600mm line — 8 tablets

The pipe line shall be slowly filled to allow proper circulation of the HTH and the solution shall be allowed to stand for a minimum of twenty-four (24) hours. The pipe line shall be flushed as directed by the Engineer. Water from the existing City system used for the initial disinfection of the new line will be furnished without charge to the Contractor. Samples shall be taken from service outlets or, if none available, from sample test stations to be provided by the contractor.

Following chlorination, all treated water shall be thoroughly flushed from the mains until the replacement water shall, upon both chemical and bacteriological tests, be proved equal to the water quality at the point of supply. All bacteriological tests shall be by the City of Benicia in its own laboratory as specified in "Standard Methods for the Examination of Water and Waste Water". Once testing is complete, and upon approval of the Engineer, the contractor can connect his facilities to the City's mains. Disposal of chlorinated water shall be as directed by the City. The contractor shall make his or her own arrangements for disposal of chlorinating and flushing satisfactory completion of water. This disposal cannot be into any natural water courses, streams, creeks, waterways, or stock ponds.

WATER SERVICES

Only after pressure test, chlorination, and flushing, and authorization to proceed in writing from the Engineer shall all existing services be replumbed to the new line. The Contractor shall notify owners and businesses 48 hours in advance prior to shut-downs for the new water connection. New taps and corporation stops shall be installed on the new line per project plans. Known water meter locations and services are shown on the plans.

MEASUREMENT AND PAYMENT

The quantity of abandon water pipeline will be determined as units from actual count.

The contract unit price paid for abandon water pipeline shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in abandoning water pipeline, including plugging, pipe removal, structure excavation, and backfill, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

Relocate fire hydrant will be measured and paid for as relocate hydrant as units from actual count.

The contract unit price paid for relocate hydrant shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in relocating fire hydrant, complete in place, including concrete, structure excavation, and backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The quantity of relocate water meter will be determined as units from actual count.

The contract unit price paid for relocate water meter shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in relocating water meter, complete in place, including structure excavation, and backfill, relocating meter box and lid, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The length of ductile iron water pipe of the size shown in the Engineer's Estimate to be paid for by the meter will be the slope length determined by the Engineer.

The contract unit price paid per meter for ductile iron water pipe of the size shown 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 constructing ductile iron water pipe, complete in place, including structure excavation, and backfill, trench shoring, bedding, thrust blocks, polyethylene wrapping, pressure testing, chlorination washing, tees, fittings, retainer glands and transition couplings, shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The quantity of Mueller butterfly valve and Mueller gate valve of the size shown in the Engineer's Estimate, air relief valve and blow-off assembly will be determined as units from actual count.

The contract unit price paid for Mueller butterfly valve and Mueller gate valve of the size shown in the Engineer's Estimate, air relief valve and blow-off assembly shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing butterfly and gate valves, air relief valve and blow-off assembly, complete in place, including structure excavation, and backfill, all metal hardware, bolts, riser stems, traffic box and lid, and thrust blocks, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

10-5.03 SANITARY SEWER WORK

ABANDON EXISTING LINES

Existing corrugated steel pipe and sewer pipelines, where shown on the plans to be abandoned, shall be abandoned in place or, at the option of the Contractor, the pipelines shall be removed and disposed of.

Abandoning pipelines in place shall conform to the following:

A. Pipelines that intersect the side slopes shall be removed to a depth of not less than one meter measured normal to the plane of the finished side slope, before being abandoned.
B. The ends of pipelines shall be securely closed by a 150 mm thick tight fitting plug of commercial quality concrete.

Corrugated steel pipe and sewer pipelines shall not be abandoned until their use is no longer required. The Contractor shall notify the Engineer in advance of any intended pipe and pipeline abandonment.

REMOVE EXISTING MANHOLE AND CONCRETE BOX

Existing sewer manhole and concrete box where shown on the plans to be removed, shall be completely removed and disposed of.

SEWER LINES, CASINGS AND MANHOLES

All sewer line construction shall conform to the City of Benicia standards and shall be the sizes and trench sections as noted on the plans and on the bid schedule.

Extreme caution with proper trench shoring will be required for any trenches over 1.8 meter deep. Any unsafe conditions may cause the City Inspectors to shut-down the job.

Sewerlines--Sewerlines shall be Ductile Iron Pipe, Class 50 Minimum, for municipal sewerlines. All ductile iron pipe shall be wrapped with minimum 8 mil thickness polyethylene sheets or tubes.

Casing--Corrugated steel pipe shall conform to the provisions in Section 66, "Corrugated Metal Pipe," of the Standard Specifications and these special provisions.

Corrugated steel pipe shall be fabricated from zinc-coated steel sheet.

Manholes--Sewer manholes shall be installed and/or constructed at the locations shown on the plans. Water stops shall be placed at incoming and outgoing pipes for all pipes in accordance with manufacturer's recommendations.

Bases will be pre-cast or cast in place concrete with smooth channel flows and will be set in place prior to attaching barrel sections. The concrete shall be minor concrete and conform to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications.

The eccentric cones shall not use polypropylene steps.

The frame and cover shall be from D & L Supply, A—1024 and marked "Sanitary Sewer" on the cover.

TIMBER RETAINING WALL

This work shall consist of constructing a timber retaining wall as shown on the plans, and as specified in these special provisions.

The material for the wall shall be treated Douglas fir and shall conform to the provisions in Section 57-1.02A, "Structural Timber and Lumber," of the Standard Specifications. The posts shall be 150 mm x 150 mm x 4 meters long.

The concrete footings shall be minor concrete and conform to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications.

The nails to secure the lagging to the posts, shall be commercial quality 16 penny galvanized nails.

EXCAVATION AND BACKFILL

The trench sizes and backfill requirements will be per City of Benicia details as shown in the plans. All backfill will be crushed aggregate base 100% imported in street areas.

All trenches in the street area will be saw-cut to provide a straight smooth edge. The pavement section removed is to be 300mm wider than the excavated trench. Care must be given to maintain a 150mm ledge on each side of the trench to allow a "T" patch paving. Any uneven or jagged edge will be resaw-cut and patched at contractor's expense.

No ponding or jetting of trench backfill will be allowed. Trench backfill materials compaction shall be by mechanical means with sufficient water added to insure compaction and consolidation. Trench compaction requirements are as follows:

A. The top 450mm– 95% compaction.
B. Remaining portions, including bedding – 92% compaction

Only that length of trench that the Contractor can excavate, install pipe, backfill, and compact per working day shall be opened up. All trench cuts shall be backfilled daily, and shall be covered with temporary paving (cold or hot mix) or proper steel plating, and shall be appropriately flagged and marked fore evenings and weekends.

PIPE LAYING

Each section of sewer pipe shall be carefully inspected for damage that may have occurred in transit. Any damaged or rejected pipe shall be marked appropriately and removed from project area.

Each section of pipe and each fitting shall be thoroughly cleaned out before it is lowered into the trench. Cleaning of each pipe or fitting shall be accomplished by swabbing, brushing, blowing, with compressed air, flushing with water, or by any combination of these methods necessary to remove all foreign matter. The most efficient method of cleaning pipe and fittings will be determined on the job by the Engineer.

If cleaned pipe sections and fitting cannot be placed in the trench without getting dirt into the open ends, the Engineer may require that a piece of tightly woven canvas be tied over the ends of the pipe or fitting until it has been lowered into position in the trench. After the pipe or fitting has been lowered into the trench, all foreign matter-shall be completely brushed from the bell and spigot ends before assembly.

No pipe or fitting shall be lowered into a trench containing water. The trench bottom shall be free from pieces of rock or other material that would damage the pipe. Water shall be pumped from wet trenches and the trenches shall be kept dry until the joints have been completed and the open ends of the main have been closed whenever possible. Whenever pipe laying is discontinued on any job for short periods, or whenever work is stopped at the end of the day, the open ends of the main shall be protected and tied-into existing main to maintain flows and keep the system functional.

CLEANING, FLUSHING, AND PLUMBING

It shall be the Contractor's responsibility to keep dirt and debris from entering the existing and newly constructed sewer lines.

Upon completion of work, the Contractor shall flush the sewer lines with water until all dirt and debris are removed. The dirt and debris shall be removed from the newly constructed lines and shall not be allowed to flow into the City of Benicia sewage system. All flushing shall be done with a Wayne sewer ball, or approved equal, and the pressure of the water during flushing shall be high enough to provide a minimum cleansing velocity of 1.5 meters per second.

The Contractor shall make his own arrangements to obtain reclaimed waste-water for flushing and cleaning. Reclaimed waste-water may be purchased from the City of Benicia Water Department.

The cleaned sewer lines shall then be plugged off at all manholes. Plugs shall be removed, by the Contractor, upon final acceptance of the work by the Engineer or upon approval from the Engineer for operation of sewer before acceptance. The procedure for the latter shall be as follows:

When deemed necessary by the Engineer, the City of Benicia may run sewage form dwellings or other buildings into a collector system, prior to acceptance of improvements by the Engineer. In such case, the following procedure will be followed:

1. The sewer collector system is thoroughly cleaned and flushed with a sewer ball.
2. All repairs are completed in the sewers and on the manholes below the castings.
3. All castings are grouted in place to grade on manholes.
4. In lieu of 3 above, a steel plate may be set over the manhole in place of the standard manhole casting.
5. A wooden protective cover shall be constructed at the bottom of the manhole directly over the sewer on top of the "shelf".

Full compensation for performing cleaning, flushing and plugging shall be considered as included in the contract price paid per meter for ductile iron sewer pipe of the size shown in the Engineer's Estimate and no separate payment will be made therefor.

AIR TEST

The section of new sewer main installed shall be pressure tested per ASTM Standards for low pressure air tests for sanitary sewers.

MEASUREMENT AND PAYMENT

The quantity of abandon corrugated steel pipe and abandon sewer will be determined as units from actual count.

The contract unit price paid for abandon corrugated steel pipe and abandon sewer shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in abandoning corrugated steel pipe and abandoning sewers, including plugging, pipe removal, structure excavation, and backfill, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The quantity of remove sewer manhole and remove concrete box will be determined as units from actual count.

The contract unit price paid for remove sewer manhole and remove concrete box shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in removing sewer manhole and removing concrete box , including, structure excavation, and backfill, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The length of ductile iron sewer pipe of the size shown in the Engineer's Estimate to be paid for by the meter will be the slope length determined by the Engineer.

The contract unit price paid per meter for ductile iron sewer pipe of the size shown 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 constructing ductile iron sewer pipe, complete in place, including structure excavation, and backfill, trench shoring, bedding, polyethylene wrapping, pressure testing, shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The length of corrugated steel pipe of the size and thickness shown in the Engineer's Estimate to be paid for by the meter will be the slope length determined by the Engineer.

The contract unit price paid per meter for corrugated steel pipe of the size and thickness shown 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 constructing corrugated steel pipe casing, complete in place, including structure excavation, and backfill, trench shoring, bedding, shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The quantity of sewer manhole will be determined as units from actual count.

The contract unit price paid for sewer manhole shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing sewer manhole, complete in place, including structure excavation, and backfill, bedding, shoring, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The quantity of sewer manhole frame and cover will be determined as units from actual count.

The contract unit price paid for sewer manhole frame and cover shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing sewer frame and cover, complete in place, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The quantity of timber retaining wall will be determined as units from actual count.

The contract unit price paid for timber retaining wall shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing timber retaining wall, 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. MODIFIED STANDARD SPECIFICATION SECTIONS

SECTION 11-1. QUALITY CONTROL / QUALITY ASSURANCE

Asphalt concrete shall conform to the provisions in this Section 11-1, "Quality Control / Quality Assurance," and the section entitled "Asphalt Concrete" in Section 10-1, "General," of these special provisions. Section 39, "Asphalt Concrete," of the Standard Specifications shall not apply to Type A and Type B asphalt concrete.

SECTION 39: ASPHALT CONCRETE

39-1 GENERAL

39-1.01 DESCRIPTION

This work shall consist of furnishing and mixing aggregate and asphalt binder at a central mixing plant, transporting, spreading and compacting the mixture, and furnishing and placing pavement reinforcing fabric, in conformance with this Section 11-1, "Quality Control / Quality Assurance," and with "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

The Contractor shall be responsible for controlling the quality of the asphalt concrete product entering the work, including aggregate, asphalt binder, additives, and asphalt concrete mixture; for controlling the quality of the work performed, including mix design, and mixing, transporting, spreading, and compacting the asphalt concrete; for controlling the quality of the finished roadway surface; and for developing, implementing, and maintaining a quality control program. The Contractor shall be responsible for the inspection, sampling, and testing required to control the quality of the asphalt concrete and the work performed.

The inspection, sampling, and testing required to control the quality of the workmanship and the asphalt concrete shall conform to this Section 11-1. Sampling shall be in conformance with the requirements of this Section 11-1 and with California Test 125. Testing shall be performed using California Tests unless otherwise directed by the Engineer or this Section 11-1.

Asphalt concrete is designated as Type A or Type B. The type of asphalt concrete will be shown on the plans or specified in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

39-2 MATERIALS

39-2.01 ASPHALTS

Asphalt binder to be mixed with aggregate shall be steam-refined paving asphalt conforming to the provisions in Section 92, "Asphalts," of the Standard Specifications. Asphalt binder shall be Grade AR-4000 unless the grade is designated in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

Liquid asphalt for prime coat shall conform to the provisions in Section 93, "Liquid Asphalts," of the Standard Specifications and shall be the grade designated by the contract item or conform to the provisions in "Asphalt Concrete," in Section 10-1, "General," of these special provisions.

Asphalt emulsion for paint binder (tack coat) shall conform to the provisions in Section 94, "Asphaltic Emulsions," of the Standard Specifications for the rapid-setting or slow-setting type and grade approved by the Engineer.

Paving asphalt to be used as a binder for pavement reinforcing fabric shall be a steam-refined paving asphalt conforming to the provisions in Section 92, "Asphalts," of the Standard Specifications, and shall be Grade AR-4000, unless otherwise ordered by the Engineer or designated in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

39-2.02 AGGREGATE

Aggregate and combined aggregate shall conform to the quality and gradation provisions in this Section 11-1, "Quality Control / Quality Assurance," for the asphalt concrete types and sizes conforming to the provisions in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

Aggregates shall be clean and free from decomposed or organic materials and other deleterious substances. Coarse aggregate is material retained on the 4.75-mm sieve, fine aggregate is material passing the 4.75-mm sieve, and supplemental fine aggregate is added fine material passing the 600-µm sieve, including, but not limited to, cement and stored fines from dust collectors.

The target value for the percent passing each designated sieve size for the aggregate blend used in the proposed asphalt concrete mix design shall fall within the "Target Value Limits" of the following table:

Table 39-1 - AGGREGATE GRADATION
Type A and Type B Asphalt Concrete
Percentage Passing

19-mm Maximum, Coarse		19-mm Maximum, Medium	
Sieve Sizes	Target Value Limits	Sieve Sizes	Target Value Limits
25-mm	100	25-mm	100
19-mm	90-100	19-mm	90-100
9.5-mm	60-75	9.5-mm	65-80
4.75-mm	45-50	4.75-mm	49-54
2.36-mm	32-36	2.36-mm	36-40
600-µm	15-18	600-µm	18-21
75-µm	3-7	75-µm	3-8

12.5-mm Maximum, Coarse		12.5-mm Maximum, Medium	
Sieve Sizes	Target Value Limits	Sieve Sizes	Target Value Limits
19-mm	100	19-mm	100
12.5-mm	95-100	12.5-mm	95-100
9.5-mm	75-90	9.5-mm	80-95
4.75-mm	55-61	4.75-mm	59-66
2.36-mm	40-45	2.36-mm	43-49
600-µm	20-25	600-µm	22-27
75-µm	3-7	75-µm	3-8

During asphalt concrete production, aggregate gradation shall be within the limits specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. Conformance with the grading requirements shall 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 portions of the aggregate or between the blends of the different aggregates. The percent passing the 75-µm sieve shall be reported to the first decimal place (tenths).

The combined aggregate shall conform to the following quality requirements prior to the addition of the asphalt binder:

Table 39-2 - AGGREGATE QUALITY REQUIREMENTS

Quality	California Test	Asphalt Concrete Type A	Asphalt Concrete Type B
Percent of Crushed Particles	205		
Coarse Aggregate (Min.)		90%	25%
Fine Aggregate (Passing 4.75-mm, Retained on 2.36-mm) (Min.)		70%	20%
Los Angeles Rattler	211		
Loss at 100 Rev. (Max.)		12%	
Loss at 500 Rev. (Max.)		45%	50%
Sand Equivalent (Min.)[1]	217	47	42
Kc Factor (Max.)	303	1.7	1.7
Kf Factor (Max.)	303	1.7	1.7

Note:

1. Reported value shall be the average of 3 tests split from a single sample.

39-2.03 ASPHALT CONCRETE MIXTURE

The asphalt concrete mixture, composed of the proposed aggregate blend and the proposed asphalt binder content as determined by California Test 367, shall conform to the following requirements:

Table 39-3 - ASPHALT CONCRETE MIXTURE REQUIREMENTS

Design Parameters	California Test	Asphalt Concrete Type and Location: Coast and Valley Type A	Coast and Valley Type B	Desert (per Engineer) Type A	Desert (per Engineer) Type B
Hveem Stabilometer Value (Min.)	367[1, 2]	37	35	37	35
Percent air voids (Mix Design)	367[1]	3-5[3]	3-5[3]	4-6[4]	4-6[4]
(Start-Up Production Evaluation)		Design Value ±1.0			
Swell [5] (mm) (Max)	305	0.76	0.76	0.76	0.76

Notes:

1. Reported value shall be the average of 3 tests from a single split sample.
2. If the range of stability for the 3 briquettes is more than 12 points, the briquettes shall be discarded and new samples shall be fabricated.
3. Modify California Test 367, paragraph C5, to "most nearly 4%."
4. Modify California Test 367, paragraph C5, to "most nearly 5%."
5. Measured at Mix Design only.

During production and placement, the asphalt concrete mixture shall conform to the requirements of Table 39-4, "Minimum Process Control Requirements," and Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. Changes in cold feed or hot bin proportions to conform to the aggregate grading requirements shall not be considered changes in the mix design.

Whenever asphalt concrete production has been suspended for longer than 30 days, the Contractor, on the first day of resumption of production, shall sample and test the asphalt concrete to demonstrate conformance with the requirements of Table 39-3, "Asphalt Concrete Mixture Requirements," Table 39-4, "Minimum Process Control Requirements," and Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1.

The target value for asphalt content may be changed by as much as ± 0.2 percent during the production start-up evaluation specified in Section 39-10.02A, "Production Start-Up Evaluation," of this Section 11-1 or after production start-up evaluation and before the first day of regular production with the Engineer's approval. The Contractor shall demonstrate that asphalt concrete that has been produced through the plant using the modified target value for asphalt content is in conformance with this Section 11-1 by submitting test results for samples obtained from the first 500 tonnes of production. Stability and percent air voids shall be determined using 3 briquettes constructed from a single sample taken from 4 locations across the mat in conformance with the requirements of California Test 125.

Changes from one mix design to another shall not be made during the progress of the work, unless approved by the Engineer. Changes in asphalt content, other than those allowed during the start-up evaluation process, or in aggregate grading target values shall be considered to be a change in the asphalt concrete mixture and shall require a new mix design

proposal. Changes in the asphalt content or aggregate grading target values approved by the Engineer will not be applied retroactively for acceptance or payment.

39-2.04 PAVEMENT REINFORCING FABRIC

Pavement reinforcing fabric shall conform to the provisions in Section 88, "Engineering Fabrics," of the Standard Specifications.

39-3 ASPHALT CONCRETE MIX DESIGN PROPOSAL AND REVIEW

39-3.01 CONTRACTOR MIX DESIGN PROPOSAL

The Contractor shall submit for the Engineer's review a proposed asphalt concrete mix design for each asphalt concrete mixture to be used at least 14 days prior to production of that asphalt concrete mixture. The asphalt concrete mix design shall be prepared by a laboratory (or laboratories) whose proficiency has been reviewed and qualified in conformance with the Department's Quality Assurance Program. Aggregate quality and asphalt concrete mix design test results shall be no more than one year old when production of the asphalt concrete mixture starts. For projects of more than one year's duration, asphalt concrete may be produced using the asphalt concrete mix design that was reviewed and accepted at the start of the project provided the asphalt concrete mixture continues to conform to the provisions of this Section 11-1, "Quality Control / Quality Assurance."

The Contractor shall submit a mix design letter that indicates the target values proposed for gradation, asphalt content, and percent air voids. This submittal shall include test results for aggregate and asphalt mixture quality; plots of the combined gradings showing the production tolerances; plots of unit weight, stability, and percent air voids versus asphalt content for the asphalt contents considered in the design process. In addition, this submittal shall include test results for stability, percent air voids, and swell for 3 briquettes constructed using the submitted aggregate and asphalt blended at the proposed target values for each asphalt concrete mixture to be used.

The Contractor shall submit the following for each asphalt concrete mixture proposed:

A. Aggregate and mineral filler:

1. Target values for percent passing each sieve size for the aggregate blend;
2. Results of tests for aggregate quality requirements;
3. Source of each aggregateto be used including producer, location, and California Mine Identification number;
4. Percentage of each aggregate stockpile, cold feed or hot bin to be used;
5. Gradation of each aggregate stockpile, cold feed or hot bin to be used; and
6. Samples that are representative of the aggregate to be used. Minimum sample sizes shall be as follows:

60 kg of each coarse aggregate;
40 kg of each fine aggregate; and
5 kg of each supplemental fine aggregate.

B. Asphalt binder:

1. Asphalt binder source and target value;
2. Four one-liter samples of the asphalt binder;
3. Results of the asphalt binder quality tests conforming to the provisions in Section 92, "Asphalts," of the Standard Specifications; and
4. Material Safety Data Sheets.

C. Antistrip additives**,** when applicable:

1. A 5-kg sample of the dry additive or a one-liter sample of the liquid antistrip additive, including name of product, manufacturer, manufacturer's designation and proposed rate, location, and method of addition; and
2. Material Safety Data Sheets.

The proposed asphalt concrete mix design submittal will be considered complete only when the mix design letter, test results, plots, and samples have been received by the Engineer.

39-3.02 ENGINEER REVIEW OF ASPHALT CONCRETE MIX DESIGN

The Engineer will review the proposed aggregate and asphalt concrete mixture for conformance with this Section 11-1, "Quality Control / Quality Assurance." The proposed asphalt concrete mixture will be reviewed at the proposed target values for aggregate grading and asphalt content. The Engineer will have 14 days to review each submittal of a proposed mix design. Production of asphalt concrete shall not begin until written notification has been received from the Engineer that the aggregates and proposed mix design meet the quality requirements of this Section 11-1.

The Engineer will reject a proposed asphalt concrete mixture that, during review, fails to meet the quality requirements of Table 39-2, "Aggregate Quality Requirements," and Table 39-3, "Asphalt Concrete Mixture Requirements," of this Section 11-1. The Contractor shall resubmit a mix design letter providing new test results, plots, and material samples.

Disagreements in mix design review shall be resolved in conformance with Section 39-6, "Dispute Resolution," of this Section 11-1. The Contractor shall use a mix design on the project only after the Engineer concurs that the aggregate and asphalt concrete represented by the proposed mix design conforms to the provisions ofthis Section 11-1.

The Engineer will review one proposed asphalt concrete mix design for each asphalt concrete type and aggregate size from each plant proposed for use on this project at the State's expense. Costs for additional reviews due to failure to conform to the quality requirements of this Section 11-1 and for reviewing other proposed asphalt concrete mix designs will be deducted from moneys due or to become due the Contractor. The cost for each review will be $1,500. Costs for reviewing changes in a mix design that are initiated by the Engineer will be waived. Contractor's retesting due to errors in the Engineer's testing will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications. Costs for reviewing mix designs not used in this project will be deducted from moneys due or to become due the Contractor.

39-4 CONTRACTOR QUALITY CONTROL

39-4.01 GENERAL

The Contractor shall be responsible for the quality of the asphalt concrete entering into the work and of the work performed. In addition, the Contractor shall be responsible for the quality of asphalt concrete or ingredients procured from subcontractors or vendors. A quality control system shall be established, maintained, and modified, if needed, that will provide assurance that materials and completed work conform to contract requirements.

At least 14 days prior to the start of production of asphalt concrete, the Contractor shall submit a written Quality Control Plan. At the request of the Engineer or the Contractor, the Contractor shall discuss the Quality Control Plan with the Engineer.

39-4.02 QUALITY CONTROL PLAN

The Quality Control Plan shall describe the organization and procedures that will be used to administer the quality control system including the procedures used to control the production process, the procedures used to determine when changes to the production process are needed, and the procedures proposed to be used to implement the required changes. The Quality Control Plan shall meet the minimum standards set forth in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete," available as specified in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

Asphalt concrete production and placement shall not begin until the Quality Control Plan has been approved by the Engineer. Approval of the Quality Control Plan does not imply a warranty by the Engineer that adherence to the plan will result in production of asphalt concrete that complies with this Section 11-1. It shall remain the responsibility of the Contractor to demonstrate such compliance.

The Quality Control Plan shall include the name and qualifications of a Quality Control Manager. The Quality Control Manager shall be responsible for the administration of the Quality Control Plan, including compliance with the plan and plan modifications. The Quality Control Manager shall be responsible to the Contractor, shall have the authority to make decisions concerning quality of the work or product, and shall be available to the project within less than 3 hours during paving. Except in cases of emergency and with the approval of the Engineer, the Quality Control Manager cannot be a foreman, member of the production or paving crew, an inspector or tester on this project during pavement production and placement.

The Quality Control Plan shall identify personnel, equipment and documentation required for a complete inspection, sampling and testing program. The Quality Control Plan shall include, but not be limited to, a list of inspectors, samplers and testers, their duties, their certifications if required, and their experience if no certification is required. It shall also list the name and location of laboratories that shall be providing information to the Engineer, the testers who conducted the tests and their certifications and the name of the Laboratory Quality Control Manager responsible for oversight of the testing program. It shall also show examples of the test result forms (if different from those in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete"), the roadway and plant inspection forms, the Quality Control Manager's daily summary form, and the compliance charts. It shall include the method by which random sampling shall be determined, a list

of the testing and sampling equipment to be used and the current calibration dates and calibration charts, and copies of nuclear gauge licenses.

The Quality Control Plan shall include the name and certification of a testing consultant to be an Independent Third Party in dispute resolution. By mutual agreement during dispute resolution, the Independent Third Party may be a District Independent Assurance Sampler and Tester, the testing consultant or both. The proficiency of the testing consultant shall be reviewed and certified in conformance with the requirements of the Department's Quality Assurance Program before the test consultant participates in dispute resolution. Attention is directed to Section 39-6, "Dispute Resolution," of this Section 11-1.

The Quality Control Plan may be modified as work progresses. A supplement shall be submitted whenever there are changes to quality control procedures or personnel. Asphalt concrete production and placement shall not resume or continue until revisions to the Quality Control Plan or quality control personnel have been approved by the Engineer.

39-4.03 CONTRACTOR QUALITY CONTROL INSPECTION, SAMPLING, AND TESTING

The Contractor shall perform process and quality control sampling and testing, provide inspection, and exercise management control to ensure that asphalt concrete production and placement conforms to the provisions of this Section 11-1. Staffing for process and quality control shall meet the minimum requirements outlined in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete."

Process and quality control, sampling, testing, and inspection shall be provided during the asphalt concrete work. Sampling, testing, and inspection shall be performed at a rate sufficient to ensure that asphalt concrete conforms to the provisions of this Section 11-1.

A roadway inspector shall be provided while asphalt concrete paving operations are in progress. The roadway inspector shall ensure that asphalt concrete placement conforms to industry standards and to the spreading, compacting, and finishing requirements of this Section 11-1, "Quality Control / Quality Assurance." Plant inspection shall be performed as necessary to maintain control of the asphalt concrete production.

Minimum sampling and testing requirements for process and quality control are specified in Table 39-4, "Minimum Process Control Requirements," and Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. Sampling shall be statistically based and random.

During production start-up evaluation, the Contractor shall sample and test in conformance with the provisions in Section 39-10.02A, "Production Start-Up Evaluation," of this Section 11-1.

A testing laboratory and personnel shall be provided for the performance of process and quality control testing. The Engineer shall have unrestricted access to mix design, sampling, and testing.

The proficiency of testing laboratories and sampling and testing personnel shall be reviewed, qualified, and certified by the Department's Independent Assurance Sampler and Tester before providing services to the project. Inspectors shall meet the standards set forth in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete."

39-4.04 CONTRACTOR PROCESS CONTROL

Process control sampling and testing shall be performed and control shall be exercised to ensure that asphalt concrete production conforms with this Section 11-1.

Minimum process control sampling and testing shall be performed in compliance with the following:

Table 39-4 - MINIMUM PROCESS CONTROL REQUIREMENTS

Quality Characteristic	Action Limit	California Test	Minimum Sampling and Testing Frequency	Point of Sampling ‡	Reporting Time Allowance
Sand Equivalent (Min)	47 (Type A) 42 (Type B)	217	One sample per 2500 tonnes	Batch plant - from hot bins. Drum plant - from cold feed.	24 hours
		(Reported value shall be the average of 3)[1]	Not less than one sample per 2 days		
Stability	37 (Type A) 35 (Type B)	366[2]	See Note 4	Mat behind paver	48 hours
		(Reported value shall be the average of 3)[1,3,5]	Not less than one sample per 5 days		

Notes:

‡ In conformance with the requirements of California Test 125.

1. Samples used for the 3 tests to be averaged shall be from a single split sample.
2. Reheat for sample preparation shall be 2 hours maximum.
   Do not place sample or briquette in oven for 15-hour cure.
3. Briquettes shall be fabricated from a single, combined sample obtained from at least 4 locations across the mat behind the paver in conformance with the requirements of California Test 125.
   If the range of stability for the three briquettes is more than 12 points, the samples shall be discarded and new samples shall be obtained before the end of the following shift of paving and tested in conformance with the requirements of Table 39-3, "Asphalt Concrete Mixture Requirements."
4. Asphalt concrete will be sampled and tested each of the first 5 days of production and may be decreased to one for each 5 days thereafter unless stability falls below the action limit.
   When stability falls below the action limit, sampling will be increased to one sample for each of the first 5 days of production and may be decreased to one for each 5 days thereafter.
   The sequence of the first 5 test results shall not be broken by more than 7 days of suspended operations.
5. During production start-up evaluation, a correlation factor for cured vs. uncured specimens shall be established in conformance with the requirements of Section 39-10.02A, "Production Start-Up Evaluation."

The process control test results shall be plotted on specification compliance charts indicating the action limits for the quality characteristic. When one test result falls below the action limit for an individual measurement, the Contractor shall notify the Engineer, take corrective action, and sample and test within the next 500 tonnes of production. When 2 consecutive test results for an individual characteristic fall below the action limit, the asphalt concrete represented by the 2 tests shall be considered not in compliance. When 2 consecutive test results for an individual characteristic fall below the action limit, the Contractor shall suspend production, notify the Engineer, and take corrective action. With the approval of the Engineer, up to 1000 tonnes of asphalt concrete may be placed to demonstrate that the asphalt concrete is once again in compliance with the provisions of this Section 11-1. Production shall begin only after the Engineer has received test results confirming compliance.

Asphalt concrete that has 2 consecutive stability test results less than or equal to 26 for Type A asphalt concrete or less than or equal to 24 for Type B asphalt concrete shall be removed at the Contractor's expense. Asphalt concrete placed to demonstrate compliance that does not meet the provisions of this Section 11-1 shall be removed at the Contractor's expense.

39-4.05 CONTRACTOR QUALITY CONTROL

Quality control, sampling, testing, and inspection shall be provided during asphalt concrete work. Sampling, testing, and inspection shall be performed at a rate sufficient to ensure that the asphalt concrete product conforms to the requirements in this Section 11-1. Sampling for testing to be reported to the Engineer shall be performed at the minimum frequency specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1, "Quality Control / Quality Assurance."

Quality control samples of aggregates and asphalt concrete mixture shall be obtained and split. One split portion of each sample shall be used for quality control testing and the other portion shall be reserved for possible retest during dispute

resolution, in conformance with Section 39-6, "Dispute Resolution," of this Section 11-1. Quality control samples shall be stored in a location listed in the Quality Control Plan until disposal has been approved by the Engineer.

The Contractor shall obtain a one-liter sample of the asphalt binder in conformance with Section 39-7.01C, "Asphalt Binder Storage," of this Section 11-1 for each day of asphalt concrete production. The sample containers shall be labeled as shown in the "Manual for Quality Control and Quality Assurance for Asphalt Concrete" and shall be sent by the Contractor to the Transportation Laboratory on a weekly basis, except for modified asphalts that shall be shipped daily. A copy of the transmittal form shall be attached to the daily report of inspection.

When test results for a single quality characteristic deviate beyond the limits specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1 the Contractor shall take corrective action and shall bring the asphalt concrete within the specification limits. The corrective action taken shall be documented in the records of inspection in conformance with Section 39-4.06B, "Records of Inspection and Testing," of this Section 11-1. When a single quality characteristic deviates 3 consecutive times beyond the limits specified in Table 39-9, "Minimum Quality Control Test Requirements," of this Section 11-1, the Contractor shall suspend production, shall notify the Engineer, and shall take corrective action. With the approval of the Engineer, up to 1000 tonnes of asphalt concrete may be placed and the requirements of Section 39-10.02A, "Production Start-Up Evaluation," of this Section 11-1 shall be used to demonstrate that the asphalt concrete is once again in compliance with this Section 11-1. Production of asphalt concrete shall start only after the Engineer has received test results confirming compliance. When an individual quality characteristic deviates 3 consecutive times beyond the specification limits and production of asphalt concrete has been suspended, the lot shall be terminated.

If an ignition oven is used for asphalt content in conformance with the requirements of California Test 382, gradations of the remaining aggregates shall be provided for each 5000 tonnes of production. Testing of the aggregates shall be in conformance with the requirements of California Test 202, Sections F and G, "Sieve Analysis of Fine and Coarse Aggregates." Test results from these gradings shall be provided prior to completion of the project. Gradings from the aggregates recovered from the ignition oven will not be used in the statistical analysis for quality or for pay. Payment for these gradings will be made as extra work as provided in Section 4-1.03D of the Standard Specifications at the rate of $150 per test result for the cost of the additional testing.

39-4.06 CHARTS AND RECORDS

The Contractor shall record sampling and testing results for both process control and for quality control on forms as provided in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete" or on forms approved by the Engineer. Complete testing records shall be maintained and posted in the Contractor's laboratory. Models of forms that are different from those in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete," locations of postings, and times and means of submissions shall be provided in the Quality Control Plan.

For every 5000 tonnes of asphalt concrete produced, the Contractor shall provide an electronic copy of the process and quality control test results using the Department's statistical evaluation program "ACPay" available as specified in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

Compliance charts and inspection and testing records, except stability test results used for process control, shall be submitted within 24 hours after completion of that shift of asphalt concrete production. If the record is incomplete or in error, a copy of the record will be returned with the deficiencies noted by the Engineer. The Contractor shall correct deficiencies and return the updated record by the start of the following working day. When errors or omissions in the inspection or testing records repeatedly occur, asphalt concrete production and placement shall be suspended and the procedures by which the records are produced shall be corrected before production and placement will be restarted.

39-4.06A Compliance Charts

The Contractor shall develop and maintain time linear specification compliance charts. The compliance charts shall identify the project, test number, test parameter, applicable upper and lower specification limits, and test results.

Compliance charts shall be kept current and shall be posted at a location designated in the Quality Control Plan. Compliance charts shall be updated each day of asphalt concrete production, and up-to-date copies shall be included in the submittals to the Engineer of each day's test results.

39-4.06B Records of Inspection and Testing

For each day of asphalt concrete production, the Contractor shall prepare an "Asphalt Concrete Construction Daily Record of Inspection," on forms provided in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete." A form shall be submitted for inspection at the plant and at the roadway.

For each day of asphalt concrete production, the Contractor shall prepare an "Asphalt Concrete Inspection and Testing Summary" on a form provided in the Department's "Manual for Quality Control and Quality Assurance for Asphalt Concrete." Plant and roadway inspection forms documenting the day's plant production and roadway placement shall be completed. Deviations from the specifications or the Contractor's regular practice shall be listed and explained. Individual inspection forms shall be signed by the inspector and initialed by the Quality Control Manager and attached to the summary

at submittal. Test forms documenting test results shall be complete, signed by the tester, checked and initialed by the Quality Control Manager, and attached to the summary at submittal. Sampling and testing data and calculations that support a test result shall be made available to the Engineer within 48 hours when requested.

The "Asphalt Concrete Inspection and Testing Summary" shall include the following certification signed by the Quality Control Manager:

> It is hereby certified that the information contained in this record is accurate, and that information, tests or calculations documented herein comply with the requirements of the contract and the standards set forth in the testing procedures. Exceptions to this certification are documented as a part of this record.

39-5 ENGINEER QUALITY ASSURANCE

39-5.01 GENERAL

The Engineer will assure conformance to contract specifications by review of the Contractor's mix design proposal, by inspection of the Contractor's procedures, by oversight of the Contractor's quality control inspection and records, by splitting and testing samples with the Contractor during evaluation of the plant production start-up and the nuclear density test strip, and by independent verification sampling and testing of the asphalt concrete and aggregates during asphalt concrete production.

The Contractor may witness assurance sampling and testing. However, the Engineer will not be required to notify the Contractor of anticipated sampling schedules or locations and will not delay sampling or testing if the Contractor is unable to attend. The Contractor shall not use samples taken for assurance testing for testing and submittal as a quality control test result.

The Engineer will provide the Contractor with copies of the assurance test results not more than 2 working days after receipt of the results. Sampling and testing data and calculations that support a test result shall be made available to the Contractor within 48 hours when requested.

The Engineer may test the asphalt, aggregates or asphalt concrete mixture to determine conformance with this Section 11-1, "Quality Control / Quality Assurance," whenever an asphalt concrete mixture or ingredient appears defective or inconsistent or whenever a test result indicates a change in the characteristics of the asphalt concrete mixture or an ingredient. Asphalt, aggregates or asphalt concrete that does not conform with this Section 11-1 will be rejected in conformance with Section 39-11, "Acceptance of Work," of this Section 11-1.

The Contractor, when directed by the Engineer, shall obtain representative samples of the asphalt concrete mixture or ingredients that appear defective or inconsistent. The samples shall be split into 4 portions. The Contractor shall retain 1 portion for testing if the Contractor chooses and 3 portions shall be delivered to the Engineer. The asphalt concrete or ingredient need not be sampled if the Contractor elects to remove and replace the asphalt concrete, at the Contractor's expense, or if the Contractor uses a method of correcting the situation that has been approved by the Engineer. Test results from these additional samples shall not be used as a basis for a calculated pay factor.

39-5.02 SAMPLING AND TESTING FOR VERIFICATION

Independent of the Contractor's quality control testing, the Engineer will obtain random samples of the aggregate and asphalt concrete mixture and test for in-place density.

Samples of aggregates and asphalt concrete will be obtained during asphalt concrete production and placement, and will be split into at least 4 portions. One of the split portions will be tested by the Engineer and used to verify quality control test results, one portion will be provided to the Contractor, and 2 portions will be reserved and stored for testing in conformance with the provisions in Section 39-6, "Dispute Resolution," of this Section 11-1. When verifying the relative compaction, the Engineer will obtain a sample of a sample of asphalt concrete from the mat behind the paver, will split the sample and apportion the sample as described above, and will test the sample for test maximum density.

The Engineer will test for material quality characteristics specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. Verification tests will be at a frequency of not less than 10 percent of the minimum quality control sampling and testing frequency and will be performed in conformance with the test methods specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. Verification tests will be performed using the same test methods used for quality control testing.

During the Engineer's verification of the relative compaction, the Engineer will determine the location of 500 tonnes of asphalt concrete to be tested using a random number, will obtain an asphalt concrete sample from within this location for determination of the test maximum density, and will determine the relative compaction of the in-place asphalt concrete as specified in California Test 375. The Contractor shall obtain one of the split samples of asphalt concrete for determination of test maximum density and shall determine the relative compaction of the 500 tonnes of asphalt tested by the Engineer using the same testing sites determined by the Engineer. The results of this common testing will be compared to the allowable testing difference defined in Table 39-6, "Allowable Testing Differences," of this Section 11-1. If the test

maximum density or the relative compaction does not comply with the allowable testing difference, then the Engineer and Contractor will use the first 500 tonnes of the next day's production to re-correlate the nuclear gauges used in testing as defined by California Test 375.

During production start-up evaluation, the Engineer will witness the sampling of asphalt concrete and aggregates and will perform tests on the materials in conformance with Section 39-10.02A, "Production Start-Up Evaluation," of this Section 11-1.

39-5.03 VERIFICATION

The Engineer will determine the acceptability of the quality control test results by using the *t*-test for sample means to test whether or not the means of the quality control test results and verification test results are within an allowable testing difference. Quality control test results and verification test results for each indexed quality characteristic will be used in the verification process.

The *t*-value of the group of test data to be verified is computed as follows:

$$t = \frac{\left|\overline{X_c} - \overline{X_v}\right|}{S_p\sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \qquad \text{and} \qquad S_p^2 = \frac{S_c^2\,(n_c - 1) + S_v^2\,(n_v - 1)}{n_c + n_v - 2}$$

where:

n_c	=	Number of Contractor's quality control tests (minimum of 2 required)
n_v	=	Number of Verification tests (minimum of 1 required)
$\overline{X}_c$	=	Mean of the Contractor's quality control tests
$\overline{X}_v$	=	Mean of the Verification tests
S_p	=	Pooled standard deviation (When $n_v = 1$, $S_p = S_c$)
S_c	=	Standard deviation of the Contractor's quality control tests
S_v	=	Standard deviation of the Verification tests (when $n_v > 1$)

The comparison of quality control test results and verification test results will be considered at a level of significance, α_____Compute *t* using the equation above and compare to the critical *t*-value, t_{crit} , from the following table:

Table 39-5 - CRITICAL t-VALUE FOR VERIFICATION OF QUALITY CONTROL TESTING

degrees of freedom (nc+nv-2)	t_{crit} (for α = 0.01)	degrees of freedom (nc+nv-2)	t_{crit} (for α = 0.01)
1	63.657	18	2.878
2	9.925	19	2.861
3	5.841	20	2.845
4	4.604	21	2.831
5	4.032	22	2.819
6	3.707	23	2.807
7	3.499	24	2.797
8	3.355	25	2.787
9	3.250	26	2.779
10	3.169	27	2.771
11	3.106	28	2.763
12	3.055	29	2.756
13	3.012	30	2.750
14	2.977	40	2.704
15	2.947	60	2.660
16	2.921	120	2.617
17	2.898	∞	2.576

Quality control test results are verified if the *t*-value computed is less than or equal to t_{crit} ($t \le t_{crit}$), and the difference between the means of the quality control test results and verification test results are within an allowable testing difference.

Quality control test results are not verified if the *t*-value computed is greater than *tcrit* ($t > t_{crit}$), and the difference between the means exceeds the allowable testing difference. The allowable testing difference shall be as follows:

Table 39-6 - ALLOWABLE TESTING DIFFERENCE

Quality	California Test	Allowable Testing Difference
Sand Equivalent (min.)	217	8
Hveem Stabilometer Value (min.)	366	10
Percent Air Voids	367	1.5
Asphalt Content	379 or 382	0.3%
Gradation	202	
19 or 12.5 mm		2
9.5 mm		4
4.75 mm		3
2.36 mm		2
600 µm		2
75 µm		1.0
Relative Compaction	375	0.8%
Test Maximum Density		0.03 g/cc

If quality control test results are not verified, the Contractor will be notified of the difference. The Engineer will sample asphalt concrete production at a more frequent interval. Resolution of the problem shall be in conformance with the provisions in Section 39-6, "Dispute Resolution," of this Section 11-1.

39-6 DISPUTE RESOLUTION

39-6.01 GENERAL

The Contractor and the Engineer shall work together to avoid potential conflicts and to resolve differences that may arise from a disagreement regarding test result comparisons.

Should the results of the testing fail to meet the criteria of the stage at which the disagreement arose, production shall be suspended. Production shall not start or resume nor shall asphalt concrete be accepted until the differences have been resolved and the Engineer is assured that the asphalt concrete conforms to this Section 11-1, "Quality Control / Quality Assurance."

When the Engineer and the Contractor, together or separately, are unable to determine the source of error, an Independent Third Party shall act as witness and referee.

In disagreements, if the Engineer's testing process meets the requirements of this Section 11-1, costs related to the review shall be borne by the Contractor. The Contractor's sampling and testing program shall be modified as necessary. New test results shall be submitted to the Engineer. Test results judged to be in error shall be removed from consideration and the new test results shall be substituted. If split samples are not available and retesting is not possible, that portion of the asphalt concrete produced or placed prior to and during the disagreement will be evaluated based on the results of the Engineer's verification test results.

In disagreements, if the Engineer's testing process fails to meet the requirements of this Section 11-1, costs related to the review shall be borne by the State. The Engineer's sampling and testing program will be modified as necessary. Test results judged to be in error shall be removed from consideration and the new test results shall be substituted. Contractor's retesting due to errors in the Engineer's testing will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications. If, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of delays or errors in the Engineer's testing, the delay will be considered a right of way delay as provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

In disagreements, if both the Contractor's and the Engineer's testing processes have failed to meet the requirements of this Section 11-1 or if the cause cannot be determined, each party will bear the costs related to their own review. When appropriate, the Contractor's and the Engineer's sampling and testing programs shall be modified as necessary, split samples of the Contractor's quality control samples or the Engineer's verification samples shall be retested, and the new quality control test results shall be submitted to the Engineer. Test results judged to be in error shall be removed from consideration and the new test results shall be substituted. If split samples of aggregates or asphalt concrete mixture from the Contractor's testing are not available where retesting is required, that portion of the asphalt concrete produced prior to and during the disagreement will be evaluated based on the results of the Engineer's verification test results.

39-6.02 DURING THE ASPHALT CONCRETE MIX DESIGN REVIEW

During the asphalt concrete mix design review, if the Engineer's review does not confirm that one or more of the aggregate or the asphalt concrete mixture qualities comply with this Section 11-1, "Quality Control / Quality Assurance," both parties will review their sampling, testing, and test results and shall share their findings. Testers and laboratories shall be made available for witnessing. Calculations and test results shall be made available for review. If an error in the Contractor's testing is detected during this review, the Contractor shall, as is appropriate, recalculate or retest. The new test results shall be submitted to the Engineer. If an error in the Engineer's testing is detected, the Engineer will, as is appropriate, recalculate or retest.

If the Contractor's and Engineer's review does not reveal the source of conflict, the Contractor's and the Engineer's sampling and testing processes shall be witnessed by the Independent Third Party. Testing to resolve the dispute in results for the mix design shall be performed using samples that were obtained and split while being witnessed by the Independent Third Party. Review of sample preparation and testing will be performed at both the Contractor's and the Engineer's laboratory on a portion of the split material while being witnessed by the Independent Third Party. The resulting mix design shall be used for production.

39-6.03 DURING THE PRODUCTION START-UP EVALUATION

When the Contractor's and Engineer's test results during production start-up fail to meet the provisions in Section 39-10.02, "Production Start-Up Evaluation and Nuclear Density Test Strips," both parties will review their sampling, testing, and test results, and shall share their findings. Testers and laboratories shall be made available for witnessing. Calculations and test results shall be made available for review. If an error in the Contractor's testing is detected during this review, the Contractor shall, as is appropriate, recalculate or retest. The new test results shall be submitted to the Engineer. If an error in the Engineer's testing is detected, the Engineer will, as is appropriate, recalculate or retest.

If the Contractor's and the Engineer's review does not resolve the differences, the Contractor's and the Engineer's testing processes shall be witnessed by the Independent Third Party using the 2 remaining portions of the split samples. If necessary, a 250-tonne to 500-tonne quantity of asphalt concrete shall be placed at a location agreed to by the Engineer to provide asphalt concrete and ingredients for sampling and testing for the Independent Third Party review.

If an error in the Contractor's testing is detected by the Independent Third Party, the Contractor shall take corrective action and, as appropriate, recalculate or retest the split portion of the trial quantity of asphalt concrete in question. The new test results shall be submitted to the Engineer. If an error in the Engineer's testing is detected by the Independent Third Party, the Engineer will take corrective action and, as appropriate, recalculate or retest the split portion of the first trial quantity.

Production shall not start nor shall asphalt concrete be accepted until the differences have been resolved and the test results meet the provisions in Section 39-10.02, "Production Start-Up Evaluation and Nuclear Density Test Strips," of this Section 11-1.

39-6.04 DURING PRODUCTION

When it is determined that the quality control test results could not be verified, both parties will review their sampling, testing, and test results, and shall share their findings. Testers and laboratories will be made available for witnessing. Calculations and results will be made available for review.

If an error in the quality control sampling or testing is detected during the Contractor's or the Engineer's review, the Contractor shall either recalculate or, if appropriate, retest using the reserved split portions of the quality control samples. These new test results shall be submitted to the Engineer. If an error in the verification sampling or testing is detected, the Engineer will recalculate or, if appropriate, retest using a reserved split portion of the verification samples. Using the new test results, the Engineer will repeat the calculation of the *t*-test and will determine if the means of the quality control tests and the verification test results are within the allowable testing difference as specified in Section 39-5.03, "Verification," of this Section 11-1.

When the verification test results do not verify the quality control test results 3 consecutive times, both the Contractor's and the Engineer's testers shall be witnessed by the Independent Third Party while sampling, splitting, and testing samples from the production unit or from the mat . The Contractor may produce and place up to 1000 tonnes of asphalt concrete to provide materials and sampling opportunities. Production and placement of asphalt concrete will be suspended until the Independent Third Party has completed the review of the Contractor's and the Engineer's sampling and testing and resolved the differences.

If an error in the Contractor's testing is detected by the Independent Third Party, the Contractor shall take corrective action and, as appropriate, recalculate or retest the split portion of the quality control samples. The new test results shall be submitted to the Engineer. If an error in the Engineer's testing is detected by the Independent Third Party, the Engineer will take corrective action and, as appropriate, recalculate or retest a split portion of the verification samples. When the error has been detected and corrected, production shall resume and the services of the Independent Third Party will be discontinued.

If a problem is not identified during the Independent Third Party review, the Independent Third Party shall be retained for the duration of the project or until a problem has been identified. Until all asphalt concrete has been produced and placed,

the Contractor shall sample and split quality control samples in the presence of the Independent Third Party. One portion of each sample shall be tested by the Contractor in conformance with the intervals specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1, and the other portion shall be delivered to the Engineer by the Independent Third Party. The Engineer will test at least one of every 5 of the split samples for verification purposes. A new lot will be designated for asphalt concrete produced since the Independent Third Party was consulted. The pay factor for this lot will be determined in conformance with Section 39-11.02, "Statistical Evaluation and Determination of Pay Factor," of this Section 11-1 with the exception that both the Contractor's quality control test results and the Engineer's verification test results will be combined and will be the basis for acceptance of that portion of the work. The pay factor for the lot of asphalt concrete which brought about the dispute resolution shall be determined in conformance with Section 39-11.02, "Statistical Evaluation and Determination of Pay Factor," of this Section 11-1 with the exception that both the Contractor's quality control test results and the Engineer's verification test results will be combined and will be the basis for acceptance of that portion of the work.

39-7 STORING, PROPORTIONING AND MIXING MATERIALS

39-7.01 STORAGE

The Contractor shall store the aggregate for asphalt concrete so that separately sized aggregates will not be intermingled and shall store asphalt binder so that different grades of asphalt will not be intermingled. Aggregate that has been intermingled with aggregate of another size shall be removed by the Contractor and replaced with aggregate of specified grading.

When the Contractor adds supplemental fine aggregate, each supplemental fine aggregate used shall be stored separately and kept thoroughly dry.

The measurement and storage provisions of this Section shall not apply to the dust collected in skimmers and expansion chambers (knock-out boxes) or to the dust collected in centrifugal (cyclone) collectors. Dust from these collectors may be returned to the aggregate without being measured or stored separately, provided the dust is returned uniformly at a point in advance of the sampling device in batch-mixing plants or is returned at or before mixing in continuous mixing plants.

Aggregate and asphalt binder shall be stored in conformance with the following requirements.

39-7.01A Aggregate Cold Storage

Material shall be fed from storage with a mechanical feeder. Before being fed to the drier, aggregate shall be separated into 3 or more sizes and stored separately.

39-7.01B Aggregate Hot Storage

Aggregate for asphalt concrete to be mixed in batch mixing plants shall be stored, after being dried, in conformance with the following requirements:

1. Aggregates for asphalt concrete shall be separated into 3 or more sizes.
2. After the aggregate is separated, each size shall be stored in a separate bin, and shall be recombined in conformance with the provisions in Section 39-7.03A, "Proportioning for Batch Mixing," of this Section 11-1 in order to conform to the gradings specified in Section 39-2, "Materials," of this Section 11-1. Storage bins shall be provided with chutes to prevent overflow into adjacent bins.

39-7.01C Asphalt Binder Storage

Asphalt to be used as a binder for asphalt concrete shall be stored in heated tanks.

A suitable sampling device shall be provided in asphalt feed lines connecting plant storage tanks to the asphalt weighing system or spray bar. The sampling device shall consist of a valve with a nominal diameter between 10 mm and 20 mm, constructed in such a manner that a one-liter sample may be slowly withdrawn during plant operations. The valve shall be maintained in good condition and, if the valve fails to function properly, the valve shall be replaced. The sampling device shall be readily accessible and in an area free of dangerous obstructions and shall be between 600 mm and 750 mm above the platform. A drainage receptacle shall be provided for flushing the device prior to sampling.

The discharge end of the asphalt binder circulating pipe shall be maintained below the surface of the asphalt binder in the storage tank to prevent discharging hot asphalt binder into open air.

A temperature sensing device shall be installed in the asphalt feed line. The device shall measure the temperature of the asphalt and shall be accurate to 5˚C increments. An automatic, continuous recording device shall be provided and used to maintain accurate records of the asphalt temperature during production. Where the plant controller has the capability of capturing production data electronically, including ingredient temperatures, and when this data represents the temperature at the time of production and is captured at intervals of not greater than 5 minutes, this process will be considered to be

continuous recording. Captured data shall be retained for the duration of the contract and shall be submitted to the Engineer on request.

39-7.02 DRYING

Aggregate shall be fed directly to a drier-drum mixer or to a drier at a uniform rate.

Aggregate shall be dried such that, at the time of spreading, the moisture content of the completed asphalt concrete mixture shall not exceed 1.0 percent and the minimum and maximum asphalt concrete mixture temperatures are not exceeded. Moisture content will be determined in conformity with the requirements of California Test 370.

The drier or drier-drum mixer shall be provided with a device that senses the temperature of the material leaving the drier or the drier-drum mixer. The temperature-sensing device shall be accurate to the nearest 5˚C. The indicator shall be located and maintained at the point where the proportioning operations are controlled. An automatic continuous recording device shall be provided and used to maintain accurate records of the temperatures during production. Where the plant controller has the capability of capturing production data electronically, including ingredient temperatures, and when this data represents the temperature at the time of production and is captured at intervals of not greater than 5 minutes, this process will be considered to be continuous recording. Captured data shall be retained for the duration of the contract and shall be submitted to the Engineer on request.

The burner used for heating the aggregate shall achieve complete combustion of the fuel.

39-7.03 PROPORTIONING

Proportioning shall be either by hot-feed control or cold-feed control. Hot-feed control and cold-feed control indicate the location of the measuring devices or controls.

The Contractor's mixing equipment shall be equipped with a suitable, safe sampling device that will provide a sample, representative of actual production, of the aggregate being incorporated into the asphalt concrete. The delivery point of samples shall be safe and convenient. When samples are taken from a location above ground level, a means shall be provided for lowering the aggregate samples to the ground.

39-7.03A Proportioning for Batch Mixing

When the Contractor elects to use batch mixing equipment, each aggregate hot storage bin shall be equipped with a sampling device that will provide a sample of the aggregate discharged into the weigh hopper.

Fine material collected in dust control systems, other than centrifugal collectors or knock-out boxes, shall be considered to be supplemental fine aggregate. When supplemental fine aggregate is used, it shall be proportioned by mass.

A sampling device for supplemental fine aggregate shall be installed in each feed line or surge tank preceding the weigh hopper.

39-7.03A(1) Batching Tolerances

Aggregate and asphalt shall be proportioned by mass as follows:

A. The zero tolerance for aggregate scales shall be 0.5-percent of the total batch mass of the aggregate. The zero tolerance for separate scales for weighing supplemental fine aggregate or asphalt binder shall be 0.05-percent of the total batch mass of the aggregate.
B. Unless otherwise approved by the Engineer, the indicated mass of material drawn from storage shall not vary from the preselected scale setting as defined by target values of the approved mix design by more than the following percentages of the total batch mass of the aggregate:

    1. Aggregate shall be within one percent, except that when supplemental fine aggregate is used and is weighed cumulatively with the aggregate, the draft of aggregate drawn immediately before the supplemental fine aggregate shall be within 0.5-percent.
    2. Supplemental fine aggregate shall be within 0.5-percent.
    3. Asphalt binder shall be within 0.1-percent.

The asphalt binder shall be measured by a tank scale.

39-7.03A(2) Automatic Controls

Batch proportioning shall be by an automatic plant controller. The proportioning devices shall be automatic to the extent that the only manual operation required for proportioning materials for one batch shall be a single operation of a switch or starter.

Proportioning devices shall be of a type in which materials discharged from the several bins are controlled by gates or by mechanical conveyors. The batching devices shall be so interlocked that no new batch may be started until weigh hoppers are empty, the scales are at zero, and the discharge gates are closed. The means of withdrawal from the bins and of discharge from the weigh box shall be interlocked so that not more than one bin can discharge onto a given scale at one time, and so that the weigh box cannot be tripped until the required quantity from each of the bins has been deposited therein. In addition, automatic proportioning devices shall be interlocked so that the weighing cycle will be interrupted whenever the amount of material drawn from storage varies from the pre-selected amount by more than the tolerances specified in this Section 11-1. Whenever the weighing cycle is interrupted, that specific batch shall not be used in the work unless it can be manually adjusted to meet the specified tolerances based on the total mass of the batch. When partial batches are batched, the interlock tolerances, except the zero tolerance, shall apply to the total mass of aggregate in the partial batch.

Proportioning devices shall be operated so that all mass increments required for a batch are preset at the same time. Controls shall be designed so that these settings may be changed without delay and the order of discharge from the several bins can be changed.

Proportioning controls shall be equipped with the means for inspection of the interlock tolerance settings. Instructions for performing the inspection shall be available at the point of operation.

The necessary means shall be provided to check the mass of various proportioned amounts on a separate vehicle scale located at the plant site.

39-7.03B Proportioning for Continuous Mixing

Asphalt binder shall be introduced into the mixer through a meter conforming to the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications. The asphalt meter shall automatically compensate for changes in the asphalt temperature, unless the meter is the mass flow, coriolis effect, type. The system shall be capable of varying the rate of delivery of binder proportionate with the delivery of aggregate. During a day's run, the temperature of asphalt binder shall not vary more than 30˚C. The meter and lines shall be heated and insulated. The binder storage shall be equipped with a device for automatic plant cut-off when the level of binder is lowered sufficiently to expose the pump suction line.

When supplemental fine aggregate is used, it shall be proportioned by a method that uniformly feeds the material within 2 percent of the required amount. Supplemental fine aggregate shall be discharged from the proportioning device directly into the mixer.

The supplemental fine aggregate proportioning system shall function with a degree of accuracy such that, when operated between 30 percent and 100 percent of maximum operating capacity, the average difference between the indicated mass of material delivered and the actual mass delivered shall not exceed one percent of the actual mass for three individual 15-minute runs. For the 3 individual 15-minute runs, the indicated mass of material delivered shall not vary from the actual mass delivered by more than 2 percent of the actual mass.

The fine material collected in dust control systems may be returned to the aggregate production stream without proportioning if returned at a rate commensurate with overall plant production, and if returned at or before the mixer. A return rate of less than 100 percent of the collection rate shall be metered as specified above for supplemental fine aggregate.

The asphalt feeder, each of the aggregate feeders, the supplemental fine aggregate feeder, if used, and the combined aggregate feeder shall be equipped with devices by which the rate of feed can be determined while the plant is in full operation.

The combined aggregate shall be weighed using a belt scale. The belt scale shall be of such accuracy that, when the plant is operating between 30 percent and 100 percent of belt capacity, the average difference between the indicated mass of material delivered and the actual mass delivered shall not exceed one percent of the actual mass for three individual 3-minute runs. For the 3 individual 3-minute runs, the indicated mass of material delivered shall not vary from the actual mass delivered by more than 2 percent of the actual mass.

The actual mass of material delivered for proportioning device calibrations shall be determined by a vehicle scale located at the plant site conforming to the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications. The vehicle scale shall be error checked within 24 hours of checking the plant's proportioning devices. The plant shall be equipped so that this accuracy check can be made prior to the first production operation for a project and at other times when requested by the Engineer.

The belt scale for the combined aggregate, the proportioning devices for supplemental fine aggregate, if used, and the asphalt proportioning meter shall be interlocked so that the rates of feed of the aggregates and asphalt will be adjusted automatically (at all production rates and production rate changes) to maintain the asphalt ratio (kilograms of asphalt per 100 kg of dry aggregate including supplemental fine aggregate, if used) designated in the mix design in conformance with the provisions in Section 39-2.03, "Asphalt Concrete Mixture," of this Section 11-1. The plant shall not be operated unless this automatic system is functioning and in good working condition.

Asphalt meters and aggregate belt scales used for proportioning aggregates and asphalt shall be equipped with rate-of-flow indicators to show the rates of delivery of asphalt and aggregate. Meters and scales shall be equipped with resettable totalizers so that the total amounts of asphalt and aggregate introduced into the asphalt concrete mixture can be determined.

Rate-of-flow indicators and totalizers for like materials shall be accurate within one percent when compared directly. The asphalt cement totalizer shall not register when the asphalt metering system is not delivering material to the mixer.

The bin or bins containing the fine aggregate and supplemental fine aggregate, if used, shall be equipped with vibrating units or other equipment that will prevent hang-up of material while the plant is operating. Each belt feeder shall be equipped with a device to monitor the depth of aggregate between the troughing rollers. The device for monitoring depth of aggregate shall automatically shut down the plant whenever the depth of aggregate is less than 70 percent of the target depth. To avoid erroneous shut down by normal fluctuations, a delay between sensing less than 70 percent flow and shutdown of the plant will be permitted, as determined by the Engineer, at the time of the initial California Test 109. A second device shall be located either in the stream of aggregate beyond the belt or where it will monitor movement of the belt by detecting revolutions of the tail pulley on the belt feeder. The device for monitoring no-flow or belt movement, as the case may be, shall stop the plant automatically and immediately when there is no flow. The plant shall not be operated unless both low-flow and no-flow monitoring devices are in good working condition and functioning properly.

For continuous pugmill mixing plants, an aggregate sampling device that will provide a 25-kg to 40-kg sample of the combined aggregate while the plant is in full operation shall be provided in advance of the point where the aggregate enters the mixer.

For drier-drum mixing plants, an aggregate sampling device that will provide a 25-kg to 40-kg sample of the combined aggregate while the plant is in full operation shall be provided in advance of the point where the aggregate enters the drier-drum mixer.

When supplemental fine aggregate is used, a sampling device shall be installed in each feed line or surge tank preceding the proportioning device for the supplemental fine aggregate.

39-7.04 (BLANK)

39-7.05 MIXING

Aggregate, supplemental fine aggregate, and asphalt binder shall be mixed in a batch mixer, continuous mixing pugmill mixer, or continuous mixing drier-drum. The charge in a batch mixer, or the rate of feed to a continuous mixer, shall not exceed that which will permit complete mixing of the material. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected by a reduction in the volume of material or by other adjustments.

Asphalt binder shall be at a temperature of not less than 120°C nor more than 190°C when added to the aggregate.

The temperature of the aggregate before adding the binder shall not be more than 165°C.

39-7.05A Batch Mixing

When asphalt concrete is produced by batch mixing, the mixer shall be equipped with a sufficient number of paddles of a type and arrangement so as to produce a properly mixed batch.

The binder shall be introduced uniformly into the mixer along the center of the mixer parallel to the mixer shafts, or by pressure spraying. When a pan is used, it shall be equipped with movable vanes in order that the flow of binder may be directed across the width of the pan, as desired. The vanes shall be equipped with a means for quick adjustment, and a positive lock to prevent shifting.

The mixer platform shall be of ample size to provide safe and convenient access to the mixer and other equipment. The mixer housing and weighbox housing shall be equipped with gates of ample size to permit ready sampling of the discharge of aggregate from each of the plant bins and from each feed line or surge tank of supplemental fine aggregate, if used. The Contractor shall provide a sampling device capable of delivering a representative sample of sufficient size to permit the required tests.

The mixer shall be equipped with a timing device that will indicate by a definite audible or visual signal the expiration of the mixing period. The device shall measure the time of mixing within 2 seconds.

The time of mixing a batch shall begin on the charging stroke of the weighhopper dumping mechanism and shall end when discharge is started. Mixing shall continue until a homogeneous asphalt concrete mixture of uniformly distributed and properly coated aggregates of unchanging appearance is produced. The time of mixing shall be not less than 30 seconds.

An interval timer shall control the time of mixing. The interval timer shall be interlocked so that the mixer cannot be discharged until the materials have been mixed for the full amount of time specified.

39-7.05B Continuous Mixing

Continuous mixing plants shall utilize pugmill or drier-drum mixers.

When asphalt concrete is produced by pugmill mixing, the mixer shall be equipped with paddles of a type and arrangement to provide sufficient mixing action and movement to the asphalt concrete mixture to produce properly mixed asphalt concrete. The combined aggregate shall be fed directly from the drier to the mixer at a uniform and controlled rate.

Mixing shall continue until a homogeneous asphalt concrete mixture of thoroughly and uniformly coated aggregates of unchanging appearance is produced at the discharge point from the mixer.

The temperature of the completed asphalt concrete mixture shall not exceed 165°C upon discharge from the mixer.

The mixer shall discharge into a storage silo with a capacity of not less than that specified in Section 39-7.06, "Asphalt Concrete Storage," of this Section 11-1. The Contractor shall provide a means of diverting the flow of asphalt concrete away from the silo to prevent incompletely mixed portions of the asphalt concrete mixture from entering the silo.

39-7.06 ASPHALT CONCRETE STORAGE

When asphalt concrete is stored, it shall be stored only in silos. Asphalt concrete shall not be stockpiled. The minimum quantity of asphalt concrete in a silo during mixing shall be 18 tonnes except for the period immediately following a shut-down of the plant of 2 hours or more. A means shall be provided to indicate that storage in each silo is being maintained as required.

Storage silos shall be equipped with a surge-batcher sized to hold a minimum of 1800 kg of material. A surge-batcher consists of equipment placed at the top of the storage silo that catches the continuous delivery of the completed asphalt concrete mix and changes it to individual batch delivery to prevent the segregation of product ingredients as the completed asphalt concrete mix is placed into storage. The surge-batcher shall be center loading and shall be constructed to prevent material buildup. Rotary chutes shall not be used as surge-batchers.

The surge-batcher shall be independent and distinct from conveyors or chutes used to collect or direct the completed asphalt concrete mixture being discharged into storage silos and shall be the last device to handle the material before it enters the silo. Multiple storage silos shall be served by an individual surge-batcher for each silo. Material handling shall be free of oblique movement between the highest elevation (conveyor outfall) and subsequent placement in the silo. Discharge gates on surge-batchers shall be automatic in operation and shall discharge only after a minimum of 1800 kg of material has been collected and shall close before the last collected material leaves the device. Discharge gate design shall prevent the deflection of material during the opening and closing operation.

Asphalt concrete stored in excess of 18 hours shall not be used in the work. Asphalt concrete mixture containing hardened lumps shall not be used. A storage facility that contained the material with the hardened lumps shall not be used for further storage until the cause of the lumps is corrected.

39-7.07 ASPHALT CONCRETE PLANTS

Plants, including commercial plants, that produce asphalt concrete subject to these specifications shall conform to the provisions in Section 7-1.01F, "Air Pollution Control," of the Standard Specifications, and shall be equipped with a wet-tube dust washer or equal and other devices that will reduce the dust emission to the degree that adjacent property is not damaged. The washer and other equipment shall function efficiently when the plant is in operation.

During production, petroleum products such as diesel fuel and kerosene shall not be used as a release agent on belts, conveyors, hoppers, or hauling equipment.

Plants shall be equipped with an inspection dock constructed so that a quality control technician or inspector standing on the dock can inspect the completed asphalt concrete mixture and take samples, as necessary, from the hauling vehicle before the vehicle leaves the plant site. This inspection dock shall allow the hauling vehicle to pull alongside and shall meet applicable safety requirements of the California Division of Occupational Safety and Health. Haul vehicle drivers shall be instructed to stop at the dock whenever a quality control technician or inspector is on the dock and to remain there until directed to leave by that individual.

39-8 SUBGRADE, PRIME COAT, PAINT BINDER (TACK COAT), AND PAVEMENT REINFORCING FABRIC

39-8.01 SUBGRADE

Immediately prior to applying prime coat or paint binder (tack coat), or immediately prior to placing the asphalt concrete when a prime coat or paint binder (tack coat) is not required, the subgrade to receive asphalt concrete shall conform to the compaction requirement and elevation tolerances specified for the material involved and shall be free of loose or extraneous material. If the asphalt concrete is to be placed on an existing base or pavement that was not constructed as part of the contract, the surface shall be cleaned by sweeping, flushing or other means to remove loose particles of paving, dirt, and other extraneous material immediately before applying the prime coat or paint binder (tack coat).

39-8.02 PRIME COAT AND PAINT BINDER (TACK COAT)

A prime coat of liquid asphalt shall be applied to the areas to be surfaced when there is a contract item for the work or when the work is required in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

Prime coat shall be applied only to those areas designated by the Engineer.

Prime coat shall be applied at the approximate total rate of 1.15 L per square meter of surface covered. The exact rate and number of applications will be determined by the Engineer.

Prime coat shall be applied at a temperature conforming to the range of temperatures specified in Section 93-1.03, "Mixing and Applying," of the Standard Specifications for distributor application of the grade of liquid asphalt being used.

A paint binder (tack coat) of asphaltic emulsion shall be furnished and applied in conformance with the provisions in Section 94, "Asphaltic Emulsions," of the Standard Specifications and shall be applied to vertical surfaces of existing pavement, curbs, gutters, and construction joints in the surfacing against which additional material is to be placed, to a pavement to be surfaced, and to other surfaces designated in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

Paint binder (tack coat) shall be applied in one application at a rate of from 0.10-L to 0.45-L per square meter of surface covered. The exact rate of application will be determined by the Engineer.

At the Contractor's option, paving asphalt may be used for paint binder (tack coat) instead of asphaltic emulsion. If paving asphalt is used, the grade to be used and the rate of application will be determined by the Engineer. The paving asphalt shall be applied at a temperature of not less than 140°C or more than 175°C.

Prime coat or paint binder (tack coat) shall be applied in advance of placing the surfacing only as far as shall be approved by the Engineer. When asphaltic emulsion is used as a paint binder (tack coat), the asphalt concrete shall not be placed until the asphaltic emulsion has cured.

Immediately in advance of placing asphalt concrete, additional prime coat or paint binder (tack coat) shall be applied as directed by the Engineer to areas where the prime coat or paint binder (tack coat) has been damaged. Loose or extraneous material shall be removed and no additional compensation will be allowed therefor.

39-8.03 PAVEMENT REINFORCING FABRIC

Pavement reinforcing fabric shall be placed on existing pavement to be surfaced or between layers of asphalt concrete when such work is shown on the plans, or specified in "Asphalt Concrete" in Section 10-1, of these special provisions, or ordered by the Engineer.

Before placing the pavement reinforcing fabric, a binder of paving asphalt shall be applied to the surface to receive the pavement reinforcing fabric at an approximate rate of 1.15 L per square meter of surface covered. The exact rate will be determined by the Engineer. The binder shall be applied to a width equal to the width of the fabric mat plus 75 mm on each side.

Before applying binder, large cracks, spalls, and depressions in existing pavement shall be repaired as directed by the Engineer and, if not included in the item, the repair work will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

The fabric shall be aligned and placed with no wrinkles that lap. The test for lapping shall be made by gathering together the fabric in a wrinkle. If the height of the doubled portion of extra fabric is 15 mm or more, the fabric shall be cut to remove the wrinkle, then lapped in the direction of paving. Lap in excess of 50 mm shall be removed. Pavement reinforcing fabric shall not be placed in areas of conform tapers where the thickness of the overlying asphalt concrete is 30 mm or less.

If manual laydown methods are used, the fabric shall be unrolled, aligned, and placed in increments of approximately 9 m.

Adjacent borders of the fabric shall be lapped 50 mm to 100 mm. The preceding roll shall be lapped 50 mm to 100 mm over the following roll in the direction of paving at ends of rolls or at a break. At fabric overlays, both the binder and the fabric shall overlap previously placed fabric by the same amount.

Seating of the fabric with rolling equipment after placing will be permitted. Turning of the paving machine and other vehicles shall be gradual and kept to a minimum to avoid damage to the fabric.

A small quantity of asphalt concrete, to be determined by the Engineer, may be spread over the fabric immediately in advance of placing asphalt concrete surfacing in order to prevent fabric from being damaged by construction equipment.

Public traffic shall not be allowed on the bare reinforcing fabric, except that public cross traffic may be allowed to cross the fabric under traffic control after the Contractor has placed a small quantity of asphalt concrete over the fabric.

Care shall be taken to avoid tracking binder material onto the pavement reinforcing fabric or distorting the fabric during seating of the fabric with rolling equipment. If necessary to protect the pavement reinforcing fabric, exposed binder material may be covered lightly with sand.

39-9 SPREADING AND COMPACTING EQUIPMENT

39-9.01 SPREADING EQUIPMENT

Asphalt pavers shall be self-propelled mechanical spreading and finishing equipment provided with a screed or strike-off assembly capable of distributing the material to not less than the full width of a traffic lane unless otherwise approved by the Engineer. Screed action shall include cutting, crowding or other practical action that is effective on the asphalt concrete mixture without tearing, shoving or gouging and that produces a surface texture of uniform appearance. The screed shall be

adjustable to the required section and thickness. The screed shall be provided with a suitable full width compacting device. Pavers that leave ridges, indentations or other marks in the surface shall not be used unless the ridges, indentations or marks are eliminated by rolling or prevented by adjustment in the operation.

When end dump haul vehicles are used, the asphalt paver shall operate independently of the vehicle being unloaded or shall be capable of propelling the vehicle being unloaded. The load of the haul vehicle shall be limited to that which will insure satisfactory spreading. While being unloaded, the haul vehicle shall be in contact with the machine and the brakes on the haul vehicle shall not be depended upon to maintain contact between the vehicle and the machine.

No portion of the mass of hauling or loading equipment, other than the connection, shall be supported by the asphalt paver. No vibrations or other motions of the loader that could have a detrimental effect on the riding quality of the completed pavement shall be transmitted to the paver.

When asphalt concrete is placed directly upon asphalt treated permeable base, the asphalt concrete shall be placed in a manner and with equipment that will not disturb or displace the asphalt treated permeable base.

39-9.02 COMPACTING EQUIPMENT

A sufficient number of rollers shall be provided to obtain the specified compaction and surface finish required by this Section 11-1. Rollers shall be sized to achieve the required results.

Rollers shall be equipped with pads and water systems that prevent sticking of the asphalt concrete mixtures to the pneumatic or steel-tired wheels. A parting agent that will not damage the asphalt concrete mixture may be used to aid in preventing the asphalt concrete mixture from sticking to the wheels.

39-10 SPREADING AND COMPACTING

39-10.01 GENERAL REQUIREMENTS

Asphalt concrete shall be handled, spread, and compacted in a manner which is in conformance with this Section 11-1, "Quality Control / Quality Assurance."

Asphalt concrete shall be placed in such a manner that cracking, shoving, and displacement will be avoided.

Type A and Type B asphalt concrete shall be placed only when the ambient temperature is above 10°C.

Asphalt concrete shall not be placed when the underlying layer or surface is frozen or not dry or when weather conditions will prevent proper handling, finishing or compaction of the mixture.

Asphalt concrete shall be spread and compacted in the layers and thicknesses indicated in the following table:

Asphalt Concrete Layers and Thickness

Total Thickness Shown on the Plans*	Number of Layers	Top Layer Thickness (Millimeters)		Next Lower Layer Thickness (Millimeters)		All Other Lower Layers Thickness (Millimeters)	
		Min.	Max.	Min.	Max.	Min.	Max.
75 mm or less	1	----	-----	----	----	----	----
76 through 89 mm	2	35	45	35	45	----	----
90 through 135 mm	2	45	60	45	75	—	—
136 mm or more	**	45	60	45	75	45	120

Notes:
*When pavement reinforcing fabric is shown to be placed between layers of asphalt concrete, the thickness of asphalt concrete above the pavement reinforcing fabric shall be considered to be the "Total Thickness Shown on the Plans" for the purpose of spreading and compacting the asphalt concrete above the pavement reinforcing fabric.
**At least 3 layers if total thickness is more than 135 mm and less than 255 mm. At least 4 layers if total thickness is 255 mm or more.

A layer shall not be placed over a layer that exceeds 75 mm in compacted thickness until the temperature of the layer being covered is less than 70°C at mid-depth unless approved by the Engineer.

Asphalt concrete to be placed on shoulders, and on other areas off the traveled way having a width of 1.50 m or more, shall be spread in the same manner as specified above.

The completed mixture shall be deposited on the roadbed at a uniform quantity per linear meter, as necessary to provide the required compacted thickness without resorting to spotting, picking-up or otherwise shifting the mixture. During transporting, spreading and compacting, petroleum products such as diesel fuel and kerosene shall not be used as a release agent on trucks, spreaders or compactors in contact with the asphalt concrete.

Segregation shall be avoided. Surfacing shall be free from pockets of coarse or fine material. Asphalt concrete containing hardened lumps shall not be used.

Longitudinal joints in the top layer of Type A or Type B asphalt concrete shall correspond with the edges of planned traffic lanes. Longitudinal joints in other layers shall be offset not less than 150 mm alternately each side of the edges of traffic lanes.

Unless otherwise provided herein or approved by the Engineer, the top layer of asphalt concrete for shoulders, tapers, transitions, road connections, private drives, curve widenings, chain control lanes, turnouts, left-turn pockets, and other areas shall not be spread before the top layer of asphalt concrete for the adjoining through lane has been spread and compacted. At locations where the number of lanes is changed, the top layer for the through lanes shall be paved first. When existing pavement is to be surfaced and the specified thickness of asphalt concrete to be spread and compacted on the existing pavement is 75 mm or less, the shoulders or other adjoining areas may be spread simultaneously with the through lane provided the completed surfacing conforms to the requirement of this Section 11-1. Tracks or wheels of spreading equipment shall not be operated on the top layer of asphalt concrete until final compaction has been completed.

At those locations shown on the plans, as specified in "Asphalt Concrete" in Section 10-1, "General," of these special provisions, or as directed by the Engineer, the asphalt concrete shall be tapered or feathered to conform to existing surfacing or to other highway and non-highway facilities.

At locations where the asphalt concrete is to be placed over areas inaccessible to spreading and rolling equipment, the asphalt concrete shall be spread by practical means to obtain the specified results and shall be compacted thoroughly to the required lines, grades, and cross sections by means of pneumatic tampers or by other methods that will produce the same degree of compaction as pneumatic tampers.

39-10.02 PRODUCTION START-UP EVALUATION AND NUCLEAR DENSITY TEST STRIPS

The Contractor shall demonstrate that the proposed asphalt concrete mixture is being produced and placed on the roadway in conformance with this Section 11-1, "Quality Control / Quality Assurance." The production start-up evaluation shall demonstrate that the aggregates and asphalt concrete mixture conform to the requirements of Table 39-3, "Asphalt Concrete Mixture Requirements," and of Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1 when produced using the plant proposed for this project. The nuclear density test strip serves to provide the Contractor with a location to develop a correlation between cores taken from the test strip and the Contractor's and Engineer's nuclear density gage readings taken from the same locations on the test strip and for the Contractor to demonstrate the ability to achieve a minimum of 96 percent relative compaction.

Production start-up evaluation and the nuclear density test strip may be constructed separately or at the same time to serve both purposes. Asphalt concrete used in the nuclear density test strip shall be representative of the asphalt concrete that shall be placed in the project.

Should the test results or testing program fail to meet these criteria, production will be suspended and the Contractor shall resolve the problem in conformance with the provisions in Section 39-6, "Dispute Resolution," of this Section 11-1.

Attention is directed to longitudinal and transverse construction joint requirements specified in "Asphalt Concrete" in Section 10-1, "General," of these special provisions.

Test data used for the production start up evaluation and the nuclear gage test strips shall not be included with the test data used for acceptance of the work in conformance with the provisions in Section 39-11, "Acceptance of Work," of this Section 11-1.

A production start-up evaluation and a nuclear density test strip shall be used when production of asphalt concrete has been resumed following a suspension of production due to unsatisfactory material quality as specified in Section 39-4.04, "Contractor Process Control," Section 39-4.05, "Contractor Quality Control," and Section 39-11.02A, "General" of this Section 11-1.

39-10.02A Production Start-Up Evaluation

Before or on the first day of asphalt concrete production, the Contractor shall produce a trial quantity of between 250 tonnes and 500 tonnes of asphalt concrete to demonstrate that asphalt concrete produced for this project conforms to the quality characteristics of this Section 11-1. The location of the production start-up evaluation shall be approved by the Engineer.

Asphalt concrete shall be produced by production procedures intended for the entire project. Production of asphalt concrete shall stop after placement of the trial quantity of asphalt concrete. Asphalt concrete production and placement may resume after the quality characteristics of the asphalt concrete mixture have been tested and found to be in conformance with the quality requirements of this Section 11-1.

The Contractor shall randomly obtain 3 aggregate samples from the plant and 3 asphalt concrete mixture samples from the mat behind the paver. Each sample from the plant shall be split into 4 portions; each sample from the mat shall be split into 4 portions. One portion of each sample shall be tested by the Contractor and one portion of each sample shall be provided to the Engineer for testing. The remaining portions shall be delivered to the Engineer and stored for dispute

resolution should the test results not conform to this Section 11-1. The Contractor and the Engineer shall evaluate the samples for conformance to the requirements for sand equivalent, stability, percent air voids, and the quality characteristics designated in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. The percent air voids of the asphalt concrete mixture shall be within ± 1.0 percent of the percent air voids designated in the Contractor's mix design.

The trial quantity of asphalt concrete will be accepted if:

A. Not more than 3 of the test results from the combined 6 test results from the Contractor's and Engineer's samples for quality characteristics indexed 2, 3, 4, and 5 in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1 are outside the specified limits.
B. Not more than one of the test results from the combined 6 test results from the Contractor's and the Engineer's samples for sand equivalent, stability, percent air voids or critical start-up characteristics designated in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1 are outside the specified limits.

If the test results from the combined 6 test results fail to meet the conditions above, corrective action shall be taken, and a new trial quantity of asphalt concrete shall be placed and evaluated in conformance with the provisions in this section to demonstrate conformance. If the test results from the combined 6 test results fail to meet the requirements above, then the trial quantity of asphalt concrete will be rejected.

The testing program will be considered adequate only if the average of the Contractor's test results and the average of the Engineer's test results for sand equivalent, stability, percent air voids, and the quality characteristics designated in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1 are within the allowable testing difference designated in Table 39-6, "Allowable Testing Difference," of this Section 11-1.

The Contractor shall not proceed to regular production until the requirements of this Section 39-10.02A, "Production Start-Up Evaluation" have been met. At the request of the Contractor, the Engineer may elect to leave the asphalt concrete which does not meet the requirements of this Section 39-10.02A in place if mitigation at the Contractor's expense can be agreed to. If this quantity of asphalt concrete is left in place, the Contractor will be paid 75 percent of the contract price paid per tonne for asphalt concrete.

The Contractor shall establish a correlation factor for stability of cured versus uncured briquettes. From a single split sample of asphalt concrete, 6 briquettes shall be fabricated. Three of the 6 briquettes shall be cured for 15 hours in conformance with the requirements of California Test 366 and 3 briquettes shall not be cured. The difference between the average stability value determined for the cured and the uncured specimens shall be considered the correlation factor, and shall be applied to stability values determined on uncured samples throughout the life of the project. The correlation factor may range from zero to 4. If the correlation factor is less than zero, a factor of zero shall be applied. If the factor is greater than 4, the correlation factor shall be approved by the Engineer.

39-10.02B Nuclear Density Test Strip

On the first day of placement of each layer of asphalt concrete the Contractor shall place a test strip in conformance with the requirements of California Test 375. The purpose of the test strip is to determine a correlation between cores taken from the test strip and the nuclear density gage readings taken at the core locations and to demonstrate that the asphalt concrete can be placed and compacted to the standards of this Section 11-1, "Quality Control / Quality Assurance." Asphalt concrete used in the nuclear density test strip shall be representative of the asphalt concrete that shall be placed in the project. The location for the nuclear density test strip shall be approved by the Engineer.

The Contractor shall place nuclear density test strips until conditions of the test method and this Section 11-1 have been met. The requirements of this section and the test method shall apply for the correlation of each gage that is used to determine relative compaction for this project. Relative compaction results will not be accepted if they have been determined using a nuclear gage that has not been correlated using a test strip.

Asphalt concrete in test strips may be left in place under the following conditions:

A. If the relative compaction for the test strip is determined to be 96 percent or greater, the Contractor will be paid at the contract price per tonne of asphalt concrete.
B. If the relative compaction for the test strip is determined to be less than 96 percent but greater than 93 percent, the Contractor will be paid at 75 percent of the contract price per tonne of asphalt concrete. A new test strip will be required, and mitigation measures shall be at Contractor's expense.

Asphalt concrete in test strips will be rejected when the relative compaction for the test strip is below 93 percent. Production and placement shall not begin until the Contractor has demonstrated the ability to achieve 96 percent relative compaction in conformance with this Section 11-1.

39-10.03 SPREADING

Layers shall be spread with an asphalt paver, unless otherwise specified or approved by the Engineer. Asphalt pavers shall be operated in such a manner as to insure continuous and uniform movement of the paver.

In advance of spreading asphalt concrete over an existing base, surfacing or bridge deck, if there is a contract item for asphalt concrete (leveling) or if ordered by the Engineer, asphalt concrete shall be spread by mechanical means that will produce a uniform smoothness and texture. Asphalt concrete (leveling) shall include, but not be limited to, the filling and leveling of irregularities and ruts. Asphalt concrete used to change the cross slope or profile of an existing surface shall not be considered as asphalt concrete (leveling).

Paint binder (tack coat) shall be applied to each layer in advance of spreading the next layer.

Before placing the top layer adjacent to cold transverse construction joints, the joints shall be trimmed to a vertical face on a neat line. Transverse joints shall be tested with a 3.6-m ± 0.06-m straightedge and shall be cut back for surface smoothness as required in conformance with Section 39-10.04, "Compacting," of this Section 11-1. Connections to existing surfacing shall be feathered to conform to the requirements for smoothness. Longitudinal joints shall be trimmed to a vertical face and on a neat line if the edges of the previously laid surfacing are, in the opinion of the Engineer, in such a condition that the quality of the completed joint will be affected.

39-10.04 COMPACTING

Compacting equipment shall conform to the provisions in Section 39-9.02, "Compacting Equipment," of this Section 11-1, "Quality Control / Quality Assurance."

Rolling shall commence at the lower edge and shall progress toward the highest portion. When compacting layers that exceed 75 mm in compacted thickness, rolling shall commence at the center and shall progress outwards.

Asphalt concrete shall be compacted to a relative compaction of not less than 96 percent and shall be finished to the lines, grades, and cross sections shown on the plans. In-place density of asphalt concrete will be determined prior to opening the pavement to public traffic. No rolling will be permitted after the asphalt concrete temperature is below 60°C.

Asphalt concrete placed in dig outs, as a leveling course, for slope correction, for detours not included in the finished roadway prism, in areas where in the judgment of the Engineer compaction or compaction measurement by conventional methods is impeded or on the uppermost lift of shoulders with rumble strips shall be compacted by a method approved by the Engineer.

Relative compaction shall be determined in conformance with the requirements of California Test 375 except that only a nuclear gauge with thin lift capability shall be used for asphalt concrete layer of 30 mm to 59 mm in thickness. Laboratory specimens shall be compacted in conformance with the requirements of California Test 304. Test locations will be established for asphalt concrete areas to be tested, as specified in California Test 375. If the Contractor compacts the asphalt concrete in any form or quantity after sites for testing have been chosen in conformance with the requirements of California Test 375 or after California Test 375 has begun, the quality control tester shall choose a new set of random numbers for locating test sites.

Upon completion of rolling operations, if ordered by the Engineer, the asphalt concrete shall be cooled by applying water. Applying water shall conform to the provisions in Section 17, "Watering," of the Standard Specifications.

The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. Ridges, indentations or other objectionable marks left in the surface of the asphalt concrete by blading or other equipment shall be eliminated by rolling or other suitable means. The use of equipment that leaves ridges, indentations or other objectionable marks in the asphalt concrete shall be discontinued.

When a straightedge 3.6 m ± 0.06 m long is laid on the finished surface and parallel with the centerline, the surface shall not vary more than 3-mm from the lower edge of the straightedge. The transverse slope of the finished surface shall be uniform to a degree such that no depressions greater than 6 mm are present when tested with a straightedge 3.6 m ± 0.06-m long in a direction transverse to the centerline and extending from edge to edge of a 3.6-m traffic lane.

Pavement within 15 m of a structure or approach slab shall conform to the smoothness tolerances specified in Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications.

39-11 ACCEPTANCE OF WORK

39-11.01 GENERAL

The Engineer shall select the procedure used to determine the quantities of asphalt concrete for acceptance and payment determination in conformance with the provisions of this Section 11-1, "Quality Control / Quality Assurance."

Quality control test results that have been verified shall form the basis for statistical evaluation of the work in conformance with Section 39-11.02, "Statistical Evaluation and Determination of Pay Factor," of this Section 11-1. The quality requirements on which statistical evaluation will be based are specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1.

Work determined to be in conformance with the provisions of this Section 11-1 will be accepted and paid for at the contract price per tonne for asphalt concrete and may be subject to compensation adjustment in conformance with Section 39-11.02C, "Pay Factor Determination and Compensation Adjustment," of this Section 11-1.

Work that is not in compliance with the provisions of this Section 11-1 may be rejected by the Engineer and shall be removed and replaced at the Contractor's expense.

When there are fewer than 5 verified quality control tests, the work will be accepted or rejected based on whether the individual test results meet the quality requirements specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. Section 39-11.02, "Statistical Evaluation and Pay Factor Determination," of this Section 11-1 shall not apply.

Aggregates, asphalt binder, and asphalt concrete mixtures that do not conform to this Section 11-1 shall not be used.

The Engineer may reject a quantity of material that is determined to be defective based on visual inspection or noncompliance with the provisions of this Section 11-1.

39-11.02 STATISTICAL EVALUATION AND DETERMINATION OF PAY FACTOR

Statistical evaluation of the work shall be used to verify the Contractor's quality control test results to determine compliance with this Section 11-1, "Quality Control / Quality Assurance."

39-11.02A General

The quality characteristics to be evaluated and the specification limits are specified in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. Asphalt content, aggregate gradation (600-µm and 75-µm sieves), and relative compaction shall be considered for purposes of this Section 11-1 to be critical quality characteristics.

A lot represents the total quantity of asphalt concrete placed. More than one lot will occur if changes in the target values, material sources or mix design are requested by the Contractor and made in conformance with this Section 11-1 or if production of asphalt concrete is suspended due to unsatisfactory performance. However, asphalt concrete placed in dig outs, as a leveling course, for slope correction, for detours not to be included in the finished roadway prism, in areas where in the judgment of the Engineer compaction or compaction measurement by conventional methods is impeded or on the uppermost lift of shoulders with rumble strips shall be considered as a separate lot from other asphalt concrete. In addition, a new lot may be designated by the Engineer if the production and placement have been suspended for longer than 30 days due to seasonal suspension of phases of work.

A minimum of 5 samples shall be required to perform a statistical evaluation. The maximum obtainable pay factor with the 5 samples shall be 1.01. A minimum of 8 samples shall be required to obtain a pay factor of 1.05. If the sampling frequencies and quantity of work would otherwise result in fewer than 8 samples, the Contractor may submit a written request to increase the sampling frequency to provide a minimum of 8 samples. The request shall be included in the Quality Control Plan.

The lot will be accepted and a final pay factor determined when the Contractor's sampling, inspection, and test results are completed, have been submitted and evaluated, and the Engineer has visually inspected the pavement. Quality control test results shall be verified using the *t*-test in conformance with the provisions of Section 39-5.03, "Verification," of this Section 11-1 before the results will be used in considering the acceptance of asphalt concrete.

If the current composite pay factor of a lot is greater than 0.90, the lot will be accepted, provided the lowest single pay factor is not within the reject portion of Table 39-8, "Pay Factors," of this Section 11-1. If the lowest single pay factor is within the reject portion of Table 39-8, "Pay Factors," of this Section 11-1, the lot will be rejected. Rejected asphalt concrete shall be removed from the project site at the Contractor's expense.

If the current composite pay factor of a lot is less than 0.90, production of asphalt concrete shall be terminated and corrective action taken. Upon approval of the Engineer, up to 1000 tonnes of asphalt concrete may be placed to demonstrate that the asphalt concrete is once again in conformance with this Section 11-1. Production of asphalt concrete shall not start until the Engineer has received test results confirming conformance with this Section 11-1. A new lot will be established when production resumes.

If a pay factor for a critical quality characteristic designated in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1 is less than 0.90 for the lot or is within the rejection range for the last 5 tests, production of asphalt concrete shall be terminated and corrective action taken. Upon approval of the Engineer, up to 1000 tonnes of asphalt concrete may be placed to demonstrate that the asphalt concrete is once again in conformance with this Section 11-1. Production of asphalt concrete shall not start until the Engineer has received test results confirming conformance with this Section 11-1. A new lot will be established when production resumes.

Defective asphalt concrete may be voluntarily removed and replaced with new asphalt concrete to avoid a low pay factor. New material will be sampled, tested, and evaluated in conformance with this Section 11-1.

39-11.02B Statistical Evaluation

The Variability-Unknown/Standard Deviation Method will be used to determine the estimated percentage of the lot that is outside specification limits. The number of significant figures used in the calculations will be in conformance with the requirements of AASHTO Designation R-11, Absolute Method.

The estimated percentage of work that is outside of the specification limits for each quality characteristic will be determined as follows:

1. Calculate the arithmetic mean ($\overline{X}$) of the test values;

$$\overline{X} = \frac{\sum x}{n}$$

where:

$\sum$	=	summation of
x	=	individual test values
n	=	total number of test values

2. Calculate the standard deviation (s);

$$s = \sqrt{\frac{n\sum(x^2)-(\sum x)^2}{n(n-1)}}$$

where:

$\sum(x^2)$	=	summation of the squares of individual test values
$(\sum x)^2$	=	summation of the individual test values squared
n	=	total number of test values

3. Calculate the upper quality index (Q_u);

$$Q_u = \frac{USL - \overline{X}}{s}$$

where:

USL	=	upper specification limit
s	=	standard deviation
$\overline{X}$	=	arithmetic mean

(Note: The USL is equal to the upper specification limit or the target value plus the production tolerance.)

4. Calculate the lower quality index (Q_L);

$$Q_L = \frac{\overline{X} - LSL}{s}$$

where:

LSL=		lower specification limit or target value minus production tolerance
s	=	standard deviation
$\overline{X}$	=	arithmetic mean

5. From Table 39-7, "Estimated Percent of Work Outside Specification Limits," of this Section 11-1, determine P*U* ;

where:

P_U	=	the estimated percentage of work outside the USL. (P_U = 0, when USL is not specified.)

6. From Table 39-7, "Estimated Percent of Work Outside Specification Limits," of this Section 11-1, 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;

Percent Defective = $P_U + P_L$

where:

P_U = the estimated percentage of work outside the USL
P_L = the estimated percentage of work outside the LSL

8. Repeat Steps 1 through 7 for each quality characteristic listed for acceptance.

39-11.02C Pay Factor Determination and Compensation Adjustment

The pay factor and compensation adjustment for a lot will be determined as follows:

1. From Table 39-8, "Pay Factors," of this Section 11-1, determine the pay factor for each quality characteristic, (PF_{QC}), using the total number of test result values and the total estimated percentage outside the specification limits ($P_U + P_L$) from Step 7 in Section 39-11.02B, "Statistical Evaluation," of this Section 11-1.
2. The pay factor for the lot is a composite of single pay factors determined for each quality characteristic designated in Table 39-9, "Minimum Quality Control Requirements," of this Section 11-1. The following formula is used:

$$PF_C = \sum_{i=1}^{8} w_i \, PF_{QC_i}$$

where:

PF_C = the composite pay factor for the lot,
PF_{QC} = the pay factor for the individual quality characteristic,
w = the weighting factor listed in Table 39-9, and
i = the quality characteristic index number in Table 39-9.

3. Payment to the Contractor for the lot of asphalt concrete will be subject to a compensation adjustment. The Compensation Adjustment Factor (CAF) will be determined as follows:

CAF = PF_C - 1

4. The amount of the compensation adjustment will be calculated as the product of:

a. the Compensation Adjustment Factor (CAF)
b. the total tonnes represented in the lot, and
c. the contract price paid per tonne for the item of asphalt concrete involved.

If the compensation adjustment is a negative value, the compensation adjustment will be deducted from moneys due, or that may become due, the Contractor under the contract. If the compensation adjustment is a positive value, the compensation adjustment will be added to moneys due, or that may become due, the Contractor under the contract.

Table 39-7.—ESTIMATED PERCENT OF WORK OUTSIDE SPECIFICATION LIMITS

P_U and/or 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
	Upper Quality Index Q_U or Lower Quality Index Q_L												
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

Table continues below

Table 39-7 (cont.).—ESTIMATED PERCENT OF WORK OUTSIDE SPECIFICATION LIMITS

P_U and/or 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
	Upper Quality Index Q_U or Lower Quality Index Q_L												
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

Notes:

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.

Table 39-8.—PAY FACTOR

Pay Factor	Sample Size (n)												
	5	6	7	8	9	10-11	12-14	15-17	18-22	23-29	30-42	43-66	>66
	Maximum Allowable Percent of Work Outside Specification Limits for A Given Pay Factor ($P_U + P_L$)												
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
	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
Reject	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:

1. To obtain a pay factor when the estimated percent outside specification limits from Table 39-7, "Estimated Percent of Work Outside Specification Limits," does not correspond to a value in the table, use the next larger value.
2. The maximum obtainable pay factor is 1.05 (with a minimum of 8 test values).

Table 39-9.—MINIMUM QUALITY CONTROL REQUIREMENTS

Index (i)	Quality Characteristic	Specification Limits	Weighting Factor (w)	California Test	Minimum Sampling and Testing Frequency	Point of Sampling
1	**Asphalt Content** [2,3]	TV ± 0.5%	0.30	379 or 382	One sample per 500 tonnes or part thereof Not less than one sample per day	Mat behind paver
	Gradation			202	One sample per 500 tonnes or part thereof Not less than one sample per day	Batch Plant - from hot bins Drum Plant - from cold feed
2	19 or 12.5 mm [4]	TV ± 5	0.01			
3	9.5 mm	TV ± 6	0.01			
4	4.75 mm	TV ± 7	0.05			
5	2.36 mm	TV ± 5	0.05			
6	600 µm [2,3]	TV ± 4	0.08			
7	75 µm [2]	TV ± 2	0.10			
8	**Relative Compaction** [2]	96%	0.40	375 [5]	One sample per 500 tonnes or part thereof Not less than one test per day	Finished mat after final rolling
	Test Maximum Density			375	Per Test Method	Mat behind the paver
9	**Mix Moisture Content**	≤1%		370	One sample per 1000 tonnes or part thereof Not less than one sample per day	
	Asphalt and Mix Temperature	120ºC to 190ºC (Asphalt) ≤165ºC (Mix)			Continuous using an automated recording device	Plant

Notes:

1. TV = Target Value from contractor's proposed mix design.
2. Depending on aggregate gradation specified.
3. Quality characteristics 1, 6, 7, and 8 are defined as critical quality characteristics in the verification testing process.
4. Quality characteristics 1, 6, and 7 are defined as critical start-up characteristics in the Production Start-Up Evaluation.
5. California Test 375, Part 3, Section B, "Testing Frequency," is revised to change 450 tonnes to 500 tonnes and 45 tonnes to 50 tonnes.

39-12 MEASUREMENT AND PAYMENT

39-12.01 MEASUREMENT

Asphalt concrete will be measured by mass. The quantity to be paid for will be the combined mass of the mixture for the various types of asphalt concrete, as designated in the Engineer's Estimate.

The mass of the materials will be determined in conformance with the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

Quantities of paving asphalt, liquid asphalt, and asphaltic emulsion to be paid for as contract items of work will be determined in conformance with the methods provided in Section 92, "Asphalts," Section 93, "Liquid Asphalts," or Section 94, "Asphaltic Emulsions," of the Standard Specifications, as the case may be.

When recorded batch masses are printed automatically, these masses may be used for determining pay quantities provided the following requirements are complied with:

A. Total aggregate and supplemental fine aggregate mass per batch shall be printed. When supplemental fine aggregate is weighed cumulatively with the aggregate, the total batch mass of aggregate shall include the supplemental fine aggregate.

B. The total bitumen mass per batch shall be printed.
C. Zero-tolerance mass shall be printed prior to weighing the first batch and after weighing the last batch of each truckload.
D. The time, date, mix number, load number, and truck identification shall be correlated with the load slip.
E. A copy of the recorded batch masses shall be certified by a licensed weighmaster and submitted to the Engineer.

Pavement reinforcing fabric will be measured and paid for by the square meter for the actual pavement area covered.

39-12.02 PAYMENT

Asphalt concrete placed in the work, unless otherwise specified, will be paid for at the contract price per tonne for asphalt concrete of the types designated in the Engineer's Estimate.

Compensation adjustment for asphalt concrete will be in conformance with Section 39-11.02C, "Pay Factor Determination and Compensation Adjustment," of this Section 11-1, "Quality Control / Quality Assurance."

When there is a contract item for asphalt concrete (leveling), quantities of asphalt concrete placed for leveling will be paid for at the contract price per tonne for asphalt concrete (leveling). When there is no contract item for asphalt concrete (leveling), and leveling is ordered by the Engineer, asphalt concrete so used will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

For asphalt concrete placed in dig outs, as a leveling course, for slope correction, for detours not included in the finished roadway prism, in areas where in the judgment of the Engineer compaction or compaction measurement by conventional methods is impeded or on the uppermost lift of shoulders with rumble strips the relative compaction provisions of Section 39-11.02, "Statistical Evaluation and Determination of Pay Factor," of this Section 11-1, shall not apply. In the computation of the composite pay factor (PF_C)for the lot composed of this asphalt concrete, an individual pay factor of 1.0 for the relative compaction (PF_{QC8}) shall be used.

Full compensation for the Contractor's Quality Control Plan, including furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in developing, implementing, modifying, and fulfilling the requirements of the Quality Control Plan shall be considered as included in the contract price paid per tonne for asphalt concrete of the types designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for Contractor sampling, testing, inspection, testing facilities, and preparation and submission of results shall be considered as included in the contract price paid per tonne for asphalt concrete of the types designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

Quantities of pavement reinforcing fabric placed and paving asphalt applied as a binder for the pavement reinforcing fabric will be paid for at the contract price per square meter for pavement reinforcing fabric and per tonne for paving asphalt (binder-pavement reinforcing fabric). Full compensation for furnishing and spreading sand to cover exposed binder material, if necessary, shall be considered as included in the contract price paid per tonne for paving asphalt (binder-pavement reinforcing fabric) and no separate payment will be made therefor.

Small quantities of asphalt concrete placed on pavement reinforcing fabric to prevent the fabric from being displaced by construction equipment or to allow public traffic to cross over the fabric shall be considered as part of the layer of asphalt concrete to be placed over the fabric and will be measured and paid for by the tonne as asphalt concrete of the types designated in the Engineer's Estimate.

When there is a contract item for liquid asphalt (prime coat), the quantity of prime coat will be paid for at the contract price per tonne for the designated grade of liquid asphalt (prime coat). When there is no contract item for liquid asphalt (prime coat) and the special provisions require the application of a prime coat, full compensation for furnishing and applying the prime coat shall be considered as included in the contract price paid per tonne for asphalt concrete of the types designated in the Engineer's Estimate and no separate payment will be made therefor.

When there is a contract item for asphaltic emulsion (paint binder), the quantity of asphaltic emulsion or paving asphalt used as paint binder (tack coat) will be paid for at the contract price per tonne for asphaltic emulsion (paint binder). When there is no contract item for asphaltic emulsion (paint binder), full compensation for furnishing and applying paint binder (tack coat) shall be considered as included in the contract price paid per tonne for asphalt concrete of the types designated in the Engineer's Estimate and no separate payment will be made therefor.

Fog seal coat will be paid for as provided in Section 37-1, "Seal Coats," of the Standard Specifications.

No adjustment of compensation will be made for an increase or decrease in the quantities of paint binder (tack coat) or fog seal coat required, regardless of the reason for such increase or decrease. The provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications shall not apply to the items of paint binder or fog seal coat.

The above contract prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing asphalt concrete, complete in place, as shown on the plans, as specified in this Section 11-1, "Quality Control / Quality Assurance," and "Asphalt Concrete" in Section 10-1, "General," of these special provisions, and as directed by the Engineer.

SECTION 11-2. PORTLAND CEMENT CONCRETE

11-2.01 GENERAL

Portland cement concrete shall conform to the provisions in this Section 11-2, "Portland Cement Concrete," and the section entitled "Portland Cement Concrete" in Section 8, "Materials," of these special provisions. Section 90, "Portland Cement Concrete," of the Standard Specifications is deleted. Section 90, "Portland Cement Concrete," of the Standard Specifications is amended to read as follows.

SECTION 90: PORTLAND CEMENT CONCRETE

90-1 GENERAL

90-1.01 DESCRIPTION

· Portland cement concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in these specifications.

· The Contractor shall determine the mix proportions for all concrete except pavement concrete. The Engineer will determine the mix proportions for pavement concrete. Concrete for which the mix proportions are determined either by the Contractor or the Engineer shall conform to the requirements of this Section 90.

· Unless otherwise specified, cementitious material shall be a combination of cement and mineral admixture. Cementitious material shall be either:

1. "Type IP (MS) Modified" cement; or
2. A combination of "Type II Modified" portland cement and mineral admixture; or
3. A combination of Type V portland cement and mineral admixture.

· Type III portland cement shall be used only as allowed in the special provisions or with the approval of the Engineer.

· Class 1 concrete shall contain not less than 400 kg of cementitious material per cubic meter.

· Class 2 concrete shall contain not less than 350 kg of cementitious material per cubic meter.

· Class 3 concrete shall contain not less than 300 kg of cementitious material per cubic meter.

· Class 4 concrete shall contain not less than 250 kg of cementitious material per cubic meter.

· Minor concrete shall contain not less than 325 kg of cementitious material per cubic meter unless otherwise specified in these specifications or the special provisions.

· Unless otherwise designated on the plans or specified in these specifications or the special provisions, the amount of cementitious material used per cubic meter of concrete in structures or portions of structures shall conform to the following:

Use	Cementitious Material Content (kg/m3)
Concrete designated by compressive strength:	
Deck slabs and slab spans of bridges	400 min., 475 max.
Roof sections of exposed top box culverts	400 min., 475 max.
Other portions of structures	350 min., 475 max.
Concrete not designated by compressive strength:	
Deck slabs and slab spans of bridges	400 min.
Roof sections of exposed top box culverts	400 min.
Prestressed members	400 min.
Seal courses	400 min.
Other portions of structures	350 min.
Concrete for precast members	350 min., 550 max.

· Whenever the 28-day compressive strength shown on the plans is greater than 25 MPa, the concrete shall be designated by compressive strength. If the plans show a 28-day compressive strength that is 28 MPa or greater, an additional 14 days will be allowed to obtain the specified strength. The 28-day compressive strengths shown on the plans that are 25 MPa or less are shown for design information only and are not a requirement for acceptance of the concrete.

· Concrete designated by compressive strength shall be proportioned such that the concrete will attain the strength shown on the plans or specified in the special provisions.

· Before using concrete for which the mix proportions have been determined by the Contractor, or in advance of revising those 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, mineral admixture 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 mineral admixture 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 $0.55 for each kilogram of cementitious material, portland cement, or mineral admixture 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 or commercial quality concrete.

90-2 MATERIALS

90-2.01 CEMENT

· Unless otherwise specified, cement shall be either "Type IP (MS) Modified" cement, "Type II Modified" portland cement or Type V portland cement.

· "Type IP (MS) Modified" cement shall conform to the requirements for Type IP (MS) cement in ASTM Designation: C 595, and shall be comprised of an intimate and uniform blend of Type II cement and not more than 35 percent by mass of mineral admixture. The type and minimum amount of mineral admixture used in the manufacture of "Type IP (MS) Modified" cement shall be in conformance with the provisions in Section 90-4.08, "Required Use of Mineral Admixtures."

· "Type II Modified" portland cement shall conform to the requirements for Type II portland cement in ASTM Designation: C 150.

· In addition, "Type IP (MS) Modified" cement and "Type II Modified" portland cement shall conform to the following requirements:

A. The cement shall not contain more than 0.60 percent by mass of alkalies, calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O, when determined by either direct intensity flame photometry or by the atomic absorption method. The instrument and procedure used shall be qualified as to precision and accuracy in conformance with the requirements in ASTM Designation: C 114;
B. The autoclave expansion shall not exceed 0.50 percent; and
C. Mortar, containing the cement to be used and Ottawa sand, when tested in conformance with California Test 527, shall not expand in water more than 0.010 percent and shall not contract in air more than 0.048 percent, except that when cement is to be used for precast prestressed concrete piling, precast prestressed concrete members, or steam cured concrete products, the mortar shall not contract in air more than 0.053 percent.

· Type III and Type V portland cements shall conform to the requirements in ASTM Designation: C 150 and the additional requirements listed above for "Type II Modified" portland cement, except that when tested in conformance with California Test 527, mortar containing Type III portland cement shall not contract in air more than 0.075 percent.

· Cement used in the manufacture of cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same cement mill.

· Cement shall be protected from exposure to moisture until used. Sacked cement shall be piled to permit access for tally, inspection, and identification of each shipment.

· Adequate facilities shall be provided to assure that cement meeting the provisions specified in this Section 90-2.01 shall be kept separate from other cement in order to prevent any but the specified cement from entering the work. Safe and suitable facilities for sampling cement shall be provided at the weigh hopper or in the feed line immediately in advance of the hopper, in conformance with California Test 125.

· If cement is used prior to sampling and testing as provided in Section 6-1.07, "Certificates of Compliance," and the cement is delivered directly to the site of the work, the Certificate of Compliance shall be signed by the cement manufacturer or supplier of the cement. If the cement 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.

· Cement furnished without a Certificate of Compliance shall not be used in the work until the Engineer has had sufficient time to make appropriate tests and has approved the cement for use.

90-2.02 AGGREGATES

· Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

· Natural aggregates shall be thoroughly and uniformly washed before use.

· The Contractor, at the Contractor's expense, 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 $4.60 per cubic meter for paving concrete and $7.20 per cubic meter 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 $4.60 per cubic meter for paving concrete and $7.20 per cubic meter 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 shall be 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 250 m^3 of concrete or one day's pour, whichever is smaller.

· Aggregates specified for freeze-thaw resistance shall pass the freezing and thawing test, California Test 528.

· The Contractor shall notify the Engineer of the proposed source of freeze-thaw resistant concrete aggregates at least 4 months before intended use. Should the Contractor later propose a different source of concrete aggregates, the Contractor shall again notify the Engineer at least 4 months before intended use. Blending of fine or coarse aggregates from untested sources with acceptable aggregates will not be permitted. Provisions for the time of submission of samples as provided in Section 40-1.015, "Cement Content," are superseded by the foregoing.

· Concurrently with notification of proposed sources of freeze-thaw resistant concrete aggregates, the Contractor shall furnish samples in the quantity ordered by the Engineer. The samples shall be secured under the direct supervision of the Engineer. Samples from existing stockpiles of processed aggregate shall be taken from washed materials and shall be visibly damp. Samples from materials in place in a material source shall be taken at depths from the existing surface that will ensure the presence of the full quantity of ground water. Excavations for the purpose of securing samples shall be made to the full depth of intended source operations. Samples shall be protected against loss of contained water until they are delivered to the Engineer.

· The Engineer will waive the above freeze-thaw test and the 4-month advance notice, required in this Section, provided aggregates are to be obtained from sources that have previously passed this test and test results are currently applicable.

· No extension of contract time will be allowed for the time required to perform the freezing and thawing test.

· When the source of an aggregate is changed, except for pavement concrete, the Contractor shall adjust the mix proportions and submit in writing to the Engineer a copy of the mix design before using the aggregates. When the source of an aggregate is changed for pavement concrete, the Engineer shall be allowed sufficient time to adjust the mix, and the aggregates shall not be used until necessary adjustments are made.

90-2.02A Coarse Aggregate

· Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, 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.

· 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:

1. coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested by California Test 227; and
2. 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]
Mortar Strengths Relative to Ottawa Sand	515	95%, min.
Sand Equivalent:		
Operating Range	217	75, min.
Contract Compliance	217	71, min.

a Fine aggregate developing a color darker than the reference standard color solution may be accepted if it is determined by the Engineer, from mortar strength tests, that a darker color is acceptable.

· 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:

1. 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
2. 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 1000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1300 parts per million of sulfates as SO_4, 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 1300 parts per million of sulfates as SO_4, when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either: 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, when compared to the results obtained with distilled water or deionized water, tested in conformance with the requirements in ASTM Designation: C 109.

· In non-reinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1500 parts per million of sulfates as SO_4, 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 ($Na_2O + 0.658\ K_2O$) 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 conform to the requirements in the following ASTM Designations:

A. Chemical Admixtures—ASTM Designation: C 494.
B. Air-entraining Admixtures—ASTM Designation: C 260.
C. Calcium Chloride—ASTM Designation: D 98.
D. Mineral Admixtures—Coal fly ash; raw or calcined natural pozzolan as specified in ASTM Designation: C618; silica fume conforming to the requirements in ASTM Designation: C1240, with reduction of mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.

· Unless otherwise specified in the special provisions, mineral admixtures shall be used in conformance with the provisions in Section 90-4.08, "Required Use of Mineral Admixtures."

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
37.5-mm x 19-mm	25-mm	19 - 41
25-mm x 4.75-mm	19-mm	52 - 85
25-mm x 4.75-mm	9.5-mm	15 - 38
12.5-mm x 4.75-mm	9.5-mm	40 - 78
9.5-mm x 2.36-mm	9.5-mm	50 - 85
Fine Aggregate	1.18-mm	55 - 75
Fine Aggregate	600-µm	34 - 46
Fine Aggregate	300-µm	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							
	37.5-mm x 19-mm		25-mm x 4.75-mm		12.5-mm x 4.75-mm		9.5-mm x 2.36-mm	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance
50-mm	100	100	—	—	—	—	—	—
37.5-mm	88-100	85-100	100	100	—	—	—	—
25-mm	x ± 18	X ± 25	88-100	86-100	—	—	—	—
19-mm	0-17	0-20	X ± 15	X ± 22	100	100	—	—
12.5-mm	—	—	—	—	82-100	80-100	100	100
9.5-mm	0-7	0-9	X ± 15	X ± 22	X ± 15	X ± 22	X ± 15	X ± 20
4.75-mm	—	—	0-16	0-18	0-15	0-18	0-25	0-28
2.36-mm	—	—	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 37.5-mm, 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 25-mm, 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 25-mm x 4.75-mm 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
9.5-mm	100	100
4.75-mm	95-100	93-100
2.36-mm	65-95	61-99
1.18-mm	X ± 10	X ± 13
600-µm	X ± 9	X ± 12
300-µm	X ± 6	X ± 9
150-µm	2-12	1-15
75-µm	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 1.18-mm sieve and the total percentage passing the 600-µm sieve shall be between 10 and 40, and the difference between the percentage passing the 600-µm and 300-µm 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. Within these limitations, the relative proportions shall be as ordered by the Engineer, except as otherwise provided in Section 90-1.01, "Description."

· The combined aggregate grading used in portland cement concrete pavement shall be the 37.5-mm, maximum grading.

· The combined aggregate grading used in concrete for structures and other concrete items, except when specified otherwise in these specifications or the special provisions, shall be either the 37.5-mm, maximum grading, or the 25-mm, maximum grading, at the option of the Contractor.

Grading Limits of Combined Aggregates

Sieve Sizes	Percentage Passing			
	37.5-mm Max.	25-mm Max.	12.5-mm Max.	9.5-mm Max.
50-mm	100	—	—	—
37.5-mm	90-100	100	—	—
25-mm	50-86	90-100	—	—
19-mm	45-75	55-100	100	—
12.5-mm	—	—	90-100	100
9.5-mm	38-55	45-75	55-86	50 - 100
4.75-mm	30-45	35-60	45-63	45 - 63
2.36-mm	23-38	27-45	35-49	35 - 49
1.18-mm	17-33	20-35	25-37	25 - 37
600-µm	10-22	12-25	15-25	15 - 25
300-µm	4-10	5-15	5-15	5 - 15
150-µm	1-6	1-8	1-8	1 - 8
75-µm	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 mass of admixture, as determined by California Test 415, shall not be used in prestressed or reinforced concrete.

· Calcium chloride shall not be used in concrete containing steel reinforcement or other embedded metals.

· Mineral admixture used in concrete for exposed surfaces of like elements of a structure shall be from the same source and of the same percentage.

· 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.

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.

· Admixture brands will be considered for addition to the approved list if the manufacturer of the admixture submits to the Transportation Laboratory a sample of the admixture accompanied by certified test results demonstrating that the admixture complies with the requirements in the appropriate ASTM Designation and these specifications. The sample shall be sufficient to permit performance of all required tests. Approval of admixture brands will be dependent upon a determination as to compliance with the requirements, based on the certified test results submitted, together with tests the Department may elect to perform.

· When 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.

· If a mineral admixture is delivered directly to the site of the work, the Certificate of Compliance shall be signed by the manufacturer or supplier of the mineral admixture. If the mineral admixture is used in ready-mix 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.

90-4.04 REQUIRED USE OF CHEMICAL ADMIXTURES AND CALCIUM CHLORIDE

· When the use of a chemical admixture or calcium chloride is specified or ordered by the Engineer, the admixture shall be used at the dosage specified or ordered, except that if no dosage is specified or ordered, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

· Calcium chloride shall be dispensed in liquid, flake, or pellet form. Calcium chloride dispensed in liquid form shall conform to the provisions for dispensing liquid admixtures in Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures."

90-4.05 OPTIONAL USE OF CHEMICAL ADMIXTURES

· The Contractor will be permitted to 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. When 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 mass, except that the resultant cementitious material content shall be not less than 300 kilograms per cubic meter; and
B. When a reduction in cementitious material content is made, the dosage of admixture used shall be the dosage used in determining approval of the admixture.

· 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 as provided in Section 40-1.015, "Cement Content."

90-4.08 REQUIRED USE OF MINERAL ADMIXTURES

· Unless otherwise specified, mineral admixture shall be combined with cement to make cementitious material.

· The calcium oxide content of mineral admixtures shall not exceed 10 percent and the available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 618.

· The amounts of cement and mineral admixture used in cementitious material shall be sufficient to satisfy the minimum cementitious material content requirements specified in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," and shall conform to the following:

A. The minimum amount of cement shall not be less than 75 percent by mass of the specified minimum cementitious material content;

B. The minimum amount of mineral admixture to be combined with cement shall be determined using one of the following criteria:

1. When the calcium oxide content of a mineral admixture is equal to or less than 2 percent by mass, the amount of mineral admixture shall not be less than 15 percent by mass of the total amount of cementitious material to be used in the mix;
   2. When the calcium oxide content of a mineral admixture is greater than 2 percent, the amount of mineral admixture shall not be less than 25 percent by mass of the total amount of cementitious material to be used in the mix;
   3. When a mineral admixture that conforms to the provisions for silica fume in Section 90-2.04, "Admixture Materials," is used, the amount of mineral admixture shall not be less than 10 percent by mass of the total amount of cementitious material to be used in the mix

C. The total amount of mineral admixture shall not exceed 35 percent by mass of the total amount of cementitious material to be used in the mix. Where Section 90-1.01, "Description," specifies a maximum cementitious content in kilograms per cubic meter, the total mass of cement and mineral admixture per cubic meter shall not exceed the specified maximum cementitious material content.

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.

· When automatic proportioning devices are required for concrete pavement, 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 2.5 L/m^3 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."

· Special admixtures, such as "high range" water reducers that may contribute to a high rate of slump loss, shall be measured and dispensed as recommended by the admixture manufacturer and as approved by the Engineer.

90-4.11 STORAGE, PROPORTIONING, AND DISPENSING OF MINERAL ADMIXTURES

· Mineral admixtures shall be protected from exposure to moisture until used. Sacked material shall be piled to permit access for tally, inspection and identification for each shipment.

· Adequate facilities shall be provided to assure that mineral admixtures meeting the specified requirements are kept separate from other mineral admixtures in order to prevent any but the specified mineral admixtures from entering the work. Safe and suitable facilities for sampling mineral admixtures shall be provided at the weigh hopper or in the feed line immediately in advance of the hopper.

· Mineral admixtures shall be incorporated into concrete using equipment conforming to the requirements for cement weigh hoppers, and charging and discharging mechanisms in ASTM Designation: C 94, in Section 90-5.03, "Proportioning," and in this Section 90-4.11.

· When concrete is completely mixed in stationary paving mixers, the mineral admixture shall be weighed in a separate weigh hopper conforming to the provisions for cement weigh hoppers and charging and discharging mechanisms in Section 90-5.03A, "Proportioning for Pavement," and the mineral admixture and cement shall be introduced simultaneously into the mixer proportionately with the aggregate. If the mineral admixture is not weighed in a separate weigh hopper, the Contractor shall provide certification that the stationary mixer is capable of mixing the cement, admixture, aggregates and water uniformly prior to discharge. 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 paving 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 paving 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 prior to discharge that are required to produce a mix that meets the requirements above.

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 also that the various sizes shall not become intermixed before proportioning.

· Aggregates shall be stored or stockpiled and handled in a manner that shall 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, "Proportioning for Pavement." Automatic devices shall be automatic to the extent that the only manual operation required for proportioning the aggregates, cement, and mineral admixture for one batch of concrete is a single operation of a switch or starter.

· Proportioning devices shall be tested at the expense of the Contractor 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 mass of each batch of material shall not vary from the mass 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 mass 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 mass designated for each size of aggregate. Equipment for cumulative weighing of cement and mineral admixtures shall have a zero tolerance of ±0.5 percent of the designated total batch mass of the cement and mineral admixture. Equipment for weighing cement or mineral admixture separately shall have a zero tolerance of ±0.5 percent of their designated individual batch masses. Equipment for measuring water shall have a zero tolerance of ±0.5 percent of its designated mass or volume.

· The mass 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 mass of the aggregate. Aggregates weighed individually shall be within 1.5 percent of their respective designated batch masses; and
B. Cement shall be within 1.0 percent of its designated batch mass. When weighed individually, mineral admixture shall be within 1.0 percent of its designated batch mass. When mineral admixture and cement are permitted to be weighed cumulatively, cement shall be weighed first to within 1.0 percent of its designated batch mass, and the total for cement and mineral admixture shall be within 1.0 percent of the sum of their designated batch masses; and
C. Water shall be within 1.5 percent of its designated mass or volume.

· Each scale graduation shall be approximately 0.001 of the total capacity of the scale. The capacity of scales for weighing cement, mineral admixture, or cement plus mineral admixture and aggregates shall not exceed that of commercially available scales having single graduations indicating a mass not exceeding the maximum permissible mass variation above, except that no scale shall be required having a capacity of less than 500 kg, with 0.5-kg 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 cement, mineral admixture, and water as provided in these specifications. Aggregates shall be proportioned by mass.

· 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 mass.

· 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) Modified" 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 mineral admixture 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 mineral admixture are weighed cumulatively, the cement shall be weighed first.

· When cement and mineral admixtures are weighed in separate weigh hoppers**,** the weigh systems for the proportioning of the aggregate, the cement, and the mineral admixture 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 mineral admixture shall be discharged into the mixer simultaneously with the aggregate.

· The scales and weigh hoppers for bulk weighing cement, mineral admixture, or cement plus mineral admixture shall be separate and distinct from the aggregate weighing equipment.

· For batches with a volume of one cubic meter 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 masses, the gross mass and tare mass 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 at the Contractor’s expense on scales designated by the Engineer.

90-5.03A Proportioning for Pavement

· Aggregates and bulk cement, mineral admixture, and cement plus mineral admixture for use in pavement shall be proportioned by mass by means of automatic proportioning devices of approved type conforming to these specifications.

· 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 mass of the fine aggregate.

· The batching of cement, mineral admixture, or cement plus mineral admixture 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 mineral admixture hoppers or the cement plus mineral admixture hopper are charged with masses that are within the tolerances specified in Section 90-5.02, "Proportioning Devices."

· When interlocks are required for cement and mineral admixture charging mechanisms and cement and mineral admixtures are weighed cumulatively, their charging mechanisms shall be interlocked to prevent the introduction of mineral admixture until the mass of cement in the cement weigh hopper is within the tolerances specified in Section 90-5.02, "Proportioning Devices."

· The discharge gate on the cement and mineral admixture hoppers or the cement plus mineral admixture hopper shall be designed to permit regulating the flow of cement, mineral admixture, or cement plus mineral admixture into the aggregate as directed by the Engineer.

· When 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.

· When the discharge from the several bins is controlled by gates, each gate shall be actuated automatically so that the required mass 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 0.25 m^3 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 cement, mineral admixture, or cement plus mineral admixture.

· 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 10 mm. 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 100 kg per cubic meter of concrete.

Average Slump	Maximum Permissible Difference
Less than 100-mm	25-mm
100-mm to 150-mm	38-mm
Greater than 150-mm to 225-mm	50-mm

· The Contractor, at the Contractor's expense, 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 10°C or more than 32°C. 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 65°C. 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.

· 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.

· Paving and 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 jobsite 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 jobsite 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 non-agitating 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).
D. Mixed completely in a paving mixer.

· 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 shall 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 non-agitating 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 24°C.

· No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point, unless authorized by the Engineer. If the Engineer authorizes additional water to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.

· The rate of discharge of mixed concrete from truck mixer-agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

· When 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 cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 30°C or above, the time allowed may be less than 1.5 hours.

· When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 30°C or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

· Each load of concrete delivered at the jobsite shall be accompanied by a weighmaster certificate showing the mix identification number, non-repeating 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 masses (kilograms) for the ingredients batched. Theoretical or target batch masses shall not be used as a substitute for actual scale masses.

· 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 90 mm diskette with a capacity of at least 1.4 megabytes. 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 masses or measurements for a load of concrete provided that both certificates are imprinted with the same non-repeating 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 paving or 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 paving or 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 paving or 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."

90-6.05 HAND-MIXING

· Hand-mixed concrete shall be made in batches of not more than 0.25 m^3 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 0.3 meters in total depth. On this mixture shall be spread the dry cement and mineral admixture 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. When Type F or Type G chemical admixtures are added to the mix, the penetration requirements shall not apply and the slump shall not exceed 225 mm after the chemical admixtures are added.

Type of Work	Nominal		Maximum	
	Penetration (mm)	Slump (mm)	Penetration (mm)	Slump (mm)
Concrete Pavement	0-25	—	40	—
Non-reinforced concrete facilities	0-35	—	50	—
Reinforced concrete structures				
Sections over 300-mm thick	0-35	—	65	—
Sections 300-mm thick or less	0-50	—	75	—
Concrete placed under water	—	150-200	—	225
Cast-in-place concrete piles	65-90	130-180	100	200

· The amount of free water used in concrete shall not exceed 183 kg/m^3, plus 20 kg for each required 100 kg of cementitious material in excess of 325 kg/m^3.· 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.

· Where 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 meter of concrete. The increase in water and cementitious material shall be at a ratio not to exceed 30 kg of water per added 100 kg of cementitious material per cubic meter. The cost of additional cementitious material and water added under these conditions shall be at the Contractor's expense 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.

· When a curing medium consisting of cotton mats, rugs, carpets, 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 mediums.

· 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 in the preceding paragraph, 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. Non-pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class B.
5. Non-pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class A.

6. Non-pigmented 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 0.15-kg/m^2 in 24 hours or more than 0.45-kg/m^2 in 72 hours.

· The curing compound to be used will be specified elsewhere in these specifications or in the special provisions.

· When 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 3.7 m^2/L, unless otherwise specified.

· At any point, the application rate shall be within ±1.2 m^2/L of the nominal rate specified, and the average application rate shall be within ±0.5 m^2/L 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 4°C and shall not be diluted or altered after manufacture.

· The curing compound shall be packaged in clean 210-L barrels or round 19-L containers or 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 210-L barrels shall have removable lids and airtight fasteners. The 19-L containers shall be round and have standard full open head and bail. Lids with bungholes shall not be permitted. 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 of California.

· 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 of California.

· 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 or at the jobsite 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 100 mm.

· 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 0.5-m 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 CURING PAVEMENT

· The entire exposed area of the pavement, including edges, shall be cured by the waterproof membrane method, or curing compound method using curing compound (1) or (2) as the Contractor may elect. Should the side forms be removed before the expiration of 72 hours following the start of curing, the exposed pavement edges shall also be cured. If the pavement is cured by means of the curing compound method, the sawcut and all portions of the curing compound that have been disturbed by sawing operations shall be restored by spraying with additional curing compound.

· Curing shall commence as soon as the finishing process provided in Section 40-1.10, "Final Finishing," has been completed. The method selected shall conform to the provisions in Section 90-7.01, "Methods of Curing."

· When the curing compound method is used, the compound shall be applied to the entire pavement surface by mechanical sprayers. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator that provides for continual agitation of the curing compound during the time of application. The spray shall be adequately protected against wind, and the nozzles shall be so oriented or moved mechanically transversely as to result in the minimum specified rate of coverage being applied uniformly on exposed faces. Hand spraying of small and irregular areas, and areas inaccessible to mechanical spraying equipment, in the opinion of the Engineer, will be permitted. When the ambient air temperature is above 15°C, the Contractor shall fog the surface of the concrete with a fine spray of water as specified in Section 90-7.01A, "Water Method." The surface of the pavement shall be kept moist between the hours of 10:00 a.m. and 4:30 p.m. on the day the concrete is placed. However, the fogging done after the curing compound has been applied shall not begin until the compound has set sufficiently to prevent displacement. Fogging shall be discontinued if ordered in writing by the Engineer.

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). The curing compound shall be applied progressively during the deck finishing operations immediately after finishing operations are completed on each individual portion of the deck. The water cure shall be applied not later than 4 hours after completion of deck finishing or, for portions of the decks on which finishing is completed after normal working hours, the water cure shall be applied not later than the following morning.

· 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 10°C, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 10°C and 32°C.
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 22°C per hour. The curing temperature throughout the enclosure shall not exceed 65°C 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 60 m 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 15°C 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 with a class designation ending in C (corrosion resistant) 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," or 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, or 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, or 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.

· 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 7°C for 72 hours after placing and at not less than 4°C for an additional 4 days. When required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.

90-8.03 PROTECTING CONCRETE PAVEMENT

· Pavement concrete shall be maintained at a temperature of not less than 4°C for 72 hours. When required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.

· Except as provided in Section 7-1.08, "Public Convenience," the Contractor shall protect concrete pavement against construction and other activities that abrade, scar, discolor, reduce texture depth, lower coefficient of friction, or otherwise damage the surface. Stockpiling, drifting, or excessive spillage of soil, gravel, petroleum products, and concrete or asphalt mixes on the surface of concrete pavement is prohibited unless otherwise specified in these specifications, the special provisions or permitted by the Engineer.

· When ordered by the Engineer or shown on the plans or specified in the special provisions, pavement crossings shall be constructed for the convenience of public traffic. The material and work necessary for the construction of the crossings, and their subsequent removal and disposal, will be paid for at the contract unit prices for the items of work involved and if there are no contract items for the work involved, payment for pavement crossings will be made by extra work as provided in Section 4-1.03D, "Extra Work.". Where public traffic will be required to cross over the new pavement, Type III portland cement may be used in concrete, if permitted in writing by the Engineer. The pavement may be opened to traffic as soon as the concrete has developed a modulus of rupture of 3.8 MPa. The modulus of rupture will be determined by California Test 523.

· No traffic or Contractor's equipment, except as hereinafter provided, will be permitted on the pavement before a period of 10 days has elapsed after the concrete has been placed, nor before the concrete has developed a modulus of rupture

of at least 3.8 MPa. Concrete that fails to attain a modulus of rupture of 3.8 MPa within 10 days shall not be opened to traffic until directed by the Engineer.

· Equipment for sawing weakened plane joints will be permitted on the pavement as specified in Section 40-1.08B, "Weakened Plane Joints."

· When requested in writing by the Contractor, the tracks on one side of paving equipment will be permitted on the pavement after a modulus of rupture of 2.4 MPa has been attained, provided that:

A. Unit pressure exerted on the pavement by the paver shall not exceed 135 kPa;
B. Tracks with cleats, grousers, or similar protuberances shall be modified or shall travel on planks or equivalent protective material, so that the pavement is not damaged; and
C. No part of the track shall be closer than 0.3-m from the edge of pavement.

· In case of visible cracking of, or other damage to the pavement, operation of the paving equipment on the pavement shall be immediately discontinued.

· Damage to the pavement resulting from early use of pavement by the Contractor's equipment as provided above shall be repaired by the Contractor at the Contractor's expense.

· The State will furnish the molds and machines for testing the concrete for modulus of rupture, and the Contractor, at the Contractor's expense, shall furnish the material and whatever labor the Engineer may require.

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 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 ASTM Designation: C 172. 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 ASTM Designation: C 39. 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 28-day 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, at the Contractor’s expense, 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 $14 for each in-place cubic meter 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 $20 for each in place cubic meter 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 curing 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 curing 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 and quality of the concrete placed in the work are acceptable. 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 250 m^3.

· When 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. When 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 is specified by compressive strength, 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 cure 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 4 MPa 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 meters and the mass, type, and source of all ingredients used.
D. Penetration 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 or class 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.

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."

90-10.02B Aggregate

· Aggregate shall be clean and free from deleterious coatings, clay balls, roots, and other extraneous materials.

· 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 37.5 mm or smaller than 19 mm.

· 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 authorized 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 32°C 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.

· 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 4°C 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.

· When it is provided that concrete will be measured at the mixer, the volume in cubic meters shall be computed as the total mass of the batch in kilograms divided by the density of the concrete in kilograms per cubic meter. The total mass 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.

· Full compensation for furnishing and incorporating admixtures required by these specifications or the special provisions will be considered as included in the contract prices paid for the concrete involved and no additional compensation will be allowed therefor.

· Should the Engineer order the Contractor to incorporate any admixtures in the concrete when their use is not required by these specifications or the special provisions, furnishing the admixtures and adding them to the concrete will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

· Should the Contractor use admixtures in conformance with the provisions in Section 90-4.05, "Optional Use of Chemical Admixtures," or Section 90-4.07, "Optional Use of Air-entraining Admixtures," or should the Contractor request and obtain permission to use other admixtures for the Contractor’s benefit, the Contractor shall furnish those admixtures and incorporate them into the concrete at the Contractor’s expense and no additional compensation will be allowed therefor.

SECTION 12. BUILDING WORK

SECTION 12-1. GENERAL REQUIREMENTS

12-1.01 SCOPE

Building work described herein and as shown on the plans shall conform to the requirements of these special provisions and Sections 1 through 9 of the Standard Specifications. Sections 10 through 95 of the Standard Specifications shall not apply to the work in this Section 12 except when specific reference is made thereto.

The building work to be done consists, in general, of constructing a 133 m^2 electrical substation with cast-in-place concrete slab, concrete walls, and concrete roof; including related mechanical and electrical work; and such other items or details, not mentioned above, that are required by the plans, Standard Specifications, or these special provisions shall be performed, placed, constructed or installed.

12-1.02 ABBREVIATIONS

Section 1-1.02, "Abbreviations," of the Standard Specifications is amended by adding the following:

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	American Plywood Association
ARI	American Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
CBC	California Building Code
CEC	California Electrical Code
CMC	California Mechanical Code
CS	Commercial Standards (US Department of Commerce)
ESO	Electrical Safety Orders
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
FS	Federal Specification
ICBO	International Conference of Building Officials
NAAMM	National Association of Architectural Metal Manufacturers
NBFU	National Board Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
PEI	Porcelain Enamel Institute
PS	Product Standard (US Department of Commerce)
RIS	Redwood Inspection Service
SCPI	Structural Clay Products Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSPC	Steel Structures Paint Council
TCA	Tile Council of America
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau (stamped WCLB)
WCLB	Grade stamp for WCLIB
WIC	Woodwork Institute of California
WWPA	Western Wood Products' Association

When reference is made to the Uniform Building Code (UBC) on the plans or in the special provisions, it shall be the 1997 Uniform Building Code as amended by the 1998 Title 24 California Building Standards Code.

12-1.03 GUARANTEE

The Contractor hereby unconditionally guarantees that the building work will be done in accordance with the requirements of the contract, and further guarantees the building work of the contract to be and remain free of defects in workmanship and materials for a period of one year from the date of acceptance of the contract, unless a longer guarantee period is required elsewhere in these special provisions. The Contractor hereby agrees to repair or replace any and all building work, together with any other adjacent work which may be displaced in so doing, that may prove to be not in accordance with the requirements of the contract or that may be defective in its workmanship or material within the guarantee period specified, without any expense whatsoever to the Department, ordinary wear and tear and unusual abuse or neglect excepted.

The performance bond for the contract price of the building work, shall remain in full force and effect during the guarantee period.

The Contractor further agrees, that within 10 calendar days after being notified in writing by the Department of any building work not in accordance with the requirements of the contract or any defects in the building work, he shall commence and prosecute with due diligence all work necessary to fulfill the terms of this guarantee, and shall complete the work within a reasonable period of time, and, in the event he fails to comply, he does hereby authorize the Department to proceed to have

such work done at the Contractor's expense and he shall honor and pay the cost and charges therefor upon demand. The Department shall be entitled to all costs and expenses, including reasonable attorney's fees, necessarily incurred upon the Contractor's refusal to honor and pay the above costs and charges.

12-1.04 AREAS FOR CONTRACTOR'S USE

No area is available within the contract limits for the exclusive use of the Contractor. The Contractor shall arrange with the Engineer for areas to store equipment and materials within the work area.

12-1.05 COOPERATION

Attention is directed to Sections 7-1.14, "Cooperation," and 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications and these special provisions.

12-1.06 SUBMITTALS

Working drawings, material lists, descriptive data, samples and other submittals specified in these special provisions shall be submitted for approval in accordance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications and these special provisions.

Unless otherwise permitted in writing by the Engineer, all submittals required by these special provisions shall be submitted within 35 days after the contract has been approved.

Attention is directed to the provisions in Section 5-1.01, "Authority of Engineer," of the Standard Specifications. The Engineer may request submittals for materials or products where submittals have not been specified in these special provisions, or may request that additional information be included in specified submittals, as necessary to determine the quality or acceptability of such materials or products.

Attention is directed to Section 6-1.05, "Trade Names and Alternatives," of the Standard Specifications. The second indented paragraph of the first paragraph of said Section 6-1.05 is amended to read:

> Whenever the specifications permit the substitution of a similar or equivalent material or article, no test or action relating to the approval of such substituted material will be made until the request for substitution is made in writing by the Contractor accompanied by complete data as to the equality of the material or article proposed. Such request shall be made within 35 days after the date the contract has been approved and in ample time to permit approval without delaying the work, but need not be made in less than 35 days after award of the contract.

Work requiring the submittal of working drawings, material lists, descriptive data, samples, or other submittals shall not begin prior to approval of said submittal by the Engineer. Fifteen working days shall be allowed for approval or return for correction of each submittal or resubmittal. Should the Engineer fail to complete his review within the time specified 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, 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.

Submittals shall be delivered to the locations indicated in these special provisions. If a specific location is not indicated, the submittal shall be delivered to the Division of Structure Design, Documents Unit, Fourth Floor, Mail Station 9-4/4I, 1801 30th Street, Sacramento, California 95816, telephone (916) 227-8252, or the submittals shall be mailed to the Division of Structure Design, Documents Unit, Mail Station 9-4/4I, P. O. Box 942874, Sacramento, California 94274-0001.

Each submission of drawings, material lists and descriptive data shall consist of at least 5 copies. Two copies will be returned to the Contractor either approved for use or returned for correction and resubmittal.

Each separate item submitted shall bear a descriptive title, the name of the project, district, county, and contract number. Plans and detailed drawings shall be not larger than 559 mm x 914 mm.

The material list shall be complete as to name of manufacturer, catalog number, size, capacity, finish, all pertinent ratings, and identification symbols used on the plans and in the special provisions for each unit.

Parts lists and service instructions packaged with or accompanying the equipment installed in the work shall be delivered to the Engineer at the jobsite. Required operating and maintenance instructions shall be submitted in triplicate.

Manufacturer's warranties for products installed in the work shall be delivered to the Engineer at the jobsite.

Unapproved samples and samples not incorporated in the work shall be removed from State property, when directed by the Engineer.

12-1.07 PROGRESS SCHEDULE

A progress schedule shall be submitted in duplicate for the building work in accordance with the requirements in Section 8-1.04, "Progress Schedule," of the Standard Specifications.

12-1.08 SCHEDULE OF VALUES

The Contractor shall prepare and submit to the Engineer 2 copies of a Schedule of Values covering each lump sum item for building work. The Schedule of Values, showing the value of each kind of work, shall be acceptable to the Engineer before any partial payment estimate is prepared.

The sum of the items listed in the Schedule of Values shall equal the contract lump sum price for building work. Overhead and profit shall not be listed. Bond premium, temporary construction facilities, plant, and other such items will not be paid for under the various building work items and shall be included in the mobilization bid item for the entire project.

12-1.09 INSPECTION

All items covered or all stages of work that are not to remain observable must be inspected and approved before progress of work conceals portions to be inspected. The Contractor shall notify the Engineer not less than 72 hours in advance of when such inspection is needed.

12-1.10 OBSTRUCTIONS

Attention is directed to Sections 7-1.11, "Preservation of Property," 7-1.12, "Responsibility for Damage," 7-1.16, "Contractor's Responsibility for the Work and Materials," and 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications.

The Contractor shall notify the Engineer and the appropriate regional notification center for operators of subsurface installations at least 5 working days prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire or other structure. Regional notification centers include but are not limited to the following:

Underground Service Alert
Northern California (USA)
Telephone: 1(800)642-2444

Underground Service Alert
Southern California (USA)
Telephone: 1(800)422-4133

South Shore Utility
Coordinating Council (DIGS)
Telephone: 1(800)541-3447

Western Utilities
Underground Alert, Inc.
Telephone: 1(800)424-3447

12-1.11 PRESERVATION OF PROPERTY

Attention is directed to Sections 7-1.11, "Preservation of Property," 7-1.12, "Responsibility for Damage," 7-1.16, "Contractor's Responsibility for the Work and Materials," and 8-1.10, "Utility and Non-Highway Facilities," of the Standard Specifications.

Operations shall be conducted in such a manner that existing facilities, surfacing, installations, and utilities which are to remain in place will not be damaged. Temporary surfacing, facilities, utilities and installations shall also be protected until they are no longer required. The Contractor, at his expense shall furnish and install piling, sheet piling, cribbing, bulkheads, shores, or whatever means may be necessary to adequately support material carrying such facilities, or to support the facilities themselves and shall maintain such support until they are no longer needed.

12-1.12 REFERENCES

When reference is made to the Uniform Building Code (UBC) on the plans or in the special provisions, it shall be the 1997 Uniform Building Code as amended by the 1998 Title 24 California Building Standards Code.

12-1.13 MEASUREMENT AND PAYMENT

The contract lump sum price paid for building work shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing 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, which are necessary to complete the buildings and appurtenances shall be considered as included in the contract lump sum price paid for building work and no additional compensation will be allowed therefor.

12-1.14 SUBSTITUTION OF NON-METRIC MATERIALS AND PRODUCTS

Only materials and products conforming to the requirements of the specifications shall be incorporated in the work. When metric materials and products are not available, and when approved by the Engineer, and at no cost to the State, materials and products in the inch-pound (imperial) system which are of equal quality and of the required properties and characteristics for the purpose intended, may be substituted for the equivalent metric materials and products, subject to the following requirements:

Materials and products shown on the plans or in the special provisions as being equivalent may be substituted for the metric materials and products specified or detailed on the plans.

Before other non-metric materials and products will be considered for use the Contractor shall furnish, at the Contractor's expense, evidence satisfactory to the Engineer that the materials and products proposed for use are equal to or better than the materials and products specified or detailed on the plans. The burden of proof as to the quality and suitability of substitutions shall be upon the Contractor and the Contractor shall furnish all information necessary as required to the Engineer. The Engineer will be the sole judge as to the quality and suitability of the substituted materials and products and the Engineer's decision shall be final.

When the Contractor elects to substitute non-metric materials and products, including materials and products shown on the plans or in the special provisions as being equivalent, a list of substitutions to be made shall be submitted for approval.

The following substitutions of materials and products will be allowed:

SUBSTITUTION TABLE FOR SIZES OF HIGH STRENGTH STEEL FASTENERS, ASTM Designation: A 325M	
METRIC SIZE SHOWN ON THE PLANS mm x thread pitch	IMPERIAL SIZE TO BE SUBSTITUTED inch
M16 x 2	5/8
M20 x 2.5	3/4
M22 x 2.5	7/8
M24 x 3	1
M27 x 3	1-1/8
M30 x 3.5	1-1/4
M36 x 4	1-1/2

SUBSTITUTION TABLE FOR REINFORCEMENT	
METRIC BAR DESIGNATION NUMBER AS SHOWN ON THE PLANS	IMPERIAL BAR DESIGNATION NUMBER TO BE SUBSTITUTED
10	3
13	4
16	5
19	6
22	7
25	8
29	9
32	10
36	11
43	14
57	18

SUBSTITUTION TABLE FOR WELDED PLAIN WIRE REINFORCEMENT, ASTM DESIGNATION: A 185	
	US CUSTOMARY UNITS SIZE TO BE SUBSTITUTED $inch^2$ x 100
MW9	W1.4
MW10	W1.6
MW13	W2.0
MW15	W2.3
MW19	W2.9
MW20	W3.1
MW22	W3.5
MW25	W3.9, except W3.5 in piles only
MW26	W4.0
MW30	W4.7
MW32	W5.0
MW35	W5.4
MW40	W6.2
MW45	W6.5
MW50	W7.8
MW55	W8.5, except W8.0 in piles only
MW60	W9.3
MW70	W10.9, except W11.0 in piles only
MW80	W12.4
MW90	W14.0
MW100	W15.5

The sizes in the following tables of materials and products are exact conversions of metric sizes of materials and products and are listed as acceptable equivalents:

CONVERSION TABLE FOR SIZES OF: (1) STEEL FASTENERS FOR GENERAL APPLICATIONS, ASTM Designation: A 307 or AASHTO Designation: M 314, Grade 36 or 55, and (2) HIGH STRENGTH STEEL FASTENERS, ASTM Designation: A 325 or A 449	
DIAMETER	
METRIC SIZE SHOWN ON THE PLANS mm	EQUIVALENT IMPERIAL SIZE inch
6, or 6.35	1/4
8 or 7.94	5/16
10, or 9.52	3/8
11, or 11.11	7/16
13 or 12.70	1/2
14, or 14.29	9/16
16, or 15.88	5/8
19,or 19.05	3/4
22, or 22.22	7/8
24, 25, or 25.40	1
29, or 28.58	1-1/8
32, or 31.75	1-1/4
35, or 34.93	1-3/8
38 or 38.10	1-1/2
44, or 44.45	1-3/4
51, or 50.80	2
57, or 57.15	2-1/4
64, or 63.50	2-1/2
70 or 69.85	2-3/4
76, or 76.20	3
83, or 82.55	3-1/4
89 or 88.90	3-1/2
95, or 95.25	3-3/4
102, or 101.60	4

CONVERSION TABLE FOR NOMINAL THICKNESS OF SHEET METAL			
UNCOATED HOT AND COLD ROLLED SHEETS		HOT-DIPPED ZINC COATED (GALVANIZED) SHEETS	
METRIC THICK-NESS SHOWN ON THE PLANS mm	EQUIVA-LENT US STAND-ARD GAGE inch	METRIC THICK-NESS SHOWN ON THE PLANS mm	EQUIVA-LENT GALVAN-IZED SHEET GAGE inch
7.94	0.3125		
6.07	0.2391		
5.69	0.2242		
5.31	0.2092		
4.94	0.1943		
4.55	0.1793		
4.18	0.1644	4.270	0.1681
3.80	0.1495	3.891	0.1532
3.42	0.1345	3.510	0.1382
3.04	0.1196	3.132	0.1233
2.66	0.1046	2.753	0.1084
2.28	0.0897	2.372	0.0934
1.90	0.0747	1.994	0.0785
1.71	0.0673	1.803	0.0710
1.52	0.0598	1.613	0.0635
1.37	0.0538	1.461	0.0575
1.21	0.0478	1.311	0.0516
1.06	0.0418	1.158	0.0456
0.91	0.0359	1.006 or 1.016	0.0396
0.84	0.0329	0.930	0.0366
0.76	0.0299	0.853	0.0336
0.68	0.0269	0.777	0.0306
0.61	0.0239	0.701	0.0276
0.53	0.0209	0.627	0.0247
0.45	0.0179	0.551	0.0217
0.42	0.0164	0.513	0.0202
0.38	0.0149	0.475	0.0187

CONVERSION TABLE FOR WIRE		
METRIC THICKNESS SHOWN ON THE PLANS mm	EQUIVALENT USA STEEL WIRE THICKNESS inch	GAGE NO.
6.20	0.244	3
5.72	0.225	4
5.26	0.207	5
4.88	0.192	6
4.50	0.177	7
4.11	0.162	8
3.76	0.148	9
3.43	0.135	10
3.05	0.120	11
2.69	0.106	12
2.34	0.092	13
2.03	0.080	14
1.83	0.072	15
1.57	0.062	16
1.37	0.054	17
1.22	0.048	18
1.04	0.041	19
0.89	0.035	20

CONVERSION TABLE FOR COMMON NAILS				
NAIL SIZE	METRIC mm		ENGLISH inch	
	Length	Diameter	Length	Diameter
8d	63.5	3.33	2 1/2	0.131
10d	76.2	3.76	3	0.148
16d	88.9	4.11	3 1/2	0.162

CONVERSION TABLE FOR LUMBER	
METRIC NOMINAL SURFACE DRY SIZE mm	EQUIVALENT NOMINAL SURFACE DRY U S SIZE inch
51	2
102	4
152	6
203	8
254	10
305	12

CONVERSION TABLE FOR PLYWOOD	
METRIC mm	ENGLISH inch
6.4	1/4
7.9	5/16
9.5	3/8
11.1	7/16
11.9	15/32
12.7	1/2
15.1	19/32
15.9	5/8
18.3	23/32
19.1	3/4
22.2	7/8
25.4	1
28.6	1 1/8

CONVERSION TABLE FOR INSULATION R-VALUE	
METRIC (K m^2/W)	ENGLISH (HR FT^2 F/BTU)
0.5	3
0.7	4
1.4	8
1.9	11
2.3	13
2.5	14
3.3	19
5.3	30

CONVERSION TABLE FOR VAPOR TRANSMISSION RATING	
METRIC (Perm-m)	ENGLISH (perm-inch)
0.29	0.02

CONVERSION TABLE FOR LOW PRESSURE	
METRIC (Pa)	ENGLISH (Inches of Water Column)
30	0.125
60	0.25
90	0.375
120	0.50
150	0.60
155	0.625
175	0.70
185	0.75
200	0.80
250	1.00
310	1.25

CONVERSION TABLE FOR PRESSURE	
METRIC (kPa)	ENGLISH (psi)
10	1.5
210	30
280	40
350	50
690	100
860	125
1040	150
1100	160
1210	175
1380	200
1730	250
2070	300
2170	315
2410	350
2590	375
2760	400
4830	700
5170	750
5520	800
13800	2000
17200	2500
20700	3000
27600	4000
34500	5000
137900	20000

CONVERSION TABLE FOR MIL THICKNESS	
METRIC (mm)	ENGLISH (inch/1000)
0.10	4
0.13	5
0.15	6
0.50	20
0.75	30
1.00	40

CONVERSION TABLE FOR HVAC DUCTING.	
METRIC (mm)	ENGLISH (inch)
100	4
125	5
150	6
175	7
200	8
225	9
250	10
300	12
360	14
410	16
460	18
510	20
560	22
610	24
660	26
710	28
760	30

CONVERSION TABLE FOR MECHANICAL PIPING		
METRIC (GSP, PVC, BSP, DUCTILE IRON)	METRIC (mm)	ENGLISH (inch)
NPS 1/2	15	1/2
NPS 3/4	20	3/4
NPS 1	25	1
NPS 1 1/4	32	1 1/4
NPS 1 1/2	40	1 1/2
NPS 2	50	2
NPS 2 1/2	65	2 1/2
NPS 3	75	3
NPS 4	100	4
NPS 6	150	6

CONVERSION TABLE FOR LUBRICATION PIPING TUBING WALL THICKNESS	
METRIC (mm)	ENGLISH (inch)
2.1	0.083
0.9	0.035

CONVERSION TABLE FOR HOSE/TUBING SIZES O. D.	
METRIC (mm)	ENGLISH (inch)
6	1/4
10	3/8
13	1/2
16	5/8
19	3/4
22	7/8
25	1

CONVERSION TABLE FOR DRUM SIZES			
METRIC		ENGLISH	
L	kg	gallons	pounds
205	180	55	400
60	55	16	120
19	16	5	35

CONVERSION TABLE FOR POWER	
METRIC (kW)	ENGLISH (HP)
0.037	1/20
0.075	1/10
0.18	1/4
0.25	1/3
0.37	1/2
0.55	3/4
0.75	1
1.1	1 1/2
1.5	2
2.2	3
3.7	5
5.5	7 1/2
7.5	10
11	15
15	20
18.5	25
22	30
30	40
37	50
45	60
55	75
75	100
90	120
110	150

CONVERSION TABLE FOR IMPELLER BALANCE		
SYNCHRONOUS RPM	METRIC (g mm/kg)	ENGLISH (ounce-inch/pound)
720	94	0.059
900	73	0.046
1200	54	0.034
1800	41	0.026
3600	17	0.011

CONVERSION TABLE FOR ELECTRICAL CONDUIT	
METRIC SIZE SHOWN ON THE PLANS mm	EQUIVALENT IMPERIAL SIZE inch
16	1/2
21	3/4
27	1
35	1 1/4
41	1 1/2
53	2
103	4

SECTION 12-2. SITEWORK

12-2.01 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, slabs, and trenches. Structure backfill shall include backfilling under slabs; backfilling under and around footings; backfilling for conduits. 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.

QUALITY ASSURANCE.--

Samples.--Samples of sand weighing not less than 11 kg, shall be submitted to the Engineer at the jobsite for approval.

SITE CONDITIONS.--

Existing surfaced areas.--Existing surfaced 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 6 mm sieve, 90 percent to 100 percent passes the 4.75 mm sieve and not more than 5 percent passes the 75 µm sieve size.

PART 3.- EXECUTION

STRUCTURE EXCAVATION.--

General.--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 ±12 mm. 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.

Excavation for conduits.--Conduits shall have not less than 0.75 meter of cover from top of 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 100 mm of compacted sand under all pipes and conduits.

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.--

General.--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 150 mm 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.

Unless approved in writing by the Engineer, compaction of structure or select backfill by jetting or ponding will not be permitted.

Backfilling conduits.--Backfill placed under conduits shall be compacted sand, 100 mm minimum depth. Backfill material placed to a level 150 mm above tops of conduits shall be sand. Backfill material placed higher than 150 mm above tops of pipes or conduits shall consist of material free of stones or lumps exceeding 100 mm in greatest dimension.

COMPACTION.--

General.--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.

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 150 mm.

Subgrade preparation.--Preparation of subgrade material for placing slabs thereon shall include fine grading, compaction, reworking as necessary. The upper 150 mm 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.

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.

12-2.02 FREE DRAINING GRANULAR MATERIAL

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and placing free draining granular material beneath slabs in accordance with the details shown on the plans and these special provisions.

PART 2.- PRODUCTS

Free draining granular material.--

Free draining granular material shall be clean, hard, durable, free-draining rock. The material gradation shall be such that all passes the 25 mm screen, and not more than 10 percent passes the 4.75 mm sieve as determined by California Test 202. Granular material shall be free from organic material, clay balls or other deleterious substances.

PART 3.- EXECUTION.--

SPREADING AND CONSOLIDATING.--

General.--Free draining granular material shall be placed, spread and consolidated by tamping or vibrating.

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.

SUBMITTALS.--

Product data.--Manufacturer's descriptive data for admixtures and hardener shall be submitted for approval. Descriptive data shall be delivered to the Engineer at the jobsite.

QUALITY ASSURANCE.--

Certificates of Compliance.--Certificates of Compliance shall be furnished for cement, reinforcement, and admixtures in accordance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

PART 2.- PRODUCTS

CONCRETE MIXES.--

Concrete (structural work).--

Commercial quality concrete shall be proportioned to provide a workable mix suitable for the intended use; shall have not less than 350 kg/m^3 of cement; 0 to 50 mm penetration, inclusive, as determined by California Test 533.

CONCRETE MATERIALS.--

Cement.--

Cement shall conform to ASTM Designation: C 150, Types II, or III portland cement; or Type IP (MS) Modified cement. Type IP (MS) Modified shall conform to ASTM Designation: C 595 and shall be comprised of an intimate mixture of Type II Modified cement and not more than 20 percent of a pozzolanic material.

Aggregates.--

Aggregates shall be free from deleterious coatings, clay balls and other extraneous materials.

Admixtures.--

Admixtures used in portland cement concrete shall be included on the Department's current list of approved admixtures, and shall conform to ASTM Designation: C 494, Types A, B, D, F or G for chemical admixtures; ASTM Designation: C 260 for air-entraining admixtures; and ASTM Designation: C 618 for mineral admixtures, except loss on ignition shall not exceed 4 percent. Properties of admixtures shall be uniform in each lot.

FORM MATERIALS.--

Forms for exposed finish concrete.--

Forms for exposed surfaces shall be plywood, metal or other panel type materials. Plywood shall be not less than 16 mm thick and without scars, dents, and delaminations. Forms shall be furnished in largest practical pieces to minimize number of joints.

Plywood shall conform to the requirements of U. S. Product Standard PS-1 for Exterior Medium Density Overlay plywood.

Forms for edges of slabs shall be nominal 50 mm solid stock lumber, plywood, or met al forms.

Forms for unexposed finish concrete.--

Forms for unexposed finish concrete surfaces shall be plywood, lumber, metal or other acceptable material.

Form ties.--

Form ties shall be factory fabricated, removable or snapoff metal ties for use as necessary to prevent spreading of forms during concrete placement.

Form oil.--

Form oil shall be commercial quality form oil which will permit the ready release of the forms and will not discolor the concrete.

REINFORCING MATERIALS.--

Bar reinforcement.--

Bar reinforcement shall conform to ASTM Designation: A 615/A 615M, Grade 60 [420], or ASTM Designation: A 706/A 706M.

Bar supports.--

Bar supports for reinforcement shall be precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads.

RELATED MATERIALS.--

Mortar.--

Mortar shall consist of one part cement to 2 parts clean sand and only enough water to permit placing and packing.

Concrete hardener.--

Concrete hardener shall be commercial quality water borne penetrating type magnesium fluosilicate, zinc fluosilicate or combination thereof.

Concrete sealer.--

Concrete sealer shall be as specified under “Water Repellent Coating” in Section 12-7, “Thermal and Moisture Protection,” of these special provisions.

ADMIXTURES.--

General.--Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option to conserve cement or to facilitate any construction operation.

Calcium chloride shall not be used in any concrete.

Admixtures shall be combined with concrete materials by methods that produce uniform properties throughout the concrete.

If more than one admixture is used, said admixtures shall be compatible with each other so that the desirable effects of all admixtures will be realized.

Mineral admixtures may be used to replace up to 15 percent of Type II portland cement provided the weight of mineral admixture used is not less than the weight of cement replaced. Mineral admixtures shall not be used to replace Type IP (MS) Modified or Type III cements. Chemical admixtures may be used to reduce up to 5 percent of the portland cement except that the cement content shall not be less than 300 kg/m^3. When both chemical and mineral admixtures are used with Type II cement, the weight of cement replaced by mineral admixture may be considered as cement in determining the resulting cement content.

Mineral admixtures will be required in the manufacture of concrete containing aggregates that are determined to be "deleterious" or "potentially deleterious" when tested in accordance with ASTM Designation: C 289. The use of mineral admixture in such concrete shall conform to the requirements in this section except that the use of set retarding admixtures will not be permitted.

When the use of a chemical admixture is specified or is ordered by the Engineer, the admixture shall be used at the rate specified or ordered. If no rate is specified or ordered, or if the Contractor uses a chemical admixture for his own convenience, the admixture shall be used at the dosage normally recommended by the admixture manufacturer.

When air-entrainment is specified or is ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce concrete having the specified or ordered air content as determined by California Test 504. If the Contractor uses air-entrainment for his own convenience, the average air content shall not exceed 4 percent and no single test shall exceed 5 1/2 percent.

Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers shall have sufficient capacity to measure at one time the total quantity required for each batch. If more than one liquid admixture is used in the concrete, a separate measuring unit shall be provided for each liquid admixture and dispensing shall be such that the admixtures are not mixed at high concentrations. When air-entraining admixtures are used with other liquid admixtures, the air-entraining admixtures shall be the first to be incorporated into the mix. Unless liquid admixtures are added to premeasured water for the batch, they shall be discharged to flow into the stream of water so that the admixtures are well dispersed throughout the batch.

BAR REINFORCING STEEL.--

Bending.--Reinforcing steel bars shall accurately conform to the dimensions shown on the plans.

Bars shall be bent or straightened in a manner that will not crack or break the material. Bars with kinks or improper bends shall not be used.

Hooks, bends and splices shall conform to the provisions of the Building Code Requirements for Reinforced Concrete of the American Concrete Institute.

MIXING AND TRANSPORTING CONCRETE.--

General.--When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be complete within 1 1/2 hours, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of cement to the aggregates.

Truck mixers or agitator 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. The counters shall be of the continuous-registering type, which accurately register the number of revolutions and shall be mounted on the truck so that the Engineer may safely and conveniently inspect them from alongside the truck. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 30°C or above, a time less than 1 1/2 hours may be required.

When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be complete within one hour after the introduction of cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 30°C, or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

Each load of concrete for the work shall be accompanied by a trip ticket, a copy of which shall be delivered to the Engineer at the jobsite. The trip ticket shall show volume of concrete, weight of cement and aggregates, quantity of each admixture, quantity of water including water added at the jobsite, time of day the concrete is batched, and revolution counter readings on transit mix trucks at the times the truck is charged and unloaded.

PART 3.- EXECUTION

PREPARATION.--

Existing concrete construction.--Where fresh concrete joins existing or previously placed concrete or masonry, the contact surfaces of the existing or previously placed material shall be roughened, cleaned, flushed with water and allowed to dry to a surface dry condition immediately prior to placing the fresh concrete. The roughened surface shall be no smoother than a wood trowelled surface. Cleaning of the contact surfaces shall remove laitance, curing compounds, debris, dirt and such other substances or materials which would prevent bonding of the fresh concrete.

Abrasive blast methods shall be used to clean horizontal construction joints to the extent that clean aggregate is exposed.

Exposed reinforcing steel located at the contact surfaces which is to be encased in the fresh concrete shall be cleaned to remove any substance or material that would prevent bonding of the fresh concrete.

Forms.--Forms shall be mortar tight, true to the dimensions, lines, and grades shown on the plans, securely fastened and supported, and of adequate rigidity to prevent distortion during placing of concrete.

Forms for exposed surfaces shall be constructed with triangular fillets not less than 19 mm x 19 mm attached so as to prevent mortar runs and to produce smooth straight chamfers at all sharp edges of the concrete.

Form fasteners shall be removable without chipping, spalling, heating or otherwise damaging the concrete surface. Form ties shall be removed to a depth of at least 25 mm below the surface of the concrete.

The inside surfaces of forms shall be cleaned of all dirt, mortar and foreign material. Forms shall be thoroughly coated with form oil prior to use.

Soffit forms and supports shall not be released or removed until at least 10 days after placing concrete. Other forms shall not be stripped until at least 40 hours after placing concrete.

Anchorages and embedded items shall be placed and rigidly secured at their planned locations prior to placing concrete.

Placing reinforcing steel.--Reinforcing steel bars shall be accurately placed to the dimensions shown on the plans.

Bar reinforcement conforming to ASTM Designation: A 615/A 615M, Grade 420, or A 706//A 706M shall be lapped at least 45 diameters.

Bars shall be firmly and securely held in position by means of wiring and approved bar supports. The spacing of supports and ties shall prevent displacement of the reinforcing or crushing of supports.

Tie wire shall be clear of concrete formwork and concrete surfaces.

All reinforcing steel shall be in place and inspected before concrete placement begins. Placing of bars on fresh layers of concrete will not be permitted.

PLACING CONCRETE.--

General.--Concrete shall be placed and consolidated by means of internal vibrators to form dense, homogeneous concrete free of voids and rock pockets.

Forms and subgrade shall be thoroughly moistened with water immediately before placing concrete.

Concrete shall be placed as nearly as possible to its final location and the use of vibrators for extensive shifting of the concrete will not be permitted.

Concrete shall be deposited and consolidated in a continuous operation within limits of construction joints, until the placing of the panel or section is completed.

FINISHING CONCRETE SURFACES.--

Finishing unformed surfaces.--Slabs shall be placed full thickness to finish elevation and leveled to screeds by use of long straightedges. The screeds shall be set to grade at approximately 1.8 meter centers. After leveling, screeds shall be removed and the surface shall be floated with wooden floats.

The floated surface shall be trowelled with steel trowels. Troweling shall form a dense, smooth and true finish. Walkways, pedestrian ramps, stairs and outdoor slabs for pedestrian traffic shall be given a non-slip broom finish unless a different finish is called for on the plans or in these special provisions.

The application of cement dust coat will not be permitted.

Finished surfaces of floor and roof slabs shall not deviate more than 3 mm from the lower edge of a 3-meter long straight edge.

Finishing formed surfaces.--Formed concrete surfaces shall be finished by filling holes or depressions in the surface, repairing all rock pockets, and removing fins. All surfaces of formed concrete exposed to view shall have stains and discolorations removed, unsightly bulges removed, and all areas which do not exhibit the required smooth, even surface of uniform texture and appearance shall be sanded with power sanders or other approved abrasive means until smooth, even surfaces of uniform texture and appearance are obtained.

Cement mortar, patching and finishing materials used to finish exposed surfaces of concrete shall closely match the color of surrounding surfaces.

CURING CONCRETE.--

General.--Freshly placed concrete shall be protected from premature drying and excessive cold or hot temperatures.

Initial curing of floor slabs shall start as soon as free water has disappeared from the concrete surface. The concrete shall be kept continuously moist for not less than 7 days after the concrete has been placed.

Cotton mats, rugs, carpets, or sand blankets may be used as a curing medium to retain the moisture during the curing period. Curing materials that will stain or discolor concrete shall not be used on surfaces exposed to view.

Prior to placing the curing medium, 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. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing mediums.

Concrete surfaces, other than floor slabs, shall be kept moist for a period of at least 5 days by leaving the forms in place or by covering the exposed surfaces using moist rugs, cotton mats or other curing materials approved by the Engineer.

PROTECTING CONCRETE.--

General.--Concrete shall not be placed on frozen or frost covered surfaces.

Concrete shall be protected from damage due to rain, freezing or inclement weather, and shall be maintained at a temperature of not less than 4°C for 72 hours. When required by the Engineer, the Contractor shall provide a written outline of his proposed methods of protecting concrete.

Vehicles, equipment, or concentrated loads weighing more than 140 kg individually and material stockpiles weighing more than 240 kg/m^2 will not be permitted on the concrete within 10 calendar days after placing.

SPECIAL TREATMENTS.--

Concrete hardener.--Chemical concrete hardener shall be applied to the floor surfaces shown on the plans, prior to the application of concrete sealer. Surfaces shall be clean and dry before the application of hardener.

The solution shall be applied in accordance with the manufacturer's instructions.
After the hardener has dried, the surface shall be mopped with water to remove encrusted salts.

SECTION 12-4. (BLANK)

SECTION 12-5. METALS

12-5.01 COLD FORMED METAL FRAMING

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing cold formed metal framing, including steel studs, in accordance with the details shown on the plans and these special provisions.

REFERENCES.--

Component design.--Structural properties of studs and joists shall be computed in accordance with American Iron and Steel Institute (AISI), "Specification for Designing of Cold-Formed Steel Structural Members."

Welding.--Welding shall be in accordance with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."
Welders shall be qualified in accordance with "Welder Qualification," procedures of AWS D1.1, "Structural Welding Code-Steel."

SUBMITTALS.--

Product data.--Manufacturer's descriptive data and installation instructions for each item of cold-formed metal framing and accessories shall be submitted for approval.
Installation instructions shall include instructions for securing studs to tracks and other framing connections.

Working drawings.--Working drawings and calculations for cold formed metal framing components not fully dimensioned in manufacturer's descriptive data shall be submitted for approval.
Working drawings shall include framing members showing size and gage designations, number, type, location and spacing. Working drawings shall include supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.

DELIVERY, STORAGE AND HANDLING.--

General.--Cold formed metal framing components shall be protected from rusting and damage. Components shall be delivered to the jobsite in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Components shall be stored off ground in a dry ventilated space.

PART 2.- PRODUCTS

COLD FORMED METAL FRAMING.--

Steel studs.--

Studs shall be formed to channel shape, punched web, and knurled faces, conforming to ASTM Designation: A 653M, Grade 340 (50). Studs shall be 1.52 mm (16-gage) minimum thickness and size as shown on the drawings.

Steel Track.--

Track shall be formed steel, channel shape, and same width as studs; solid web; not less than 1.21 mm (18-gage) thickness.

ACCESSORIES.--

Fasteners.--

Fasteners shall be hot-dipped galvanized, self-drilling, self-tapping screws, or bolts, nuts and washers.

Anchorages.--

Anchorages shall be ICBO approved for the purpose intended, integral stud type, powder driven or drilled expansion bolts.

FINISHES.--

Studs, track and headers.--

Studs, tracks and headers shall be hot-dipped galvanized to conform to ASTM Designation: A 653M, G60.

Miscellaneous metal parts.--

Miscellaneous parts, including, bracing, furring, plates, gussets, and bridging, shall be hot dipped galvanized to not less than 381 kilograms per square meter.

FABRICATION.--

General.--Cold formed metal framing components shall be fabricated in place or prefabricated into panels to the maximum extent possible prior to erection. Panels shall be fabricated plumb, square, true to line and braced against racking with joints welded. Lifting of prefabricated panels shall be performed in a manner to prevent damage or distortion.

Panels shall be fabricated in jig or templates to hold members in proper alignment and position to assure accurate placement.

Fastenings.--Components shall be fastened by shop welding, bolting or screw fasteners as shown on the approved drawings.

PART 3.- EXECUTION

INSTALLATION.--

Studs.--Studs shall be erected plumb, except as needed for diagonal bracing or similar requirements. Channel tracks shall be aligned accurately to the wall layout at both floor and ceiling. Tracks shall be secured to floor and ceiling with fasteners spaced at not more than 406 mm intervals. Fasteners shall be provided at corners and ends of track.

Studs shall extend from floor to underside of ceiling. Each stud shall be secured to tracks at both top and bottom by bolting or screw fastening at both inside and outside flanges. Field welding shall not be permitted. A 12 mm clearance shall be provided at the top shoes.

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:

Vault covers
Miscellaneous shapes

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.”

SUBMITTALS.--

Product data.--Submit manufacturer's specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications.

Working drawings.--Working drawings of fabricated items shall be submitted for approval.

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.

PART 2.- PRODUCTS

MATERIALS.--

Steel bars, plates and hot-rolled shapes.--

Steel bars, plates and hot-rolled shapes shall conform to ASTM Designation: A 36/A 36M.

Checkered floor plate vault covers.--

Checkered floor plate vault covers shall be commercial quality steel with standard raised pattern, fabricated and sized with all the necessary bearing members included.

Bolts, nuts and washers.--

Bolts and nuts for general application shall conform to ASTM Designation: A 307.
Washers shall be commercial quality.

Expansion anchors.--

Expansion anchors shall be ICBO approved for the purpose intended, integral stud type anchor or internally threaded type with independent stud, hex nut and washer.

Powder driven anchors.--

Powder driven anchors shall be plated, spring steel alloy drive pin or threaded stud type anchors for use in concrete or steel. Spring steel shall conform to ASTM Designation: A 227M, Class 1. The diameter, length and type of shank and the number and type of washer shall be as recommended by the manufacturer for the types and thickness of material being anchored or fastened.

FABRICATION.--

Workmanship and finish.--Workmanship and finish shall be equal to the best general practice in modern shops.

Miscellaneous metal shall be clean and free from loose mill scale, flake rust and rust pitting, and shall be well formed and finished to shape and size with sharp lines and angles. Bends from shearing or punching shall be straightened.

The thickness of metal and details of assembly and support shall give ample strength and stiffness.

Built-up parts shall be true to line and without sharp bends, twists and kinks. Exposed ends and edges of metal shall be milled or ground smooth, with corners slightly rounded.

Joints exposed to the weather shall be made up to exclude water.

Galvanizing.--Items indicated on the plans to be galvanized shall be hot-dip galvanized after fabrication. The weight of galvanized coating shall be at least 460 grams per square meter of surface area.

PART 3.- EXECUTION

GENERAL.--

Anchorages.--Anchorage devices and fasteners shall be provided for securing miscellaneous metal in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws and other connectors.

Cutting, drilling and fitting shall be performed as required for installation of miscellaneous metal fabrications. Work is to set accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.

Powder driven anchors.--Powder driven anchors shall be installed with low velocity powder actuated equipment in accordance with the manufacturer's instructions and State and Federal OSHA regulations.

DAMAGED SURFACES.--

General.--Galvanized surfaces that are abraded or damaged at any time after the application of the zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the clean areas shall be painted with 2 applications of unthinned zinc-rich primer (organic vehicle type). Aerosol cans shall not be used.

SECTION 12-6. WOOD AND PLASTICS

12-6.01 CARPENTRY

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing materials and performing carpentry work in accordance with the details shown on the plans and these special provisions.

DELIVERY, HANDLING AND STORAGE.--

Delivery and storage.--Materials shall be kept under cover and dry. All materials shall be protected from exposure to weather and contact with damp or wet surfaces with blocking and stickers. All plywood shall be stacked in such a manner to provide air circulation within and around the stacks.

PART 2.- PRODUCTS

PLYWOOD.--

General.--Plywood panels shall comply with Voluntary Product Standard PS 1, "U. S. Product Standard for Construction and Industrial Plywood." or American Plywood Association (APA), "Performance Standards and Policies for Structural Use Panels."

Each panel shall be factory marked with APA or other trademark evidencing compliance with grade requirements.

Structural plywood wall sheathing.--

Structural plywood wall sheathing shall be APA RATED SHEATHING, Exposure 1. Thickness shall be as shown on the plans.

MISCELLANEOUS MATERIALS.--

Rough Carpentry Hardware.--

Nails, screws, bolts, nuts, washers shall be commercial quality. Exposed fasteners shall be hot-dip galvanized, aluminum or stainless steel.

Expansion anchors and powder driven anchors shall be as specified under "Building Miscellaneous Metal," in Section 12-5, "Metals," of these special provisions.

WOOD TREATMENT BY PRESSURE PROCESS.--

Preservative treatment.--

Preservative treatment shall be copper napthenate, pentachlorophenol or water-borne arsenicals (ACA, CCA or ACZA).

All holes, daps and cut ends of treated lumber shall be thoroughly swabbed with 2 applications of copper napthenate.

PART 3.- EXECUTION

INSTALLATION.--

Plywood panels.--Panels shall be screwed to the framing system as shown on the plans.

Wall sheathing shall have all edges blocked.

Spacing between panels shall be 3 mm.

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 the details shown on the plans and these special provisions.

The water repellent coating shall be applied to all exterior exposed 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.

12-7.02 INSULATION (GENERAL)

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing insulation in accordance with the details shown on the plans and these special provisions.
Insulation materials shall be as specified in these special provisions.

SUBMITTALS.--

Product data.--A list of materials, manufacturer's descriptive data, location schedule, and time schedule shall be submitted for approval.
The list of materials to be used shall include the trade name, manufacturer's name, smoke developed and flame spread classification, resistance rating and thickness for the insulation materials and accessories.

Schedules.--A location schedule and time schedule shall be submitted for approval.
The location schedule shall show where each material is to be installed.
The Contractor shall provide the Engineer at the jobsite with an accurate time schedule of the areas of the building to be insulated each day. The time schedule shall be submitted 3 working days in advance of the work.

Samples --Samples of insulation material shall be submitted to the Engineer at the jobsite.

QUALITY ASSURANCE.--

Codes and standards.--All insulating materials shall be certified to comply with the California Quality Standards for Insulating Materials and shall be listed in the Department of Consumer Affairs publication "Consumer Guide and Directory of Certified Insulation Material."

DELIVERY, STORAGE AND HANDLING.--

General.--Insulating materials shall be delivered to the jobsite and stored in a safe dry location with labels intact and legible.

Insulating materials shall be protected from physical damage and from becoming wet or soiled.

In the event of damage, materials shall be repaired or replaced as necessary to comply with these specifications.

PART 2.- PRODUCTS (Not applicable.)

PART 3.- EXECUTION (Not applicable.)

12-7.02A RIGID WALL AND CEILING INSULATION

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing rigid wall and ceiling insulation in accordance with the details shown on the plans and these special provisions.

Rigid insulation shall include rigid insulation, wood nailers, fasteners and such other materials, not mentioned, which are required for the complete installation of the rigid insulation system.

QUALITY ASSURANCE.--

Codes and standards.--Rigid foam insulation shall have a flame-spread rating not to exceed 75 and a smoke density not to exceed 450 when tested in accordance with UBC Standard No. 8-1. Rigid foam insulation shall be approved in accordance with UBC Standard 26-3 to be installed without a thermal barrier on the room side of the insulation.

PART 2.- PRODUCTS

Rigid insulation.--

Rigid insulation shall be rigid rectangular boards of polyisocyanurate foam with aluminum foil facing on both sides and an aged thermal resistance of R-1.9 K• m^2/W. Facing on exposed insulation shall be white tinted aluminum foil.

Wood nailers.--

Wood nailers shall be Douglas fir. Nailers in contact with concrete shall be pressure treated after fabrication. Wood preservatives shall be waterborne type.

Insulation tape.--

Insulation tape shall be as recommended by the insulation manufacturer.

Adhesive.--

Adhesive shall be construction grade panel adhesive as recommended by the insulation manufacturer.

Fasteners.--

Fasteners shall be concrete nails; Bostich, Pneumatic Nail System; Buildex, Tampcon Fasteners; or equal.

EXECUTION.--

Installation of rigid insulation-The preparation of the wall surfaces and the installation of insulation shall conform to the manufacturer's recommendations and these special provisions.

Rigid insulation placed behind fiberglass reinforced plastic (FRP) panels shall be tight fitting between nominal 51 mm x 102 mm wood nailers laid flat and spaced 0.6 meter on center. Wood nailers shall also be placed at the top and bottom of the FRP panels.

All joints between insulation boards and between insulation boards and wood nailers shall be taped.

Insulation panels with broken or crushed corners or edges shall be trimmed free of such defects or shall be discarded. Replacement boards less than 300 mm wide shall not be used.

Damaged insulation in the completed work shall be removed and replaced. Insulation that has been wet or is wet shall be considered damaged.

12-7.03 TORCH APPLIED ROOFING

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing a torch applied roof covering system in accordance with the details shown on the plans and these special provisions.

Torch applied roofing system shall have a granular surfacing, and shall include all materials for constructing the roofing system complete and in place.

SUBMITTALS.--

Product data.--Manufacturer's descriptive data and installation instructions for torch applied roofing system shall be submitted for approval.

QUALITY ASSURANCE.--

Codes and standards.--Roofing materials shall conform to the rules for control of volatile organic emissions adopted by the local air pollution control district having jurisdiction in the area.

Field samples.--Materials shall be delivered to the jobsite in labeled containers or wrappings sufficiently ahead of their intended use to allow sampling and testing by the Engineer.

DELIVERY AND HANDLING.--

Storage.--Stored or stockpiled roof roofing shall be set on end and shall be protected from the elements. Roofing rolls compressed into oval cross section shall not be used.

PART 2.- PRODUCTS

Torch applied roofing and flashing.--

Torch applied roofing shall be Class A or B fire retardant plastic bituminous roofing membrane. Plasticized bituminous compound, consisting of distilled asphalt mixed with polypropylene and petrochemical woven around a nonwoven polyester core.

Flashing rolls shall be properly sized for the application intended.

Top surface shall be embedded with slate flakes or mineral granules as follows:

4.5 mm granular--- For torch applied roofing on flat surfaces.

Primer.--

Primer for torch applied roofing shall be a water-based asphalt primer. for application for concrete surfaces.

PART 3.- EXECUTION

PREPARATION.--

General.--Surfaces to be covered shall be smooth, hard, dry and shall be free from high spots, depressions, frost or defects from frost, dust loosened material or other debris.

Openings, holes or crevices shall be filled or covered before any roofing materials are applied.

INSTALLATION.--

Application.--Torch applied roofing shall be installed to provide a watertight, non-leaking roof covering in accordance with the manufacturer's recommendations.

Torch applied roofing work and work of other trades shall be coordinated and scheduled to minimize interference and to eliminate traffic on the completed roof.

Torch applied roofing and roofing materials shall not be applied in wet weather or when ambient temperature is below 50° F.

Primer shall be applied in a thin, continuous, uniform coating without skips or dry spots.

Flashing.--Flashings shall be installed as the roofing progresses to protect new facilities from damage resulting from rain, wind and storms. Any damage resulting from rain, wind or storms shall be corrected at the Contractors expense.

Torch applied flashings shall be placed after roofing is placed unless otherwise shown on the plans.

Torch applied flashings shall be one layer of flashing applied to metal substrate free of voids, fish mouths and wrinkles. No splices will be permitted.

CLEANUP.--

General.--Upon completion of the work, the Contractor shall clean all exposed surfaces that are subject to spillage, over run and marking by torch applied roofing. Clean up methods and materials shall be as recommended by the manufacturer.

Cleanup methods shall not damage, discolor or otherwise affect the exposed surfaces.

12-7.04 SEALANTS AND CAULKING

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and applying sealants and caulking which are required for this project, but not specified elsewhere, in accordance with the details shown on the plans and these special provisions.

QUALITY ASSURANCE.--

Certificates of Compliance.--Certificates of compliance shall be furnished for the sealants and caulking in accordance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

SUBMITTALS.--

Product data.--Manufacturer’s descriptive data and installation instructions for all sealants shall be submitted for approval.

Samples.--Color samples of all sealants shall be submitted for approval. Unless otherwise shown on the plans, colors will be selected by the Engineer from the manufacturer’s standard colors.

PART 2.- PRODUCTS

MATERIALS.--

General.--All sealants, primers and accessories shall be non-staining to adjacent exposed surfaces. Products having similar applications and usage shall be of the same type and same manufacturer. Gun consistency compound shall be used unless otherwise required by the job conditions.

Acrylic sealant.--

Acrylic sealant shall be one compound, solvent release acrylic sealant.

Butyl sealant.--

Butyl sealant shall be one component, skinning type.

Silicone sealant.--

Silicone sealant shall be one component, low modulus building sealant. Sealant shall be tack-free in one hour, shall not sag or flow, shall be ozone resistant and capable of 100 percent extension without failure.

Backer rod.--

Backer rod shall be round, open or closed cell polyurethane. Backer rod shall be sized such that it must be compressed between 25 and 75 percent of its uncompressed diameter during installation in the joint.

Neoprene.--

Neoprene shall conform to the requirements of ASTM Designation: C 542.

PART 3.- EXECUTION

APPLICATION.--

General.--Unless otherwise shown on the plans, sealants shall be applied in accordance with the manufacturer's instructions.

Silicone sealants shall not be used in locations where painting is required.

Butyl sealants shall not be used in exterior applications, and acrylic sealants shall not be used in interior applications.

Sealants shall be applied in a continuous operation for the full length of the joint. Immediately following the application of the sealant, the sealant shall be tooled smooth using a tool similar to that used to produce concave masonry joints. Following tooling, the sealant shall remain undisturbed for not less than 48 hours.

SECTION 12-8. DOORS AND WINDOWS

12-8.01 HINGED DOORS

GENERAL.--This work shall consist of furnishing and installing hinged doors and frames in accordance with the details shown on the plans and these special provisions.

SUBMITTALS.--Manufacturer's descriptive data, installation instructions for fire rated assemblies and a door schedule shall be submitted for approval. The door schedule shall include a description of the type, location and size of each door and frame.

PRODUCTS.--

Metal door.--

Metal door shall be flush, seamless steel door factory prepared and reinforced to receive hardware and having cold rolled stretcher leveled sheet steel face sheets not less than 1.2 mm thick (18-gage). Face sheets shall be bonded with thermosetting adhesive to rigid board honeycomb or precured foam core; or face sheets shall be welded to all parts of an assembled grid of cold formed pressed metal stiffeners and framing members located around edges, ends, openings and at all locations necessary to prevent buckling of face sheets. Seams shall be tack welded, filled and ground smooth. Bottom edge and internal stiffeners of grid type core shall have moisture vents. Welds on exposed surfaces shall be ground smooth. Louvered openings shall be provided where shown on the plans.

Active leaf of double door shall have a full height astragal of 3 mm flat bar or folded sheet strip, not less than 1.5 mm thick (16-gage), welded on the outside of the active leaf.

Door shall be cleaned and treated by the bonderized process or approved phosphatizing process and then given one factory application of metal protective rust inhibitive primer. Primer shall not contain lead type pigments.

Door louvers.--

Door louvers shall be inverted V-type factory primed, galvanized sheet steel louvers. Exterior door louvers shall not be removable from outside of the building. Louvers at exterior doors shall have inside mounted bronze insect screens.

Louvers shall be cleaned and treated by the bonderized process or approved phosphatizing process and then given one factory application of metal protective rust inhibitive primer. Primer shall not contain lead type pigments.

Pressed metal frame.--

Pressed metal frame shall be not less than 1.5 mm thick (16-gage) sheet steel with integral stop, mitered corners, face welded and ground smooth corners. Frames shall be reinforced for all hardware and shall be cleaned and treated by the bonderized process or an approved phosphatizing process and then given one factory application of metal protective rust inhibitive primer. Primer shall not contain lead type pigments.

Sealants.--

Sealants shall be ultraviolet and ozone resistant, gun grade polysulfide or polyurethane, multicomponent, Federal Specification: TT-S-227.

EXECUTION.--

INSTALLATION.--Doors and frames shall be installed rigidly, securely, plumb and true and in such a manner that the doors operate freely without rubbing or binding. Clearance between frame and door shall be not more than 3 mm. The exterior frame shall be sealed weathertight.

Pressed metal frames shall be secured with clips and anchors as shown on the plans.

PAINTING.--Except for the primer application specified herein, doors and frames shall be cleaned, prepared and painted in accordance with the requirements specified under "Painting" in Section 12-9, "Finishes," of these special provisions.

12-8.02 FINISH HARDWARE

PART 1.- GENERAL

SUMMARY.--

This work shall consist of furnishing and installing hardware items for doors in accordance with the details shown on the plans and these special provisions.

SUBMITTALS.—

Manufacturer's technical information and catalog cuts for each item of door hardware and a door hardware schedule shall be submitted for approval prior to installation.

Manufacturer's catalog cuts shall include catalog numbers, material, grade, type, size, function, design, quality and finish of hardware.

The door hardware schedule shall indicate the location and size of door opening, the door and frame material, and the size, style, finish and quantity of the hardware components required.

FINISHES.—

Hardware shall be provided with standard US 26D metal plated finish.

KEYING INSTRUCTIONS.—

Padlocks for security slide bolts shall be keyed to the electrical maintenance personnel requirements.

Key bows shall be stamped "State of California" and "Do Not Duplicate."

PART 2.- PRODUCTS.--

GENERAL.—

Door hardware equal in material, grade, type, size, function, design, quality and manufacture to that specified herein may be submitted for approval.

Butt hinges.--

Butt hinges shall be steel, 1 1/2-pair per door unless otherwise specified or shown on the plans. Nonremovable pins shall be provided at outswing exterior doors. Hinge size shall be 114 mm x 114 mm unless otherwise noted.

Heavy weight hinges shall be:

Hager	BB 1168
McKinney	T4B 37869
Stanley	BB 168
or equal.	

Dummy knob.--

Dummy knob shall act as pull only, no operation.

Dummy knob shall be:

Corbin Russwin
Falcon
Schlage
or equal.

Security slide bolt.--

Security slide bolt shall have plate that covers padlock when it is locked, preventing shackle from being cut. Security slide bolt shall be equipped with padlock.

Door chain bolt.--

Door chain bolt shall be mounted at the top of the inactive leaf of double doors. Door chain bolt shall be approximately 200 mm long with a 600 mm chain. Door chain bolt shall have a spring that automatically releases the bolt when the chain is released.

Foot door bolt.--

Foot door bolt shall be mounted at the bottom of the inactive leaf of double doors. Foot door bolt shall be approximately 200 mm long and be operated by foot pressure.

Door closers.--

Parallel arms for closers with hold-open feature shall be installed at outswing exterior doors. Closers shall have sprayed finish to match other hardware on door.

Door closers shall be:

LCN	4040
Norton	85001
Dorma	7800
or equal.	

Kickplates.--

Kickplates shall be 254 mm in height x 51 mm less than door width x 1.52 mm (16-gage).

Kickplates shall be:

Builders Brass	37
Quality	48
Trimco	6000
or equal.	

Rain drips, door sweeps and door shoes.--

Rain drips, door sweeps and door shoes shall conform to the sizes and configurations shown on plans. Thresholds at door openings with accessibility requirements shall not exceed 13 mm in height.

Rain drip, door sweep and door shoe manufacturers shall be Pemko, Reese, Zero, or equal.

Weatherstrip.--

Weatherstrip shall conform to the sizes and shapes shown on plans. Assemblies shall be UL listed and shall be provided where shown on the plans or as specified in these special provisions.

Weatherstrip manufacturers shall be Pemko, Reese, Zero, or equal.

PART 3.- EXECUTION

DOORS AND FRAMES.--Doors and frames shall be set square and plumb and be properly prepared before the installation of hardware.

INSTALLATION.--Hardware items shall be accurately fitted, securely applied, and adjusted and lubricated in accordance with the manufacturer's instructions. Installation shall provide proper operation without bind or excessive play.

Hinges shall be installed at equal spacing with the center of the end hinges not more than 244 mm from the top and bottom of the door. Security slide bolts shall be 1024 mm from the finished floor. Kickplates shall be mounted on the push side of the doors, 25 mm clear of door edges.

Door controls shall be set so that the effort required to operate doors with closers shall not exceed 3.9 kg maximum for exterior doors and 2.7 kg maximum for interior doors.

Hardware, except hinges, shall be removed from surfaces to be painted before painting.

Upon completion of installation and adjustment, the Contractor shall deliver to the Engineer all dogging keys, closer valve keys, lock spanner wrenches, and other factory furnished installation aids, instructions and maintenance guides.

DOOR HARDWARE GROUPS AND SCHEDULE.--Hardware groups specified herein shall correspond to those shown on the plans:

GROUP 1 (at double doors)

3-pair butt hinges
2 each dummy knob
1 each door closer
2 each weatherstrip
2 each kickplate
1 each security slide bolt with padlock
1 each door chain bolt
1 each floor foot bolt

GROUP 2 (at single door)

1 1/2-pair butt hinges
1 each dummy knob
1 each door closer
1 each weatherstrip
1 each kickplate
1 each security slide bolt with padlock

SECTION 12-9. FINISHES

12-9.01 GYPSUM WALLBOARD

GENERAL.--This work shall consist of furnishing, installing and finishing gypsum wallboard in accordance with the details shown on the plans and these special provisions.

Where assembly fire ratings are indicated on the plans, construction shall provide the fire resistance in accordance with the details shown on the plans.

PRODUCTS.--

Gypsum wallboard.--

Gypsum wallboard shall conform to ASTM Designation: C 36.

Joint tape and joint and finishing compound.--

Joint tape and joint and finishing compound shall conform to ASTM Designation: C 475.

Fasteners.--

Fasteners shall be steel drill screws conforming to ASTM Designation: C 1002.

EXECUTION.--

DELIVERY AND STORAGE.--Materials shall be delivered in original packages, containers or bundles bearing brand name, applicable standard of manufacture, and name of manufacturer or supplier and shall be kept dry and fully protected from weather and direct sunlight exposure. Gypsum wallboard shall be stacked flat with adequate support to prevent sagging or damage to edges, ends and surfaces.

INSTALLATION.--Wallboard panels to be installed on walls may be installed with the long dimension of the panels either parallel or perpendicular to the framing members. The direction of placing the panels shall be the same on any one wall or partition assembly.

Edges of wallboard panels shall be butted loosely together. All cut edges and ends shall be smoothed as needed for neat fitting joints.

All edges and ends of gypsum wallboard panels shall coincide with the framing members, except those edges and ends which are perpendicular to the framing members.

Fastener spacing shall be as shown on the plans.

Type S steel drill screws shall be used to fasten wallboard to metal framing.

Adhesives shall not be used for securing wallboard to framing.

Gypsum wallboard panels shown on the plans for fire resistive assemblies shall be fastened to all framing members. Fasteners shall be located at least 10 mm from wallboard panel edges and ends. All metal fasteners shall be driven slightly below surface level without breaking the paper or fracturing the core.

Joints between face panels shall be filled and finished with joint tape and at least 3 coats of joint compound. Tape at joints shall be embedded in joint compound.

Dimples at screw heads, dents, and voids or surface irregularities shall be patched with joint compound. Each patch shall consist of at least 3 coats and each coat shall be applied in a different direction.

Each coat of joint compound shall be feathered out onto the panel surface and shall be dry and lightly sanded before applying the next coat. The finished surfaces of joint compound at the panel joints and patches shall be flat and true to the plane of the surrounding surfaces and shall be lightly sanded.

Good lighting of the work area shall be provided during the final application and sanding of the joint compound.

12-9.02 PAINTING

PART 1.- GENERAL

SUMMARY.--This work shall consist of preparing surfaces to receive coatings, and furnishing and applying coatings, in accordance 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.

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 50 mm x 75 mm, for each color of coating shown on the plans

REGULATORY REQUIREMENTS.--Coatings and applications shall conform to the rules for control of volatile organic compound emissions adopted by the air quality control district in the air basin in which the coatings are applied.

SITE ENVIRONMENTAL REQUIREMENTS.--Coatings shall not be applied when the air temperature is below 10°C (20°C for varnishes) or when the relative humidity exceeds 75 percent.

The surface to be coated shall be maintained at a minimum temperature of 7°C for a period of 24 hours prior to, and 48 hours after the application of the coating. Heating facilities shall be provided when necessary.

Continuous ventilation shall be provided during application of the coatings.

A minimum lighting level of 865 lux, measured 1 m from the surface to be coated, 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 7°C. 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 3.8 liter 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

GENERAL.--The products shall be the best quality grade coatings of the specified types as regularly manufactured by nationally recognized paint and varnish manufacturers that have not less than 10 years experience in manufacturing paints and varnishes. Products that do not bear the manufacturer's identification as the best quality grade product shall not be used. Products for each coating system shall be by a single manufacturer and shall not contain lead type pigments.

Thinners, shellac, fillers, patching compounds, coloring tint, and other products required to achieve the specified finish shall be the manufacturer's best quality and shall be used as recommended.

PART 3.- EXECUTION

INSPECTION.--Surfaces to be coated at the jobsite shall be approved by the Engineer prior to the application of coatings. 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 accordance with the following, except that the surfaces not specified herein shall be prepared as recommended by the coating manufacturer.

GENERAL.--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.--Oils, grease, and fabrication lubricants shall be removed by solvent wash. Surfaces shall be cleaned of remaining surface treatments by hand cleaning. New surfaces shall be roughened by hand cleaning or light abrasive blasting.

Abraded or corroded areas shall be hand cleaned and spot coated with one coat of vinyl wash pretreatment. Abraded or corroded areas on new surfaces not scheduled to be painted shall be cleaned by solvent wash, hand cleaned, and given 2 spot applications of zinc rich paint.

ALUMINUM AND OTHER NON-FERROUS METALS.--Oils, grease, and fabrication lubricants shall be removed by solvent wash. Dirt, water soluble chemicals, and similar surface contamination shall be removed by detergent wash.

SHOP PRIMED 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.

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 which 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 oil, grease, form release agents, paint, dirt, rust, mill scale, efflorescence, weak concrete, or laitance, by the use of airborne abrasives, and removal of loose particles, dust, and abrasives by blasting with clean air.

Abrasives shall be limited to clean dry sand, mineral grit, steel grit, or steel shot, and shall be graded to produce satisfactory results. Unwashed beach sand containing salt or silt shall not be used.

Abrasive blasting shall conform to the requirements of SSPC-SP6-85, Commercial Blast Cleaning, as defined in the Steel Structures Painting Council Manual.

Light abrasive blasting shall conform to the requirements of SSPC-SP7-85, Brush-Off Blast Cleaning, as defined in the Steel Structures Painting Council Manual.

SOLVENT WASH.--Removal of oil, grease, wax, dirt, or other foreign matter by using solvents, such as mineral spirits or xylol, or other approved cleaning compounds.

STEAM CLEANING.--Removal of oil, grease, dirt, rust, scale, 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.--High pressure, low volume water stream for removing dirt, light scale, chalking or peeling paint. Water blasting equipment shall produce not less than a 13 800 MPa minimum output pressure when used. Heated water shall not exceed 66°C. 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 his expense and the original surface restored to the satisfaction of the Engineer.

APPLICATION.--

GENERAL.--Coatings shall be applied in accordance with the printed instructions and at the application rates recommended by the manufacturer to achieve the dry film thickness specified in these special provisions.

Mixing, thinning and tinting shall conform to the manufacturer's printed instructions. Thinning will be allowed only when recommended by the manufacturer.

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 metal doors, and other surfaces not normally visible from eye level.

APPLICATION SURFACE FINISH.--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 accordance with the coating manufacturer's recommendations before applying the succeeding coating. Enamels and clear finishes shall be lightly sanded, dusted, and wiped clean between applications.

Stain blocking primer shall be spot applied whenever stains bleed through the previous application of a coating.

TIMING OF APPLICATIONS.--The first application of the specified coating system shall be applied prior to any deterioration of the newly prepared surface. Metal surfaces shall be prepared and prime coated the same day that cleaning of bare metal is performed. Additional prime coats shall be applied as soon as drying time of the preceding coat permits.

Metal surfaces shall be prime coated within 12 hours of application of vinyl wash pretreatment.

Shellac sealer shall be allowed to dry at least 12 hours before applying the next coat.

Drying time between applications of water borne coatings shall be at least 12 hours.

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 2 m 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 that the work is unsatisfactory and the Contractor shall apply the remainder of the coating by brush or roller, as approved by the Engineer.

DRY FILM THICKNESS.--

Vinyl wash pretreatment	0.007 mm to 0.13 mm, maximum.
Bituminous paint	0.1 mm, minimum.
Primers, undercoats, sealers, and coatings	As recommended by the manufacturer.

BACKPRIMING.--All primed metal surfaces in contact with concrete exterior walls shall be coated with a bituminous paint on those surfaces in contact with the wall.

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.

COATING SYSTEMS.--The surfaces to be coated shall be as shown on the plans and as specified elsewhere 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 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.

SYSTEM 1- ALUMINUM AND OTHER NON-FERROUS METALS.--

1 pretreat coat: vinyl wash pretreatment
1 prime coat: aluminum primer
2 finish coats: acrylic, exterior enamel, semi-gloss

SYSTEM 2- GALVANIZED METAL.--

1 pretreat coat: vinyl wash pretreatment
1 prime coat: galvanized metal primer
2 finish coats: acrylic, exterior enamel, semi-gloss

SYSTEM 3- SHOP PRIMED STEEL.--

1 prime coat : red oxide ferrous metal primer
2 finish coats: alkyd, exterior enamel, semi-gloss

COLOR SCHEDULE.--Colors shall be as shown on the plans.

12-9.03 FIBERGLASS REINFORCED PLASTIC PANELS

GENERAL.--This work shall consist of furnishing and installing fiberglass reinforced plastic (FRP) panels and trim molding in accordance with details shown on the plans and these special provisions.

SUBMITTALS.--Manufacturer's descriptive data, installation instructions, and finish options shall be submitted for approval.

Product descriptive data shall show the manufacturer's name and shall indicate conformance to these special provisions.

Installation instructions shall show the FRP panel manufacturer's recommended method of installation.

Finish options shall show the manufacturer's standard color palette for FRP panels, top set base, and trim molding. Color shall be selected from the manufacturer's standard color palette by the Engineer after the award of the contract.

PRODUCTS.--

FRP panel.--

FRP panel shall be Class I flame-spread, minimum nominal thickness of 2 mm; Marlite, Class A/I FRP; Kemlite, Fire-X Glasbord; or equal.

Trim molding.--

Trim molding shall be manufacturer's standard vinyl molding with nailing flanges and a 9 mm deep channel of sufficient width to receive panels and sealant.

Top set base.--

Top set base shall be manufacturer's best grade rubber base, with premolded internal and external corner pieces. The height shall be as shown on the plans.

Adhesive and sealant.--

Adhesive and sealant shall be as recommended by the FRP panel manufacturer.

EXECUTION.--

INSTALLATION.--The FRP panels and trim molding shall be installed in accordance with the manufacturer's installation instructions.

Trim molding shall be nailed through the flange into solid wood backing. All nails shall be concealed by FRP panels in the completed installation. Trim shall be one continuous piece along each wall unless the wall length exceeds the manufacturer's standard trim length. If more than one piece is used on one wall, the pieces shall be approximately equal length, with no piece less than 1 m in length. All FRP panel edges shall be covered by a trim molding.

Panels shall be one continuous piece along each wall unless the wall length exceeds the manufacturer's standard panel length. If more than one panel piece is used on one wall, the pieces shall be approximately equal length, with no piece less than one meter in length.

CLEAN-UP.--Adjacent surfaces shall be protected from adhesive or sealant. Excess adhesive and sealant shall be removed as the installation progresses using a solvent or cleaning agent recommended by the FRP panel manufacturer.

SECTION 12-10. SPECIALTIES

12-10.01 LOUVERS

GENERAL.--This work consists of furnishing and installing louvers in accordance with the details shown on the plans and these special provisions.

SUBMITTALS.--Manufacturer's descriptive data and installation instructions shall be submitted for approval.

PRODUCTS.--

Louvers.--

Louvers shall be factory fabricated units of extruded aluminum alloy not less than 2 mm thick (12-gage) or galvanized steel sheet not less than 1.63 mm thick (16-gage) with standard "Z" type blades, and removable bronze 16 x 16 mesh insect screens mounted on the inside of the units.

Louvers shall have integral caulking strips and retaining beads.

EXECUTION.--

INSTALLATION.--Louvers shall be installed in accordance with the manufacturer's instructions. The completed louver installation shall be weather tight.

PAINTING.--Louvers shall be cleaned, prepared and painted in accordance with the requirements specified under "Painting" in Section 12-9, "Finishes," of these special provisions.

12-10.02 FIRE EXTINGUISHERS

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing fire extinguishers with mounting brackets in accordance with the details shown on the plans and these special provisions.

REFERENCES.--

General.--Fire Extinguishers shall conform to the requirements in California Code of Regulations, Title 19 Division 1, Chapter 3, “Portable Fire Extinguishers.”

SUBMITTALS.--

Product data.--Manufacturer's descriptive data and installation instructions shall be submitted for approval.

QUALITY ASSURANCE.--

Codes and standards.--Fire extinguishers shall be Underwriters Laboratories or Factory Mutual Laboratories approved for the type, rating and classification of extinguisher specified.

PART 2.- PRODUCTS

MANUFACTURER’S.--

Acceptable manufacturers,--Subject to contract compliance, manufacturers shall be J. L. Industries; Larsen’s Manufacturing; Potter-Roemer; or equal.

COMPONENTS.--

Fire extinguisher.--

Fire extinguisher shall be fully charged, multi-purpose dry chemical type, with charge indicator, hose and nozzle, and attached service record tag. Fire extinguisher shall be of the capacity and type rating shown on the plans.

Mounting bracket.--

Mounting bracket shall be the manufacturer’s standard painted, surface mounted type.

PART 3.- EXECUTION

INSTALLATION.--

General.--Fire extinguishers shall be installed in locations and at mounting heights shown on the plans, or if not shown, at a height of 1220 mm from the finished floor to the top of the fire extinguisher.

Fire extinguisher mounting brackets shall be attached to structure, square and plumb, in accordance with the manufacturer's recommendations.

IDENTIFICATION.--

Bracket-mounted.--Extinguishers shall be identified with red letter decals spelling “FIRE EXTINGUISHER” applied to wall surface. Letter size, style and location as selected by the Engineer.

SERVICING.--

General.--Fire extinguishers shall be serviced, charged, and tagged not more than 5 days prior to contract acceptance.

SECTION 12-11. EQUIPMENT

12-11.01 COMPRESSED AIR SYSTEM

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing a compressed air system in accordance with the details shown on the plans and these special provisions.

The compressed air system shall include air compressors, filters, gauges, compressed air piping, receiver and other items as shown on the plans.

Pipes and fittings shall be in accordance with the requirements specified under "Pipes, Fittings, and Valves," in this Section 12-15, "Mechanical," of these special provisions.

Permits to operate.--Attention is directed to the latest Division of Industrial Safety (DIS) regulations regarding air compressors.

The Contractor shall provide all permits to operate pressure vessels in accordance with the requirements of the DIS and shall pay all costs for such permits. Such permits shall be posted under glass at the work site.

SUBMITTALS.--

Product data.--Manufacturer's descriptive data shall be submitted for approval.

Manufacturer's descriptive data shall include a complete description, performance data and installation instructions for the materials and equipment specified herein.

CLOSEOUT SUBMITTALS.--

Operation and maintenance manuals.--Prior to the completion of the contract, 3 identified copies of the operation and maintenance instructions with parts lists for the air compressor and filter shall be delivered to the Engineer at the jobsite. The instructions and parts lists shall be in a bound manual form and shall be complete and adequate for the equipment installed. Inadequate or incomplete material shall be returned. The Contractor shall resubmit adequate and complete manuals at no expense to the State.

WARRANTY.--

Warranties and guarantees.--Manufacturer's warranties and guarantees for materials or equipment used in the work shall be delivered to the Engineer at the jobsite prior to acceptance of the contract.

PART 2.- PRODUCTS

Air compressor.—

The air compressor shall be a 2 stage, air cooled, oil free rotary screw type. The compressor elements shall be driven from a common gearbox and shall be liquid cooled. Each element shall have a safety relief valve. The unit

shall include a water cooled inter and after cooler, each with an automatic drain. The oil system shall include an air-cooled oilcooler, filter, pump drain and sight gage. The motor shall be high efficiency type, TEFC and shall include a reduced voltage starter. The unit shall be electronically controlled with readouts for operating conditions, temperatures, and pressures, control status. Service limits and safety warnings and shutdowns. The entire system shall be installed in a sound deadening enclosure. The output shall be as shown on the plans.

Receiver.—

The receiver shall be a vertical galvanized steel tank with a galvanized or epoxy interior. The receiver shall be sized and have the openings as shown on the plans. The receiver shall include three welded steal legs as shown on the plans with feet for bolting to the building foundation. The receiver shall be certified as an unfired ASME pressure vessel and shall be stamped accordingly. The receiver shall be rated for a minimum working pressure of 1700 kPa.

Drain valve.—

The drain valve shall be manufactured to operate as an automatic tank condensate valve. The valve shall include a timer that opens the valve for 15 seconds for every hour. The valve shall include all wiring and controls required to operate.

Filter.—

Filter shall be replaceable duel element type with a .254 mm retention rating. The unit shall have a flow rating of 400 liters/second and a pressure rating of 1375 kPa. The unit shall have flanged inlets and outlets and include an automatic drain which is routed to the floor sink. The unit shall remove solid particles and coalesce aerosols and liquids.

Safety relief valve.—

Safety valve shall be rated for a working pressure of 1700 kPa, set at 1200 kPa and equipped with a manual test lever. The size shall be as shown on the plans.

Flexible coupling.--

Flexible coupling shall be brass flexible metal hose with threaded union or flanged ends and a minimum working pressure of 1380 kPa.

Pressure gage.--

Pressure gage shall be rotary type ANSI Standard: B40.1, Grade A, with 90 mm dial, liquid filled with cover, plain case, reset screw and bottom inlet. Pressure gage movement shall be phosphor bronze bushed. Gage shall read from 0 kPa to 2000 kPa. Each gage shall be equipped with a shut-off valve. Pressure gage shall be Marsh, Ashcroft, US Gage, or equal.

PART 3.- EXECUTION

INSTALLATION.--

General.--Air compressor shall be installed with drain piping, vibration isolation pads and expansion anchors, as recommended by the manufacturer.

FIELD QUALITY CONTROL.--

Testing.--All tests, including general performance tests to demonstrate the proper operation of the air compressor system, shall be performed by the Contractor in the presence of the Engineer.

The air compressor system shall be tested for the operational range, the cut-off pressure and the operation of system components.

SECTIONS 12-12. THRU 12-14. (BLANK)

SECTION 12-15. MECHANICAL

12-15.01 MECHANICAL WORK

GENERAL.--

Scope.--This work shall consist of performing mechanical work in accordance with the details shown on the plans and these special provisions.

Mechanical work shall include furnishing all labor, materials, equipment and services required for providing ventilating, air conditioning, plumbing and compressed air systems.

Earthwork, foundations, sheet metal, painting, electrical, and such other work incidental and necessary to the proper installation and operation of the mechanical work shall be in accordance with the requirements specified for similar type work elsewhere in these special provisions.

System layouts are generally diagrammatic and location of equipment is approximate. Exact routing of pipes, ducts, etc., and location of equipment is to be governed by structural conditions and obstructions. Equipment requiring maintenance and inspection is to be readily accessible.

SUBMITTALS.--

Product data.--A list of materials and equipment to be installed, manufacturer's descriptive data, and such other data as may be requested by the Engineer shall be submitted for approval.

Manufacturer's descriptive data shall include complete description, performance data and installation instructions for the materials and equipment specified herein. Control and wiring diagrams, rough-in dimensions for plumbing fixtures, and component layout shall be included where applicable.

Manufacturer's descriptive data shall be submitted for the following:

Air Conditioning Unit
Diffuser
Floor Sink

CLOSEOUT SUBMITTALS.--

Operation and maintenance manuals.--Prior to the completion of the contract, 3 identified copies of the operation and maintenance instructions with parts lists for the equipment specified herein shall be delivered to the Engineer at the jobsite. The instructions and parts lists shall be indexed and bound in a manual form and shall be complete and adequate for the equipment installed. Inadequate or incomplete material shall be returned. The Contractor shall resubmit adequate and complete manuals at no expense to the State.

Operation and maintenance manuals shall be submitted for the following equipment:

Air conditioning unit

QUALITY ASSURANCE.--

Codes and standards.--Mechanical work, including equipment, materials and installation, shall conform to the California Building Standards Code, Title 24, and to the California Code of Regulations, Title 8, Chapter 4, Division of Industrial Safety (DIS).

WARRANTY.--

Warranties and guarantees.--Manufacturer's warranties and guarantees for materials or equipment used in the work shall be delivered to the Engineer at the jobsite prior to acceptance of the contract.

12-15.02 PIPE, FITTINGS AND VALVES

PART 1.- GENERAL

SUMMARY.--

Scope.--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 plumbing and 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 pipe size (NPS). 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.

QUALITY ASSURANCE.--

Codes and standards.--Pipe, fittings and valves shall be installed in accordance with the requirements in the latest edition of the Uniform Plumbing Code, the manufacturer's recommendations and the requirements specified herein.

PART 2.- PRODUCTS

MATERIALS.--

PIPE AND FITTINGS --

Class	Description

A1.--

Schedule 40 galvanized steel pipe conforming to ASTM Designation: A 53, with 1040 kPa galvanized malleable iron banded screwed fittings and galvanized steel couplings. The weight of the zinc coating shall be not less than 90 percent of that specified in ASTM Designation: A 53.

C1.--

Hub and plain end cast iron soil pipe with neoprene gaskets conforming to Cast Iron Soil Pipe Institute's Standard 301. Pipe, fittings and gaskets shall be of one manufacturer.

C2.--

Hubless cast iron soil pipe with neoprene gaskets, corrugated stainless steel shields and stainless steel clamps conforming to Cast Iron Soil Pipe Institute's Standard 301. Joint materials shall be furnished by pipe manufacturer.

H3.--

Type L hard copper tubing conforming to ASTM Designation: B 88, with wrought copper or cast bronze solder joint pressure fittings, stop type couplings and threaded adapters. Solder shall be lead-free.

Unions (for steel pipe).--

Unions (for steel pipe) shall be 1730 kPa, threaded malleable iron, ground joint, brass to iron seat, galvanized or black to match piping.

Unions (for copper or brass pipe).--

Unions (for copper or brass pipe) shall be 1040 kPa cast bronze, ground joint, bronze to bronze seat with silver brazing threadless ends or 860 kPa cast brass, ground joint, brass to brass seat with threaded ends.

VALVES.--

Gate valve (NPS 2 1/2 and smaller).--

Gate valve (NPS 2 1/2 and smaller) shall be bronze body and trim, removable bonnet and non rising stem, Class 125 and same size as pipe in which installed. Gate valve shall be Crane, 438; Nibco Scott, T-113; Jenkins, 370; or equal.

Gate valve in nonferrous water piping systems may be solder joint type with bronze body and trim. Valve shall be Kitz, 59; Nibco Scott, S-113; Jenkins, 1240; or equal.

Gate valve (NPS 3 and larger, above ground).--

Gate valve (NPS 3 and larger, above ground) shall be iron body with bronze trim, removable bonnet and non-rising stem, class 125 and same size as pipe in which installed. Gate valve shall be Crane, 461; Nibco Scott, F-619; Jenkins, 326; or equal.

Ball valve.--

Ball valve shall be two piece, minimum 2760 kPa WOG, bronze body and chrome plated or brass ball with full size port. Valve shall be Nibco Scott, T-580; Watts, B-6000; Kitz, 56; or equal.

CLEANOUTS.--

Cleanout to grade.--

Cleanout to grade shall be cast iron ferrule type. Plug shall be countersunk brass or bronze with tapered threads. Cleanout to grade shall be Wade, No. W-8450; Smith, 4420; Zurn, No 1440; or equal.

MISCELLANEOUS ITEMS.--

Floor Sink.—

The floor sink shall be stainless steel, 300 mm square by 150 mm deep with an NPS 3 outlet. The floor sink shall include a stainless steel dome strainer, raise rim and a square flange.

Supports.—

Pipe supports shall be assembled from standard products of the types and load ratings as shown on the plans. All metal parts shall be galvanized at the factory or shall be hot dip galvanized after assembly. Load ratings shall be submitted for each component and shall be greater then the load on the support.

PART 3.- EXECUTION

INSTALLATION.--

INSTALLATION OF PIPES AND FITTINGS.--

Pipe and fittings.--Pipe and fittings shall be installed in accordance with the following designated uses:

Designated Use	Pipe and Fitting Class
Drain and vent piping underground within 1.5 m of the building	C1 or C2
Vent piping above ground in building	C1, or C2
Drain pipe, 1.5 m beyond the building	C1, C2,
Compressed air	A1
Equipment drains and relief valve discharge	H3 or A1

Installing piping.--Water piping shall be installed generally level, free of traps and bends, and arranged to conform to the building requirements.

Piping installed underground shall be tested as specified elsewhere in these special provisions before backfilling.

Piping shall be installed parallel to walls. All obstructions shall be cleared, headroom preserved and openings and passageways kept clear whether shown or not. Piping shall not interfere with other work.

Where pipes pass through exterior walls, a clear space around pipe shall be provided. Space shall be caulked water tight with silicone caulk.

Forty-five degree bends shall be used where offsets are required in venting. Vent pipe headers shall be sloped to eliminate any water or condensation.

Vent piping shall extend a minimum of 200 mm above the roof.

Drainage pipe shall be run as straight as possible and shall have easy bends with long turns.

Wye fittings and 1/8 or 1/16 bends shall be used where possible. Long sweep bends and combination Wye and 1/8 bends may be used only for the connection of branch pipes to fixtures and on vertical runs of pipe.

Pipe sleeves.--The Contractor shall provide sleeves, inserts and openings necessary for the installation of pipe, fittings and valves. Damage to surrounding surfaces shall be patched to match existing.

PVC pipe sleeves shall be provided where each pipe passes through concrete floors, footings, walls or ceilings. Inside diameter of sleeves shall be at least 20 mm larger than outside diameter of pipe. Sleeves shall be installed to provide at least 10 mm space all around pipe the full depth of concrete. Space between pipes and pipe sleeves shall be caulked watertight.

Cutting pipe.--All pipe shall be cut straight and true and the ends shall be reamed to the full inside diameter of the pipe after cutting.

Damaged pipe.--Pipe that is cracked, bent or otherwise damaged shall be removed from the work.

Pipe joints and connections.--Joints in threaded steel pipe shall be made with teflon tape or a pipe joint compound that is nonhardening and noncorrosive, placed on the pipe and not in the fittings.

The use of thread cement or caulking on threaded joints will not be permitted. Threaded joints shall be made tight. Long screw or other packed joints will not be permitted. Any leaky joints shall be remade with new material.

Cleaning and closing pipe.--The interior of all pipe shall be cleaned before installation. All openings shall be capped or plugged as soon as the pipe is installed to prevent the entrance of any materials. The caps or plugs shall remain in place until their removal is necessary for completion of the installation.

Securing pipe.--Pipe in the buildings shall be held in place by iron hangers, supports, pipe rests, anchors, sway braces, guides or other special hangers. Material for hangers and supports shall be compatible with the piping or neoprene isolators shall be used. Allowances shall be made for expansion and contraction. Steel pipe shall have hangers or supports every 3 m. Copper pipe NPS 1 or smaller shall have hangers or supports every 2 m and sizes larger than NPS 1 shall have hangers or supports every 3 m. Cast iron soil pipe with neoprene gaskets shall be supported at each joint. Vertical pipes shall be supported with clamps or straps. Horizontal and vertical piping shall be securely supported and braced to prevent swaying, sagging or flexing of joints.

Hangers and supports.--Hangers and supports shall be selected to withstand all conditions of loading to which the piping and associated equipment may be subjected and within the manufacturer's load ratings. Hangers and supports shall be spaced and distributed so as to avoid load concentrations and to minimize the loading effect on the building structure.

Hangers and supports shall be sized to fit the outside diameter of pipe or pipe insulation. Hangers shall be removable from around pipe and shall have provisions for vertical adjustment after erection. Turnbuckles may be used.

Materials for holding pipe in place shall be compatible with piping material.

Union.—Unions or flanges shall be installed where shown and at each threaded connection to equipment and tanks. Unions shall be located so piping can be easily disconnected for removal of equipment or tanks.

INSTALLATION OF CLEANOUTS.--

Cleanouts.--A concrete pad 0.5 m long and 100 mm thick shall be placed across the full width of trench under cleanout Wye or 1/8 bend. Cast iron soil pipe (C1 or C2) and fittings shall be used from Wye to surface. Required clearance around cleanouts shall be maintained.

Cleanout risers outside of a building installed in a surface other than concrete shall terminate in a cleanout to grade. Cleanout to grade shall terminate in a valve box with cover marked "CO-SS". Top of box shall be set flush with finished grade. Cleanout plug shall be 100 mm below grade and shall be located in the box to provide sufficient room for rodding.

FIELD QUALITY CONTROL.--

Testing.--The Contractor shall test piping at completion of roughing in, before backfilling, and at other times as directed by the Engineer.

The system shall be tested as a single unit, or in sections as approved by the Engineer. The Contractor shall furnish necessary materials, test pumps, instruments and labor and notify the Engineer at least 3 working days in advance of testing. After testing, the Contractor shall repair all leaks and retest to determine that leaks have been stopped. Surplus water shall be disposed of after testing as directed by the Engineer.

The Contractor shall take precautions to prevent joints from drawing while pipes and appurtenances are being tested. The Contractor shall repair damage to pipes and appurtenances or to other structures resulting from or caused by tests.

General tests.--All piping shall be tested after assembly and prior to backfill, and covering the pipe. Systems shall show no loss in pressure or visible leaks.

The Contractor shall test systems according to the following schedule for a period of not less than 4 hours:

Test Schedule		
Piping System	Test Pressure	Test Media
Drain and vent	250 mm head	Water
Air	860 kPa	Air

Drains shall be cleared of obstructions before testing for leakage. The pipe shall be proved clear of obstructions by pulling an appropriate size inflatable plug through the pipe. The plug shall be moved slowly through the pipe with a tag line. The Contractor shall remove or repair any obstructions or irregularities.

Drain pipes beyond 1.5 m perpendicular to the building shall be tested for leakage for a period of not less than 4 hours by filling with water to an elevation of 1.2 m above average invert of sewer or to top of manholes where less than 1.2 m deep. The system shall show no visible leaks.

12-15.03 VENTILATING AND AIR CONDITIONING EQUIPMENT AND SYSTEMS

PART 1.- GENERAL

Scope.--This work shall consist of furnishing, installing and testing ventilating and air conditioning (HVAC) equipment and systems in accordance with the details shown on the plans and these special provisions.

The performance rating and electric service of the HVAC equipment shall be as shown on the plans.

Temperature controls.--Thermostats, relays, timer switches, and other sensor type control devices required for this work shall be furnished and installed by the supplier of the ventilating and air conditioning equipment. All temperature control wiring shall be furnished and installed in accordance with the requirements specified in Section 12-16, "Electrical," of these special provisions.

Codes and standards.--Equipment and systems shall conform to California State Energy Commission Regulations and, where applicable, shall be American Refrigeration Institute (ARI), Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), and Air Movement and Control Association (AMCA) approved for performance ratings and application shown on the plans.

Any appliance for which there is a California standard established in the Appliance Efficiency Standards may be installed only if the manufacturer has certified to the Commission, as specified in those regulations, that the appliance complies with the applicable standards for that appliance. Space conditioning equipment may be installed only if the

manufacturer has certified that the equipment meets or exceeds all applicable efficiency requirements listed in the Energy Efficiency Standards.

PART 2.- PRODUCTS

COOLING UNITS.--

Cooling unit (single package - rooftop).--

Cooling unit shall be standard, commercial quality, single package, curb pump mounted unit with weatherproof acoustically lined cabinet. The cabinet shall have convenient access panels and a baked-on enamel finish. The roof curb shall be insulated and shall be supplied by the unit manufacturer.

Compressor shall be hermetically sealed unit, vibration isolated, with quick-start components, short cycling protection, pressure relief valve, high and low pressure switches, liquid-line filter-dryer and crankcase heater.

Indoor air blower shall be direct or adjustable V-belt drive type. The fan and fan motor shall provide the specified air flow, with wet coil, against the external static pressure as noted on the plans.

Motors shall have integral thermal overload protection.

Unit shall be equipped with a low ambient temperature kit.

HVAC CONTROLS.--

Thermostat.--

Thermostat shall be low voltage, heating and cooling thermostat with setback and shall be provided with an independent thermometer.

AUXILIARY HVAC COMPONENTS.--

Unless specified herein, all components shall be sized and have the characteristics as shown on the plans.

Rigid ductwork.--

Rigid ductwork shall be galvanized steel sheet metal conforming to the latest edition of the SMACNA "Low Velocity Duct Construction Standards." Galvanized steel shall be cleaned by washing with mineral spirit solvent sufficient to remove any oil, grease or other materials foreign to the galvanized coating.

Duct supports.--

Duct supports shall be hot-dip galvanized steel.

Flexible connection.--

Flexible connection shall be prefabricated type and shall be commercial quality flexible glass fabric coated on both sides with neoprene or hypalon.

Concentric converter assembly.—

Concentric converter assembly shall include double deflection diffusers with adjustable aluminum louvers, center return with removable aluminum grille, molded fiberglass interior transition with supply air turning vanes, and duct connection collars.
Unit shall be factory assembled, internally sealed and supplied with hanging support. Concentric converter assembly shall be Micro Melt; Stiles; or equal

Insulated adapter.—

Insulated adapter pan shall be curb mounted, 24-gage galvanized steel, internally insulated with duct connection collars. Adapter pan shall match concentric converter assembly. Adapter pan shall be Micro Melt; Stiles; or equal.

Air filter (for HVAC units).--

Air filter shall be permanent metal viscous impingement type, constructed of aluminum or galvanized steel, 50 mm minimum thickness and be approved for Class 2 use. Filter shall have a minimum efficiency rating of 50 percent as determined when tested in accordance with ASHRAE Test Standard 52. Filter shall be mounted in 1.52 mm (16-gage) galvanized steel holding frames. Two cans of recharging adhesive shall be provided with the filter and shall be nearly odorless, have a high flash point, rapid wetting characteristics, dye tracer and be water soluble. Filter shall be Airspan, Type AF, Eco-Air Products, Inc., Type HIA; Snyder General, Type AAF; or approved equal.

Condensate drain piping.--

Condensate drain piping shall be rigid, Type L copper tubing with brazed solder fittings.

PART 3.- EXECUTION

INSTALLATION.--

Condensate drains.--Air conditioning units shall be provided with condensate drain trap and piping. Outdoor piping shall extend to the nearest roof drain, gutter or as shown on the plans. Air gap shall be installed where required by code.

Ducts and vents.--Ductwork within the building shall be installed to clear lighting fixtures, doors, windows and other obstructions. Ductwork shall preserve head room and shall keep openings and passageways clear whether shown on plans or not.

Ductwork shall be installed and braced according to the latest edition of the SMACNA "HVAC Duct Construction Standards."

Slopes in sides at transitions shall be approximately one to five. The ductwork system shall not contain abrupt changes or offsets of any kind unless otherwise shown on the plans.

Duct sections shall be connected by beaded sleeve-type couplings using joint sealer as recommended by the duct manufacturer. Duct sections shall be mechanically fastened with pop rivets or sheet metal screws and sealed with mastic or insulated, reinforced silver tape.

All standing seams and transverse joints of supply, return and exhaust ducts and seams around plenums, fan and coil housings shall be sealed with sealant and taped.

FIELD QUALITY CONTROL.--

Pre-test requirements.--Before starting or operating systems, equipment shall be cleaned and checked for proper installation, lubrication and servicing.

Final adjustments and balancing of the systems shall be performed in such a manner that the systems will operate as specified and as shown on the plans.

The Contractor shall replace or revise any equipment, systems or work found deficient during tests.

All automatic operating devices which are pertinent to the adjustment of the aforementioned air systems shall be set and adjusted to deliver the required quantities of air and at temperatures specified by the Engineer. All control work shall be done in collaboration with the control manufacturer's representative.

Project completion tests.--The Engineer shall be notified at least 3 working days in advance of starting project completion tests.

Upon completion of mechanical work and pre-test requirements, or at such time prior to completion as determined by the Engineer, the Contractor shall operate and test installed mechanical systems for at least 3 consecutive 8-hour days to demonstrate satisfactory overall operation.

SECTION 12-16. ELECTRICAL

12-16.01 SUBSTATION ELECTRICAL WORK

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of performing electrical work associated with the substation in accordance with the details shown on the plans and these special provisions.

Electrical work shall include furnishing all labor, materials, equipment and services required to construct and install the complete electrical system shown on the plans and the work of installing electrical connections for the thermostats, exhaust fan, air conditioners, air compressors, and controls specified elsewhere in these special provisions.

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.

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 work shall be done in accordance with the requirements specified for similar work elsewhere in these special provisions.

QUALITY ASSURANCE.--

Codes and standards.--All work performed and materials installed shall be in accordance with the National Electrical Code; the California Building Standards Code, Title 24, Part 3, "California Electrical Code," and the California Code of Regulations, Title 8, Chapter 4, "Electrical Safety Orders," and all state ordinances.

Warranties and guarantees.--Manufacturer's warranties and guarantees for materials or equipment used in the work shall be delivered to the Engineer at the jobsite prior to acceptance of the contract.

TESTING.--

After the electrical system installation work has been completed, the electrical system shall be tested in the presence of the Engineer to demonstrate that the electrical system functions properly. The Contractor shall make necessary repairs, replacements, adjustments and retests at his expense. The contractor shall provide 3-phase, 480/277-volt, 60 hz power to Panelboard A for the duration of equipment testing. Three phase power supplied shall be of sufficient size to run all the substation electrical and mechanical equipment at the same time.

12-16.02 BASIC MATERIALS AND METHODS

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing conduits, conductors, fittings, and wiring devices in accordance with the details shown on the plans and these special provisions.

Conduits, conductors, fittings, and wiring devices shall include those accessories and appurtenances, not mentioned, that are required for the proper installation and operation of the electrical system.

Related work.--Roof penetrations shall be flashed and sealed watertight conforming to the requirements specified under "Sheet Metal Flashing" in Section 12-7, "Thermal and Moisture Protection," of these special provisions.

SUBMITTALS.--

Product data.--A list of materials and equipment to be installed, manufacturer's descriptive data, and such other data as may be requested by the Engineer shall be submitted for approval.

Manufacturer's descriptive data shall include complete description, performance data and installation instructions for the materials and equipment specified herein. Control and wiring diagrams, rough-in dimensions for recessed junction and pull boxes, and component layout shall be included where applicable. All control and power conductors on the shop drawings shall be identified with wire numbers.

Manufacturer's descriptive data shall be submitted for the following:

Panelboard A
Panelboard B
DS-1 (total 2)
Compressor disconnect switch (total 2)
Transformer A
Light Switch
Magnetic Contact Switch
Conductors
Conduits
Ground Bus
Lighting Fixtures
Ground rods
Ground well box
Exothermic welds

PART 2.- PRODUCTS

CONDUITS AND FITTINGS.--

Rigid steel conduit and fittings.--

Rigid steel conduit shall be threaded, full weight rigid steel, hot-dip galvanized inside and outside with steel or malleable iron fittings. Fittings shall be threaded unless otherwise specified or shown on the plans.

Split or three-piece couplings shall be electroplated, malleable cast iron couplings.

Insulated grounding bushings shall be threaded malleable cast iron body with plastic insulated throat and steel, lay-in ground lug with compression screw.

Insulated metallic bushings shall be threaded malleable cast iron body with plastic insulated throat.

Electrical metallic tubing (EMT) and fittings.--

Electrical metallic tubing shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam with zinc coating outside and enamel or lacquer coating inside.

Couplings shall be electroplated, rain and concrete tight, gland compression type, steel body couplings with malleable iron nuts.

Connectors shall be electroplated, rain and concrete tight, gland compression type, steel body connectors with male hub, malleable iron nut and insulated plastic throat.

Liquid tight flexible metallic conduit and fittings.--

Liquid tight flexible metallic conduit shall be fabricated in continuous length from galvanized sheet steel, spirally wound and formed to provide an interlocking design with an extruded polyvinyl chloride cover.

Fittings shall be electroplated, malleable cast iron body, with cap nut, grounding ferrule, and connector body with insulated throat.

Rigid non-metallic conduit and fittings.--

Rigid non-metallic conduit shall be Schedule 40, high impact, nonconducting, self-extinguishing polyvinyl chloride (PVC) rigid non-metallic conduit for direct underground burial.

Couplings shall be PVC, socket type or thread on one end and socket type on the other end as required for the particular application.

Terminal adapters for adapting PVC conduit to boxes, threaded fittings, or metallic conduit system shall be PVC adapters with threads on one end and socket type on the other end.

CABLES AND CONDUCTORS.--

Cables.--

Cables shall be stranded copper wire.

Conductors.--

Conductors shall be stranded copper wire.

Conductor insulation types unless otherwise shown or specified, shall be as follows:

1. Conductors across hinges of control panel enclosures shall be Type MTW.
2. Conductors shall be type XHHW in wet and outdoor locations.
3. Conductors shall be type THHN in dry locations.
4. Conductors for ground ring shall be bare stranded copper wire.

Wire connections and devices.--

Wire connections and devices shall be pressure or compression type, except that connectors for No. 10 AWG and smaller conductors in dry locations may be preinsulated spring-pressure type.

ELECTRICAL BOXES.--

Outlet, device and junction boxes.--

Unless otherwise shown or specified, boxes shall be galvanized steel boxes with knock-outs and shall be the size and configuration best suited to the application indicated on the plans. Minimum size of outlet, receptacle, switch or junction boxes shall be 100 mm square by 40 mm deep, except that switch boxes for the installation of single switches and outlet boxes for flush-mounted light fixtures shall be 50 mm by 75 mm by 40 mm deep.

Multiple switches shall be installed in standard gang boxes, unless otherwise specified or shown on the plans.

Cast metal boxes shall be cast iron boxes with threaded hubs and shall be of the size and configuration best suited to the application shown on the plans.

Flush-mounted boxes shall have stainless steel covers, one mm thick. Cover screws shall be metal with finish to match cover finish.

Unless otherwise shown or specified, surface-mounted boxes shall have galvanized steel covers with metal screws.

Weatherproof junction boxes shall have cast metal covers with gaskets.

Weatherproof switch and receptacle boxes shall have gasketed covers with gasketed hinged flaps to cover switches and receptacles.

Underground pull boxes.--

Pull boxes shall be high density reinforced concrete box with ultraviolet inhibitor polyethylene etched face anchored in concrete and fiberglass cover with hold down bolts. The polyethylene and fiberglass material shall be fire

resistant and show no appreciable change in physical properties with exposure to the weather. No. 3 1/2 pull box shall be Brooks Products, No. 3 1/2; Christy Concrete Products, N9; or equal. No. 5 pull box shall be Brooks Products No. 5; Christy Concrete Products, N30; or equal.

Traffic rated pull boxes shall be high density reinforced concrete box with steel cover with hold down bolts and bonding strap. Pull box and cover shall be designed for H20 loading. No. 3 1/2 pull box shall have inside dimensions of 270 mm by 440 mm and No. 5 pull box shall have inside dimensions of 335 mm by 610 mm.

RECEPTACLES AND SWITCHES.--

Duplex receptacles.--

Duplex receptacles shall be NEMA Type 5-20R, 3-wire, 20-ampere, 125-volt AC, safety grounding, ivory color, specification grade receptacle suitable for wiring with stranded conductors.

Timer switch.--

Timer switch shall be spring wound, single-pole, single throw switch, rated for 0.75 kW at 120 volts, AC. The timer switch shall fit in a single gang box. The timer switch shall be adjustable from 0 to 60 minutes.

MISCELLANEOUS MATERIALS.--

Warning Tape.--

Warning tape shall be 100 mm wide and contain the printed warning "CAUTION ELECTRICAL CONDUIT" in bold 19 mm black letters at 760 mm intervals on bright orange or yellow background. The printed warning shall be non-erasable when submerged under water and resistant to insects, acids, alkali, and other corrosive elements in the soil. The tape shall have a tensile strength of not less than 70 kg per 100 mm wide strip and shall have a minimum elongation of 700 percent before breaking.

Pull ropes.—

Pull ropes shall be nylon or polypropylene with a minimum tensile strength of 8000 N.

Watertight conduit plugs.--

Watertight conduit plugs shall be a hollow or solid stem expansion plugs complete with inner and outer white polypropylene compression plates and red thermoplastic rubber seal. Seal material shall be non-stick type rubber resistant to oils, salt, and alkaline substances normally available at the construction sites.

Anchorage devices.--

Anchorage devices shall be corrosion resistant, toggle bolts, wood screws, bolts, machine screws, studs, expansion shields, and expansion anchors and inserts.

Electrical supporting devices.--

Electrical supporting devices shall be one hole conduit clamps with clamp backs, hot-dipped galvanized, malleable cast iron.

Construction channel shall be 41 mm x 41 mm, 2.66 mm (12-gage) galvanized steel channel with 13 mm diameter bolt holes, 40 mm on center in the base of the channel.

Ground rod(s).--

Ground rod(s) shall be a 19 mm (minimum) galvanized or copper clad steel rod, 3 meters long.

Ground Bus.--

Ground bus shall be a solid copper bar of the size shown on the plans. It shall have holes drilled in it for terminating ground conductors. It shall come with mounting brackets, holes and instructions as required for installation.

Exothermic weld.--

Ground ring conductor connection to ground rods and ground conductor to ground ring conductor connection shall be fusion welded type made by molten copper flowing into weld cavity of a properly fitted graphite mold. Molten copper metal shall be a mixture of copper oxide and aluminum.

Exothermic welding equipment.--

The welder size and shape and weld metal size and shape shall be as recommended by the manufacturer. Exothermic welding equipment shall be ERICO Products, Inc., "Cadweld Process"; CONTENENTAL Industries, Inc., "Thermoweld Process"; or equal.

PART 3.- EXECUTION

INSTALLATION.--

Conduit, general.--Rigid steel conduit shall be used unless otherwise shown on the plans or specified in these special provisions.

Electrical metallic tubing may be used in furred spaces and for exposed work indoors above the switch height.

Unless otherwise specified or shown on the plans, liquid-tight flexible metal conduit shall be used to connect motors, HVAC equipment, and other equipment subject to vibration.

Conduit installation.--Conduit trade sizes are shown on the plans. No deviation from the conduit size shown on the plans will be permitted without written permission from the Engineer.

Conduit shall be concealed unless otherwise shown on the plans.

Conduits shall be tightly covered and well protected during construction using metallic bushings and bushing "pennies" to seal open ends.

A pull rope shall be installed in all empty conduits. At least one meter of pull rope shall be doubled back into the conduit at each termination.

Locations of conduit runs shall be planned in advance of the installation and coordinated with the ductwork, plumbing, ceiling and wall construction in the same areas and shall not unnecessarily cross other conduits or pipe, nor prevent removal of ceiling tiles or panels, nor block access to mechanical or electrical equipment.

Where practical, conduits shall be installed in groups in parallel, vertical or horizontal runs and at elevations that avoid unnecessary offsets.

Exposed conduit shall be installed parallel and at right angles to the building lines.

Conduits shall not be placed closer than 300 mm from a parallel hot water or steam pipe or 75 mm from such lines crossing perpendicular to the runs.

All raceway systems shall be secured to the building structures using specified fasteners, clamps and hangers.

Single conduit runs shall be supported by using one hole pipe clamps. Where run horizontally on walls in damp or wet locations, conduit shall be installed with "clamp backs" to space conduit off the surface.

Multiple conduit runs shall be supported with construction channel secured to the building structure. Conduits shall be fastened to construction channel with channel compatible pipe clamps.

Raceways of different types shall be joined using approved couplings or transition fittings.

Expansion couplings shall be installed where conduit crosses a building separation or expansion joint.

All floor and wall penetrations shall be sealed water-tight.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or cylindrical wire brush and blown out with compressed air.

Conduit terminations.--Rigid steel conduits shall be securely fastened to cabinets, boxes and gutters using 2 locknuts and specified insulating metallic bushing. Electrical metallic tubing shall be securely fastened to cabinets, boxes and gutters using specified connectors. Conduit terminations at exposed weatherproof enclosures and cast outlet boxes shall be made watertight using specified hubs.

Grounding bushings with bonding jumpers shall be installed on all type of conduits terminating at concentric knockouts and on all conduits containing service conductors, grounding electrode conductor, and conductors feeding separate buildings.

All future conduits terminated in underground pull boxes or exposed indoor and outdoor shall be provided with watertight conduit plugs.

Warning Tape.--Warning tape shall be placed over each conduit in a trench. Each warning tape shall be centered over the conduit and shall be placed over the 150 mm layer of sand covering the conduit as described elsewhere in these special provisions.

Conductor and cable installation.--Conductors shall not be installed in conduit until all work of any nature that may cause injury is completed. Care shall be taken in pulling conductors that insulation is not damaged. An approved non-petroleum base and insulating type pulling compound shall be used as needed.

All cables shall be installed and tested in accordance with manufacturer's recommendations.

Splices and joints shall be insulated with insulation equivalent to that of the conductor.

Provide 155 mm of slack at each outlet and device connection. If the outlet or device is not at the end of a run of wire, connection shall be made with correctly colored pigtails tapped to the runs with splices as specified herein.

Branch circuit conductors in panelboards and load centers shall be neatly trained along a path from the breaker terminals to their exit point. The conductors shall have ample length to transverse the path without strain, but shall not be so long as to require coiling, doubling back, or cramming. The path shall transverse the panelboard gutter spaces without entering a gutter containing service conductors and, unless otherwise shown on the plans, without entering the gutter space of any panelboard feeder.

All pressure type connectors and lugs shall be retightened after the initial set.

Splices in underground pull boxes and similar locations shall be made watertight.

Conductor identification.--The neutral and equipment grounding conductors shall be identified as follows:

Neutral conductor shall have a white or natural gray insulation except that conductors No. 4 and larger may be identified by distinctive white marker such as paint or white tape at each termination.

Equipment grounding conductor shall be bare or insulated. If insulated, equipment grounding conductors shall have green or green with one or more yellow stripes insulation over its entire length except that conductors No. 4 and larger may be permanently identified by distinctive green markers such as paint or green tape over its entire exposed insulation.

Feeder and branch circuit ungrounded conductors shall be color coded by continuously colored insulation, except conductors No. 6 AWG or larger may be color coded by colored tape at each connection and where accessible. Ungrounded conductor color coding shall be as follows:

SYSTEM	COLOR CODE
120/240V-Single phase	Black, blue
277/480V-Three phase	Brown, orange, yellow

Where more than one branch circuit enters or leaves a conduit, panel, gutter, or junction box, each conductor shall be identified by its panelboard and circuit number. All control conductors including control conductors of manufacturer supplied and field wired control devices shall be identified at each termination with the wire numbers shown on the plans, approved working drawings, and as directed by the Engineer where deemed necessary. Identification shall be made with one of the following:

1. Adhesive backed paper or cloth wrap-around markers with clear, heat shrinkable tubing sealed over either type of marker.
2. Self-laminating wrap around type, printable, transparent, permanent heat bonding type thermoplastic film markers.
3. Pre-printed, white, heat-shrinkable tubing.

Each terminal block shall have a molded marking strip attached with screws. The identifying numbers of the terminating conductors, as shown on the plans or on the submittal drawings, shall be engraved in the marking strip.

Outlet, device and junction box installation.--Where one or more threaded steel conduits are required to connect to an outlet, device, or junction box, the box shall be a cast metal box with threaded hubs. Unless otherwise shown on the plans or specified in these special provisions, all other boxes shall be sheet steel boxes. Weatherproof outlet, device and junction boxes shall have cast metal covers with gaskets. Unless otherwise shown on the plans or specified in these special provisions, all other boxes shall have standard galvanized covers.

All boxes shall finish flush with building walls, ceiling and floors except where exposed work is called for.

No unused openings shall be left in any box. Knockout seals shall be installed as required to close openings.

Outlet, device, and junction boxes shall be installed at the locations and elevations shown on the plans or specified herein. Adjustments to locations may be made as required by structural conditions and to suit coordination requirements of other trades.

Fixture outlet boxes installed in suspended ceilings of gypsum board or lath and plaster construction shall be mounted on 1.52 mm (16-gage) metal channel bars attached to main ceiling runners.

Fixture outlet boxes for pendant-mounted fixtures installed in suspended ceilings supporting acoustical tiles or panels shall be supported directly from the structures above.

Underground pull box installation.--Electrical pull box covers or lids shall be marked "ELECTRICAL." Telephone service pull box covers or lids shall have plain, unmarked covers.

The bottom of pull boxes shall be bedded in 155 mm of clean, crushed rock or gravel and shall be grouted with 40 mm thick grout prior to installation of conductors. Grout shall be sloped to a 25 mm PVC pipe drain hole. Conduit shall be sealed in place with grout.

Top of pull boxes shall be flush with surrounding grade or top of curb. In unpaved areas where pull box is not immediately adjacent to and protected by a concrete foundation, pole or other protective construction, the top of pull box shall be set at plus 30 mm above surrounding grade. Pull boxes shown on the plans in the vicinity of curbs shall be placed adjacent to the back of curb. Pull boxes shown on the plans adjacent to lighting standards shall be placed on the side of foundation facing away from traffic.

Ground well box installation.—Ground well box covers shall have plain, unmarked covers. The bottom of boxes shall be bedded in 155 mm of clean, crushed rock or gravel. Installation shallbe as shown on the plans.

Ground rod(s) installation.--The ground rod(s) for the ground ring shall be driven vertically until the top is 155 mm below the finished grade. When vertical penetration of the ground rod cannot be obtained, an equivalent horizontal grounding system, approved by the Engineer, shall be installed. The ground rods shall be bonded to the ground ring conductor by means of exothermic welds.

Anchorages.--Hangers, brackets, conduit straps, supports, and electrical equipment shall be rigidly and securely fastened to surfaces by means of toggle bolts on hollow masonry; expansion shields and machine screws, or expansion anchors and studs or standard preset inserts on concrete or solid masonry; machine screws or bolts on metal surfaces; and wood or lag screws on wood construction.

Anchorage devices shall be installed in accordance with the anchorage manufacturer's recommendations.

Mounting heights.--Electrical system components shall be mounted at the following mounting heights, unless otherwise shown on the plans. The mounting height dimensions shall be measured above the finished floor to the bottom of the device or component.

Thermostats	1.1 m
Wall switches	1.0 m
Convenience outlets	1.25 m

TESTING.--

Exothermic welding test.-- Welds shall be tested by striking around the weld with a one kg hammer while the conductor is being pulled. For this test, the conductor shall be pulled parallel to the weld surface, and the weld shall be struck with the hammer at an angle of 45 degrees to the surface. Defective welds shall be removed and replaced at the Contractor's expense.

12-16.03 ELECTRICAL EQUIPMENT

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing panelboards, disconnect switches, transformers, and related accessories in accordance with the details shown on the plans and these special provisions.

Related work.--Anchorage devices shall be as specified under "Basic Materials and Methods" elsewhere in this Section 12-16.

SUBMITTALS.--

Product data.--A list of materials and equipment to be installed, manufacturer's descriptive data, and such other data as may be requested by the Engineer shall be submitted for approval.

Manufacturer's descriptive data shall include complete description, performance data and installation instructions for the materials and equipment specified herein. Control and wiring diagrams, rough-in dimensions, and component layout shall be included where applicable. All control and power conductors on the shop drawings shall be identified with wire numbers.

PART 2.- PRODUCTS

PANELBOARDS.--

Panelboard _A.--

Panelboard A shall be indoor type, surface-mounted, factory assembled, 3-phase, 4-wire, 480/277-volt, AC panelboard 500 mm wide with 100-ampere main circuit breaker, insulated groundable neutral, hinged door and molded case branch circuit breakers as shown on the plans. Panel shall be Square D Company, Type NQOD; Westinghouse, Type AQ; General Electric, Type Power-R-Line 1; or equal.

Panelboard B.--

Panelboard B shall be indoor type, surface-mounted, factory assembled, single-phase, 3-wire, 120/240-volt, AC panelboard 500 mm wide with 70-ampere main circuit breaker, insulated groundable neutral, hinged door and molded case branch circuit breakers as shown on the plans. Panels shall be Square D Company, Type NQOD; Westinghouse, Type AQ; General Electric, Type Power-R-Line 1; or equal.

SWITCHES.--

Air conditioner disconnect switch, DS-1 (total 2).--

Air Conditioner Disconnect switch shall be 3-pole, 600-volt, AC, 30-ampere, fused, heavy duty safety switch in a NEMA-3R enclosure. The fuses shall be sized to suit the air conditioning unit furnished.

Compressor disconnect switch (total 2).--

Compressor disconnect switch shall be 3-pole, 600-volt, AC, 400-ampere, fused, heavy duty safety switch in a NEMA-1 enclosure with provision for padlocking in the "OFF" position.

TRANSFORMER.--

Transformer A.--

Transformer A shall be indoor, dry type, wall mounted, 3-phase, 480-volt primary, 120/240-volt secondary, 30-kVA transformer with NEMA Type 1 enclosure. Transformer shall have two 2 1/2 percent full capacity taps above and four 2 1/2 percent full capacity taps below normal primary voltage.

MISCELLANEOUS MATERIALS.--

Nameplates.--

Nameplates shall be laminated phenolic plastic with white core and black front and back. Nameplate inscription shall be in capitals letters etched through the outer layer of the nameplate material.

PART 3.- EXECUTION

INSTALLATION.--

Panelboard installation.--Set cabinets plumb and symmetrical with building lines. Train interior wiring as specified under "Conductor and Cable Installation" in "Basic Materials and Methods" of these special provisions. Touch-up paint any marks, blemishes, or other finish damage suffered during installation. Replace cabinets, doors or trim exhibiting dents, bends, warps or poor fit which may impede ready access, security or integrity.

Mounting height shall be 1.4 meters to the highest circuit breaker handle, measured above the finished floor.

Where "Future" or "Space" is indicated on the plans, branch connectors, mounting brackets, and other hardware shall be furnished and installed for future breaker.

A typewritten directory under transparent protective cover shall be provided and set in metal frame inside each cabinet door. Directory panel designation for each circuit breaker shall include complete information concerning equipment controlled, including room number or area designated on the plans.

Transformer installation.--Connect primary to minimum value taps during construction period and prior to initial building start-up. Make voltage readings and adjust tap connections to nominal voltage during final construction review and prior to building occupancy. Install conduit connections which will prevent transmission of the transformer vibrations to the conduit system. Transformer shall be bolted to wall with support brackets when wall mounted.

Equipment identification.--Equipment shall be identified with nameplates fastened with self-tapping, cadmium-plated screws or nickel-plated bolts.

Nameplate inscriptions shall read as follows:

Item	Letter height, mm	Inscription
Panelboard A	6	Panelboard A 480/277 V, 3 Phase, 4 Wire
Panelboard B	6	Panelboard B 120/240 V, 3 Phase, 4 Wire
DS-1 (total 2)	6	AC Disconnect
Air Compressor DS (total 2)	6	Compressor Disconnect Switch
Transformer A	6	Transformer, 30 KVA, 480 Volt, Single Phase Primary, 120/240 volt Secondary

12-16.04 LIGHTING

GENERAL.--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.

SUBMITTALS.--Manufacturer's descriptive information, photometric curves, catalog cuts, and installation instructions shall be submitted for approval.

PRODUCTS.--

Lighting fixture lamps.--

Lighting fixture lamps shall be type and size as shown on the plans. Lamps shall be General Electric, Phillips, Sylvania, or equal. Fluorescent lamps, unless otherwise noted, shall be 4100K tri-phosphor with a CRI of 70 or greater.

Ballasts.--

All fixtures shall be equipped with high power factor ballasts suitable for the line voltage and for the type, size and number of lamps required by the fixture. Fluorescent ballasts shall be UL Listed, Class P and ETL Certified ballasts with sound rating A. Fluorescent ballasts shall be high-frequency electronic ballasts with power factor greater then 0.95, nominal ballast factor of 0.88 unless specified otherwise, total harmonic distortion less than 20 percent, crest factor less than or equal to 1.7, complying with ANSI C 62.41 Category A for surge protection, and FCC Part 18 for interference. Dimming ballasts shall be high frequency ballasts as specified above and shall be capable of dimming the light output from 100 percent to 20 percent of the rated light output.

Lighting fixtures.--

Lighting fixtures shall be as shown on the plans and as specified herein. Outdoor luminaires shall be listed and labeled "Fixture Suitable For Wet Locations."

F1.--

Ceiling-mounted fluorescent fixture with two F40 lamps, electronic ballast and one-piece, clear acrylic, wrap-around diffuser. The fixture shall be Day Brite, Catalog No. AWN 240; Keystone Lighting, Catalog No. PRN 240-A; Lithonia, Catalog No. LB 240; or equal.

H1.--

Outdoor, wall mounted, 70-watt, 120-volt high pressure sodium luminaire with integral ballast and built-in photocell. The luminaire shall be Holophane, Catalog No. WL2K-070HP-12-BK-F1 with WL2KKPR12 ; ITT, Catalog No. 181-562E1 ; Daybrite, catalog No. WLM 70HS 12 PE ; Lithonia, Catalog No. TWH 70S 120 PE ; or equal.

EXECUTION.--

LIGHTING FIXTURES.--Lighting fixtures shall be mounted securely in accordance with the manufacturer's recommendations. Mounting methods shall be suitable for the particular type of ceiling or support at each location.

The Contractor shall provide all supports, hangers, spacers, channels, fasteners and other hardware necessary to support the fixtures.

Fixtures shall be set at the mounting heights shown on the plans, except heights shown shall be adjusted to meet conditions.

BALLASTS.--All fluorescent fixtures shall be equipped with high power factor ballasts suitable for the line voltage and for the type, size and number of lamps required by fixture. All ballasts used in unheated areas inside the building shall be -20°C ballasts or less.

12-16.05 INTRUSION ALARM SYSTEM

PART 1.- GENERAL

SUMMARY.--

Scope.--This work shall consist of furnishing and installing an intrusion alarm system in accordance with the details shown on the plans and these special provisions.

The system shall include all materials, whether mentioned or not, that are necessary for a complete and operational intrusion alarm system.

SYSTEM DESCRIPTION.--

Design requirements.--The intrusion alarm system shall be a low voltage, direct current, zoned alarm system, and shall consist of magnetic contact switches. Each zone shall be "supervised, Class B circuit."

The alarm system components shall be U.L. or F.M. Listed. The system proposed shall be approved by the Federal Communication Commission (FCC).

SUBMITTALS.--

Product data.--Manufacturer's descriptive information and installation instructions shall be submitted for approval.

Installation instructions shall include manufacturer and catalog reference, and model number of equipment to be furnished, conduit and conductor sizes, wiring diagram, and floor plan showing locations of magnetic contact switches.

QUALITY ASSURANCE.--

Installer qualification.--The installer of the security alarm system shall be licensed by the State Department of Consumer Affairs, Bureau of Collection and Investigative Services. License numbers and expiration dates shall be included on all correspondence.

PART 2.- PRODUCTS

Magnetic contact switch.--

Magnetic door switch for pedestrian door shall be a 2-section, self-lock mounting type switch, and shall be compatible with the material of the door on which it is installed. The switch shall be epoxied in the switch housing. Magnetic contact switches shall be the type capable of being concealed on the top of the door frame.

Magnetic contact switches for the overhead vehicle doors shall be 2-section, extra heavy-duty, floor mounting type switch with stainless steel armored cable.

Switch shall be housed in a non-magnetic case.

PART 3. EXECUTION.--

INSTALLATION.--

General.--The intrusion alarm system shall be installed in accordance with the manufacturer's recommendations.

The switch section without wires shall be recessed flush into the top edge of the door at the approximate center of the door, and the switch section with wires shall be recessed flush in the top section of the door frame. The two sections of the switch shall be mounted directly opposite each other to provide maximum sensitivity. The wiring from each magnetic switch shall be run to the control panel in the zone dedicated for the intrusion alarm circuit.

The switch section mounted on the bottom edge of the overhead door shall be without wires. The switch section with wire shall be mounted on the floor directly below the switch part without wires.

Intrusion alarm zoning.--Intrusion alarm panel zoning shall be as follows:

Zone 1: Pedestrian double doors Compressor Room (Item No. 1)
Zone 2: Pedestrian North door Substation Room (Item No. 2)
Zone 3: Pedestrian East door Substation Room (Item No. 3)
Zone 4: Pedestrian Southeast door Substation Room (Item No. 4)
Zone 5. Pedestrian Southwest door Substation Room (Item No. 5)

Conduit and conductors.--All intrusion alarm system wiring shall be installed in conduit system conforming to the requirements under "Basic Materials and Methods" elsewhere in these special provisions. All conductors and cables for the intrusion alarm system wiring shall be as recommended by the intrusion alarm system manufacturer.

FIELD QUALITY CONTROL.--

Testing.--The operational test for the intrusion alarm system shall be performed by the Contractor in the presence of the Engineer. The operational tests shall demonstrate that all functions of the system operate in the manner described in the manufacturer's literature and demonstrate system stability under normal vibration and shocks to components. The Contractor shall notify the Engineer in writing not less than 10 days in advance of performing the operational tests.

Exhibit "B"

SECTION 13. RAILROAD RELATIONS AND INSURANCE REQUIREMENTS
SECTION 13-1. RELATIONS WITH RAILROAD COMPANY

13-1.01 GENERAL.- The term "Railroad" shall be understood to mean the Union Pacific Railroad Company.

It is expected that the Railroad will cooperate with the Contractor to the end that the work may be handled in an efficient manner. However, except for the additional compensation provided for hereinafter for delays in completion of specific unit of work to be performed by the Railroad, and except as provided in Public Contracts Code Section 7102, the Contractor shall have no claim for damages, extension of time, or extra compensation in the event his work is held up by any of the work to be performed by the Railroad.

The Contractor must understand the Contractor's right to enter Railroads property is subject to the absolute right of Railroad to cause the Contractor's work on Railroad's property to cease if, in the opinion of Railroad, Contractor's activities create a hazard to Railroad's property, employees, and/or operations.

The Contractor will be required to sign and submit to the Railroad the Contractor's Endorsement, in the form attached hereto.

· **RAILROAD REQUIREMENTS.** The contractor shall notify Jim Smith, Manager Industry and Public Projects, 10031 Foothills Blvd., Roseville, CA 95678, Telephone (916) 789-6352 and the Engineer, in writing, at least ten (10) working days before performing any work on, or adjacent to the property or tracks of the Railroad.

The Contractor shall cooperate with the Railroad where work is over or under the tracks, or within the limits of Railroad property, in order to expedite the work and to avoid interference with the operation of railroad equipment.

The Contractor shall comply with the rules and regulations of Railroad or the instructions of its representatives in relation to the proper manner of protecting the tracks and property of Railroad and the traffic moving on such tracks, as well as the wires, signals and other property of Railroad, its tenants or licensees, at and in the vicinity of the work during the period of construction.

The Contractor shall perform his work in such manner and at such times as shall not endanger or interfere with the safe operation of the tracks and property of Railroad and traffic moving on such tracks, as well as wires, signals and other property of Railroad, its tenants or licensees, at or in the vicinity of the work.

The Contractor shall take protective measures necessary to keep railroad facilities, including track ballast, free of sand or debris resulting from his operations. Any damage to railroad facilities resulting from Contractor's operations will be repaired or replaced by Railroad and the cost of such repairs or replacement shall be deducted from the contractor's progress and final pay estimates.

The Contractor shall contact the Railroad's "Call Before You Dig" at least 48 hours prior to commencing work, at 1-800-336-9193 (a 24 hour number) to determine location of fiber optics. If a telecommunications system is buried anywhere on or near railroad property, the Contractor will co-ordinate with the Railroad and the Telecommunication Company(ies) to arrange for relocation or other protection of the system prior to beginning any work on or near Railroad Property.

The Contractor shall not pile or store any materials nor park any equipment closer than 25'- 0" to the centerline of the nearest track, unless directed by Railroad's representative.

The Contractor shall also abide by the following temporary clearances during the course of construction:

12'-0" horizontally from centerline of track
21'-0" vertically above top of rail

The temporary vertical construction clearance above provided will not be permitted until authorized by the Public Utilities Commission. It is anticipated that authorization will be received not later than fifteen days after the

approval of the contract by the Attorney General. In the event authorization is not received by the time specified, and, if in the opinion of the Engineer, the Contractor's operations are delayed or interfered with by reason of authorization not being received by the said time, the State will compensate the Contractor for such delay to the extent provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications and not otherwise.

Walkways with railing shall be constructed by Contractor over open excavation areas when in close proximity of tracks, and railings shall not be closer than 8'-6" horizontally from centerline of the nearest track, if tangent, or 9'-6" if curved.

Any infringement on the above temporary construction clearances due to the Contractor's operations shall be submitted to the Railroad by way of Engineer, and shall not be undertaken until approved by the Railroad, and until the Engineer has obtained any necessary authorization from any governmental body or bodies having jurisdiction thereover. No extension of time or extra compensation will be allowed in the event the Contractor's work is delayed pending Railroad approval and governmental authorization.

When the temporary vertical clearance is less than 22'-6" above top of rail, Railroad shall have the option of installing tell-tales or other protective devices Railroad deems necessary for protection of Railroad trainmen or rail traffic.

Four sets of plans, in 11" x 17" format, and two sets of calculations showing details of construction affecting the Railroad's tracks and property not included in the contract plans, including but not limited to shoring and falsework, shall be submitted to the Engineer for review prior to submittal to Railroad for final approval. Falsework shall comply with UPRR guidelines. Demolition of existing structures shall comply with UPRR guidelines. Shoring shall be designed in accordance with UPRR's shoring requirement of Drawing No. 106613 and guidelines for shoring and falsework, latest edition, issued by the Railroad's Office of Chief Engineer. Shoring and falsework plans and calculations shall be prepared and signed by a registered professional engineer. This work shall not be undertaken until such time as the Railroad has given such approval, review by Railroad may take up to six (6) weeks after receipt of all necessary information.

The Contractor shall notify the Engineer in writing, at least 25 calendar days but not more than 40 days in advance of the starting date of installing temporary work with less than permanent clearance at each structure site. The Contractor will not be permitted to proceed with work across railroad tracks unless this requirement has been met. No extension of time or extra compensation will be allowed in the event that the Contractor's work is delayed because of his failure to comply with the requirements in this paragraph.

Private crossings at grade over tracks of Railroad for the purpose of hauling earth, rock, paving or other materials will not be permitted. If the Contractor, for the purpose of constructing highway-railway grade separation structures, including construction ramps thereto, desires to move equipment or materials across Railroad's tracks, Contractor must first obtain permission from Railroad. Should Railroad approved the crossing, Contractor may be required to execute a private crossing agreement. By this agreement, the Contractor would be required to bear the cost of the crossing surface, together with any warning devices that might be required. Contractor shall furnish his own employees as flagmen to control movements of vehicles on the private roadway and shall take all measures necessary to prevent the use of such roadway by unauthorized persons and vehicles.

No blasting will be permitted by Contractor unless approved by the Railroad.

The Contractor shall, upon completion of the work covered by this contract to be performed by Contractor upon the premises or over or beneath the tracks of Railroad, promptly remove from the premises of Railroad all of Contractor's tools, implements and other materials, whether brought upon said premises by said Contractor or any subcontractor, employee or agent of Contractor or of any subcontractor, and cause said premises to be left in a clean and presentable condition.

All under track pipeline installations shall be constructed in accordance with Railroad's current standards which may be obtained from Railroad. The general guidelines are as follows:
Edges of jacking or boring pit excavations shall be kept a minimum of 20 feet from the centerline of the nearest track. If the pipe to be installed under the track is four (4) inches in diameter or less, the top of the pipe shall be at least 42 inches below base of rail. If the pipe diameter is greater than four (4) inches in diameter, it must be encased and the top of the steel pipe casing shall be at least 66 inches below base of rail. Installation of any pipe or conduit under Railroad's tracks is to be done by dry bore and jack method. No hydraulic jacking or boring will be permitted. Care is to be exercised so as not to damage any underground facilities of Railroad.

13-1.03 PROTECTION OF RAILROAD FACILITIES

(1). Upon advance notification of not less than ten (10) working days by Contractor, Railroad representatives, conductors, flagmen or watchmen will be provided by Railroad to protect its facilities, property and movements of its trains or engines. Said notice shall be made to Jim Smith, Manager Industry and Public Projects of Railroad at (916) 789-6352. At the time of such notification, Contractor shall provide Railroad with a schedule of dates that flagging services will be needed , as well as times, if outside normal working hours. Any subsequent deviation from said schedule shall also require ten (10) working days advance notice from the first affected date. In general, Railroad will furnish such personnel or other protective devices:

(a) When any part of any equipment is standing or being operated within 25 feet, measured horizontally, from centerline of any track on which trains may operate, or when any erection or construction activities are in progress within such limits, regardless of elevation above or below track.
(b) For any excavation below elevation of track subgrade if, in the opinion of Railroad's representative, track or other Railroad facilities may be subject to settlement or movement.
(c) During any clearing, grubbing, grading or blasting in proximity to Railroad which, in the opinion of Railroad's representative, may endanger Railroad facilities or operations.
(d) During any of Contractor's operations when, in the opinion of Railroad's representatives, Railroad facilities, including, but not limited to, tracks, buildings, signals, wire lines or pipe lines, may be endangered.

(2) The cost of flagging and inspection provided by Railroad during the period of constructing that portion of the project located on or near Railroad property, as deemed necessary for the protection of Railroad's facilities and trains, will be borne by the State for a period of 700 working days beginning on the date work commences on or near property of Railroad. The Contractor shall pay to the State liquidated damages in the sum of $500 per day for each day in excess of the above 700 working days the Contractor works on or near Railroad property, and which requires flagging protection of Railroad's facilities and trains.

(3) The temporary access crossing shall be used as a limited access to work area crossing and not as conventional track crossing. Gate shall be provided at the temporary fence and crossing to be used by the contractor at times authorized by the railroad and under the supervision of the Railroad flagmen.

Cranes and construction equipment shall not be placed or operated within 25 feet of the nearest rail of any track on which trains may operate without the approval and protection of the flagman.

Contractor to provide a temporary fence 6" high or combination of 32" K-rail and 4' high fence on top of K-rail on both sides of Railroad tracks on the field side from interchange 680 to 780 and extend past the structure at least 50'.

Contractor to submit design plans for installation of access crossing for Railroad for review and approval.

Contractor's shoring and falsework plans shall be submitted to the Railroad for review and approval.

At the Bayshore Crossing, stop signs will be used to control traffic along Bayshore Road and out of Benicia Industries. In the event that the stop signs are not being observed, the contractor will at his own cost be required by railroad to install crossing protection.

4) Excavations at Bents 21 of bridges 23-0125R and 2300212G located between the proposed columns and the Railroad shall be protected if greater than three (3) feet in depth. All shoring systems at these locations shall follow process as outlined in this agreement.

13-1.04 WORK BY RAILROAD. Railroad will furnish or cause to be furnished as necessary due to construction, labor materials, tools and equipment to perform certain works including relocation of telephone, telegraphy and signal lines and appurtenances and will perform any other work in connection therewith.

The work by Railroad will be performed by its own forces and is not a part of the work under this contract.

(a) The Railroad will perform preliminary engineering inspection and flagging as specified in Section 13-1.03 “Protection of Railroad Facilities”.

13-1.05 DELAYS DUE TO WORK BY RAILROAD.—No delays due to work by Railroad are anticipated.

If delays due to work by the Railroad occur, and the Contractor sustains loss which, in the opinion of the Engineer, could not have been avoided by the judicious handling of forces, equipment and plant, the amount of said loss shall be determined as provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

If a delay due to work by Railroad occurs, an extension of time determined pursuant to the provisions in Section 8-1.07, "Liquidated Damages," of the Standard Specifications will be granted.

13-1.05 LEGAL RELATIONS.- The provisions of this section, "Relations with Railroad Company" and the provisions of the following section, "Railroad Protective Insurance," of these special provisions shall inure directly to the benefit of Railroad

SECTION 13-2. RAILROAD PROTECTIVE INSURANCE

The term "Railroad" shall be understood to mean the Union Pacific Railroad Company.

In addition to any other form of insurance or bonds required under the terms of the contract and specifications, the Contractor will be required to carry insurance of the kinds and in the amounts hereinafter specified.

Such insurance shall be approved by the Railroad before any work is performed on Railroad's property and shall be carried until all work required to be performed on or adjacent to the Railroad's property under the terms of the contract is satisfactorily completed as determined by the Engineer, and thereafter until all tools, equipment and materials have been removed from Railroad's property and such property is left in a clean and presentable condition.

The insurance herein required shall be obtained by the Contractor, who shall furnish the Railroad with completed certificates, in the form attached hereto, signed by the insurance company or its authorized agent or representative, reflecting the existence of each of the policies required by 1 and 2 below including coverage for X, C and U and completed operations hazards, and the original policy of insurance (or a certified duplicate original policy) required by 3 below, to:

Judy Scott
Union Pacific Railroad Company
Insurance Group
1416 Dodge Street, Room 820
Omaha, NE 68179

Certificate of insurance shall guarantee that the policy under 1 and 2 will not be amended, altered, modified or canceled insofar as the coverage contemplated hereunder is concerned, without at least thirty (30) days notice mailed by registered mail to the Railroad.

Full compensation for all premiums which the Contractor is required to pay on all the insurance described hereinafter shall be considered as included in the prices paid for the various items of work to be performed under the contract, and no additional allowance will be made therefor or for additional premiums which may be required by extensions of the policies of insurance.

The approximate ratio of the estimated cost of the work over or under or within 50 feet of Railroad's tracks to the total estimated cost is 0.12. Approximate daily train traffic is 18 passenger trains and 30 freight trains.

1. Contractor's Public Liability and Property Damage Liability Insurance

The Contractor shall, with respect to the operations he performs within or adjacent to Railroad's property, carry regular Contractor's Public Liability and Property Damage Liability Insurance providing for the same limits as specified for Railroad's Protective Public Liability and Property Damage Liability insurance to be furnished for and in behalf of Railroad as hereinafter provided.

If any part of the work within or adjacent to Railroad's property is subcontracted, the Contractor in addition to carrying the above insurance shall provide the above insurance on behalf of the subcontractors to cover their operations.

2. Contractor's Protective Public Liability and Property Damage Liability Insurance.

The Contractor shall, with respect to the operations performed for him by subcontractors who do work within or adjacent to Railroad's property, carry in his own behalf regular Contractor's Protective Public Liability and Property Damage Liability Insurance providing for the same limits as specified for Railroad's Protective Public Liability and Property Damage Liability Insurance to be furnished for and on behalf of Railroad as hereinafter provided.

3. Railroad's Protective Public Liability and Property Damage Liability Insurance

The Contractor shall, with respect to the operations he performs within or adjacent to Railroad's property or that of any of his subcontractors who do work within or adjacent to Railroad's property perform, have issued and furnished in favor of Railroad, Policy or policies of insurance in the Railroad Protective Liability Form as hereinafter specified.

Railroad Protective Liability Form

_____
(Name of Insurance Company)

DECLARATIONS

Item 1. Named Insured:

Union Pacific Railroad Company
1416 Dodge Street - Mail Code 10049
Omaha, Nebraska 68179

Item 2. Policy Period: From _____to _____ 12:01 a.m., Standard Time, at the designated job site as stated herein.

Item 3. The insurance afforded is only with respect to such of the following coverage's as are indicated in Item 6 by specific premium charge or charges. The limit of the company's liability against such coverage or coverage's shall be as stated herein, subject to all the terms of this policy having reference thereto.

Coverage's		Limits of Liability Each Occurrence	Aggregate
A B & C	Bodily Injury Liability Property Damage Liability and Physical Damage to Property	$2,000,000 Combined Single Limit	$6,000,000 for Coverage's A, B & C

Item 4. Name and Address of Contractor:

Item 5. Name and Address of Governmental Authority for whom the work by the Contractor is being performed: State of California, acting by and through its Department of Transportation, P.O. Box 942874, Sacramento, California 94274-0001

Item 6. Designation of the Job Site and Description of Work:

FOR CONSTRUCTION ON _____

_____

_____

_____

Premium Bases	Rates per $100 of Cost Coverage A	Coverage's B & C	Advance Premiums Coverage A	Coverage's B & C
Contract Cost	$	$	$	$
Rental Cost	$	$	$	$

Countersigned _____, 20____ by _____

_____
Title

POLICY

_____
(Name of Insurance Company)

A _____ insurance company, herein called the company, agrees with the insured, named in the declarations made a part hereof, in consideration of the payment of the premium and in reliance upon the statements in the declaration made by the named insured and subject to all of the terms of this policy:

INSURING AGREEMENTS

I. Coverage A--Bodily Injury Liability.

To pay on behalf of the insured all sums which the insured shall become legally obligated to pay as damages because of bodily injury, sickness, or disease, including death at any time resulting therefrom, hereinafter called "bodily injury," either (1) sustained by any person arising out of acts or omissions at the designated job site which are related to or are in connection with the work described in Item 6 of the declarations, or (2) sustained at the designated job site by the Contractor or any employee of the Contractor, or by any employee of the Governmental Authority specified in Item 5 of the Declarations, or by any designated employee of the insured whether or not arising out of such acts or omissions.

Coverage B--Property Damage Liability.

To pay on behalf of the insured all sums which the insured shall become legally obligated to pay as damages because of physical injury to or destruction of property, including loss of use of any property due to such injury or destruction, hereinafter called "property damage," arising out of acts or omissions at the designated job site which are related to or are in connection with the work described in Item 6 of the declarations.

Coverage C--Physical Damage to Property.

To pay for direct and accidental loss of or damage to rolling stock and their contents, mechanical construction equipment, or motive power equipment, hereinafter called "loss," arising out of acts or omissions at the designated job site which are related to or are in connection with the work described in Item 6 of the declarations; provided such property is owned by the named insured or is leased or entrusted to the named insured under a lease or trust agreement.

II. Definitions.

(a) **Insured**.--The unqualified word "insured" includes the named insured and also includes any executive officer, director or stockholder thereof while acting within the scope of his duties as such.

(b) **Contractor.--**The word "contractor" means the Contractor designated in Item 4 of the declarations and includes all subcontractors of said Contractor but shall not include the named insured.

(c) **Designated employee of the insured.--**The words "designated employee of the insured" mean:

(1) any supervisory employee of the insured at the job site,

(2) any employee of the insured while operating, attached to or engaged on work trains or other railroad equipment at the job site which are assigned exclusively to the Contractor, or

(3) any employee of the insured not within (1) or (2) who is specifically loaned or assigned to the work of the Contractor for prevention of accidents or protection of property, the cost of whose services is borne specifically by the Contractor or by governmental authority.

(d) **Contract.--**The word "contract" means any contract or agreement to carry a person or property for a consideration or any lease, trust or interchange contract or agreement respecting motive power, rolling stock or mechanical construction equipment.

III. Defense, Settlement, Supplementary Payments.

With respect to such insurance as is afforded by this policy under Coverage's A and B, the company shall:

(a) defend any suit against the insured alleging such bodily injury or property damage and seeking damages which are payable under the terms of this policy, even if any of the allegations of the suit are groundless, false or fraudulent; but the company may make such investigation and settlement of any claim or suit as it deems expedient;

(b) pay, in addition to the applicable limits of liability:

(1) all expenses incurred by the company, all costs taxed against the insured in any such suit and all interest on the entire amount of any judgment therein which accrues after entry of the judgment and before the company has paid or tendered or deposited in court that part of the judgment which does not exceed the limit of the company's liability thereon;

(2) Premiums on appeal bonds required in any such suit, premiums on bonds to release attachments for an amount not in excess of the applicable limit of liability of this policy, but without obligation to apply for or furnish any such bonds;

(3) expenses incurred by the insured for such immediate medical and surgical relief to others as shall be imperative at the time of the occurrence;

(4) all reasonable expenses, other than loss of earnings, incurred by the insured at the company's request.

IV. Policy Period, Territory.

This policy applies only to occurrences and losses during the policy period and within the United States of America, its territories or possessions, or Canada.

EXCLUSIONS

This policy does not apply:

(a) to liability assumed by the insured under any contract or agreement except a contract as defined herein;

(b) to bodily injury or property damage caused intentionally by or at the direction of the insured;

(c) to bodily injury, property damage or loss which occurs after notification to the named insured of the acceptance of the work by the governmental authority, other than bodily injury, property damage or loss resulting from the existence or removal of tools, uninstalled equipment and abandoned or unused materials;

(d) under Coverage's A(1), B and C, to bodily injury, property damage or loss, the sole proximate cause of which is an act or omission of any insured other than acts or omissions of any designated employee of any insured;

(e) under Coverage A, to any obligation for which the insured or any carrier as his insurer may be held liable under any workmen's compensation, unemployment compensation or disability benefits law, or under any similar law; provided that the Federal Employers' Liability Act, U.S. Code (1946), Title 45, Sections 51-60, as amended, shall for the purposes of this insurance be deemed not to be any similar law;

(f) under Coverage B, to injury to or destruction of property (1) owned by the named insured or (2) leased or entrusted to the named insured under a lease or trust agreement.

(g) 1. Under any liability coverage, to injury, sickness, disease, death or destruction

(a) with respect to which an insured under the policy is also an insured under a nuclear energy liability policy issued by Nuclear Energy Liability Insurance Association, Mutual Atomic Energy Liability Underwriters or Nuclear Insurance Association of Canada, or would be an insured under any such policy but for its termination upon exhaustion of its limit of liability; or

(b) resulting from the hazardous properties of nuclear material and with respect to which (1) any person or organization is required to maintain financial protection pursuant to the Atomic Energy Act of 1954, or any law amendatory thereof, or (2) the insured is, or had this policy not been issued would be, entitled to indemnity from the United States of America, or any agency thereof, under any agreement entered into by the United States of America, or any agency thereof, with any person or organization.

2. Under any medical payments coverage, or under any Supplementary Payments provision relating to immediate medical or surgical relief, to expenses incurred with respect to bodily injury, sickness, disease or death resulting from the hazardous properties of nuclear material and arising out of the operation of a nuclear facility by any person or organization.

3. Under any liability coverage, to injury, sickness, disease, death or destruction resulting from the hazardous properties of nuclear material, if

(a) the nuclear material (1) is at any nuclear facility owned by, or operated by or on behalf of, an insured or (2) has been discharged or dispersed therefrom;

(b) the nuclear material is contained in spent fuel or waste at any time possessed, handled, used, processed, stored, transported or disposed of by or on behalf of an insured; or

(c) the injury, sickness, disease, death or destruction arises out of the furnishing by an insured of services, materials, parts or equipment in connection with the planning, construction, maintenance, operation or use of any nuclear facility, but if such facility is located within the United States of America, its territories or possessions or Canada, this exclusion (c) applies only to injury to or destruction of property at such nuclear facility.

4. As used in this exclusion:

"hazardous properties" include radioactive, toxic or explosive properties;

"nuclear material" means source material, special nuclear material or byproduct material;

"source material", "special nuclear material", and "byproduct material" have the meanings given them in the Atomic Energy Act of 1954 or in any law amendatory thereof;

"spent fuel" means any fuel element or fuel component, solid or liquid, which has been used or exposed to radiation in a nuclear reactor;

"waste" means any waste material (1) containing byproduct material and (2) resulting from the operation by any person or organization of any nuclear facility included within the definition of nuclear facility under paragraph (a) or (b) thereof;

"nuclear facility" means

(a) any nuclear reactor,

(b) any equipment or device designed or used for (1) separating the isotopes of uranium or plutonium, (2) processing or utilizing spent fuel, or (3) handling, processing or packaging waste,

(c) any equipment or device used for the processing, fabricating or alloying of special nuclear material if at any time the total amount of such material in the custody of the insured at the premises where such equipment or device is located consists of or contains more than 25 grams of plutonium or uranium 233 or any combination thereof, or more than 250 grams of uranium 235,

(d) any structure, basin, excavation, premises or place prepared or used for the storage or disposal of waste, and includes the site on which any of the foregoing is located, all operations conducted on such site and all premises used for such operations;

"nuclear reactor" means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material;

with respect to injury to or destruction of property, the word "injury" or "destruction" includes all forms of radioactive contamination of property.

(h) under Coverage C, to loss due to nuclear reaction, nuclear radiation or radioactive contamination, or to any act or condition incident to any of the foregoing.

CONDITIONS

(The conditions, except conditions 3, 4, 5, 7, 8, 9, 10, 11 and 12, apply to all coverage's. Conditions 3, 4, 5, 7, 8, 9, 10, 11 and 12, apply only to the coverage noted thereunder.)

1. Premium.--The premium bases and rates for the hazards described in the declarations are stated therein. Premium bases and rates for hazards not so described are those applicable in accordance with the manuals in use by the company.

The term "contract cost" means the total cost of all work described in Item 6 of the declarations.

The term "rental cost" means the total cost to the Contractor for rental of work trains or other railroad equipment, including the remuneration of all employees of the insured while operating, attached to or engaged thereon.

The advance premium stated in the declarations is an estimated premium only. Upon termination of this policy the earned premium shall be computed in accordance with the company's rules, rates, rating plans, premiums and minimum premiums applicable to this insurance. If the earned premium thus computed exceeds the estimated advance premium paid, the company shall look to the Contractor specified in the declarations for any such excess; if less, the company shall return to the said Contractor the unearned portion paid.

In no event shall payment of premium be an obligation of the named insured.

2. Inspection.--The named insured shall make available to the company records of information relating to the subject matter of this insurance.

The company shall be permitted to inspect all operations in connection with the work described in Item 6 of the declarations.

3. Limits of Liability, Coverage A.--The limit of bodily injury liability stated in the declarations as applicable to "each person" is the limit of the company's liability for all damages, including damages for care and loss of services, arising out of bodily injury sustained by one person as the result of any one occurrence; the limit of such liability stated in the declarations as applicable to "each occurrence" is, subject to the above provision respecting each person, the total limit of the company's liability for all such damage arising out of bodily injury sustained by two or more persons as the result of any one occurrence.

4. Limits of Liability, Coverage's B and C.--The limit of liability under Coverages B and C stated in the declarations as applicable to "each occurrence" is the total limit of the company's liability for all damages and all loss under Coverage B and C combined arising out of physical injury to, destruction or loss of all property of one or more persons or organizations, including the loss of use of any property due to such injury or destruction under Coverage B, as the result of any one occurrence.

Subject to the above provision respecting "each occurrence," the limit of liability under Coverage's B and C stated in the declarations as "aggregate" is the total limit of the company's liability for all damages and all loss under Coverage's B and C combined arising out of physical injury to, destruction or loss of property, including the loss of use of any property due to such injury or destruction under Coverage B.

Under Coverage C, the limit of the company's liability for loss shall not exceed the actual cash value of the property, or if the loss is of a part thereof the actual cash value of such part, at time of loss, nor what it would then cost to repair or replace the property or such part thereof with other of like kind and quality.

5. Severalty of Interests, Coverage's A and B.-- The term "the insured" is used severally and not collectively, but the inclusion herein of more than one insured shall not operate to increase the limits of the company's liability.

6. Notice.--In the event of an occurrence or loss, written notice containing particulars sufficient to identify the insured and also reasonably obtainable information with respect to the time, place and circumstances thereof, and the names and addresses of the injured and of available witnesses, shall be given by or for the insured to the company or any of its authorized agents as soon as practicable. If claim is made or suit is brought against the insured, he shall immediately forward to the company every demand, notice, summons or other process received by him or his representative.

7. Assistance and Cooperation of the Insured, Coverage's A and B.--The insured shall cooperate with the company and, upon the company's request, attend hearings and trials and assist in making settlements, securing and giving evidence, obtaining the attendance of witnesses and in the conduct of suits. The insured shall not, except at his own cost, voluntarily make any payment, assume any obligation or incur any expense other than for such immediate medical and surgical relief to others as shall be imperative at the time of accident.

8. Action Against Company, Coverages A and B.--No action shall lie against the company unless, as a condition precedent thereto, the insured shall have fully complied with all the terms of this policy, nor until the amount of the insured's obligation to pay shall have been finally determined either by judgment against the insured after actual trial or by written agreement of the insured, the claimant and the company.

Any person or organization or the legal representative thereof who has secured such judgment or written agreement shall thereafter be entitled to recover under this policy to the extent of the insurance afforded by this policy. No person or organization shall have any right under this policy to join the company as a party to any action against the insured to determine the insured's liability. Bankruptcy or insolvency of the insured or of the insured's estate shall not relieve the company of any of its obligations hereunder.

Coverage C.--No action shall lie against the company unless, as a condition precedent thereto, there shall have been full compliance with all the terms of this policy nor until 30 days after proof of loss is filed and the amount of loss is determined as provided in this policy.

9. Insured's Duties in Event of Loss, Coverage C.--In the event of loss the insured shall:

(a) protect the property, whether or not the loss is covered by this policy, and any further loss due to the insured's failure to protect shall not be recoverable under this policy; reasonable expenses incurred in affording such protection shall be deemed incurred at the company's request;
(b) file with the company, as soon as practicable after loss, his sworn proof of loss in such form and including such information as the company may reasonably require and shall, upon the company's request, exhibit the damaged property.

10. Appraisal, Coverage C.--If the insured and the company fail to agree as to the amount of loss, either may, within 60 days after the proof of loss is filed, demand an appraisal of the loss. In such event the insured and the company shall each select a competent appraiser, and the appraisers shall select a competent and disinterested umpire. The appraisers shall state separately the actual cash value and the amount of loss and failing to agree shall submit their differences to the umpire. An award in writing of any two shall determine the amount of loss. The insured and the company shall each pay his chosen appraiser and shall bear equally the other expenses of the appraisal and umpire.

The company shall not be held to have waived any of its rights by any act relating to appraisal.

11. Payment of Loss, Coverage C.--The company may pay for the loss in money but there shall be no abandonment of the damaged property to the company.

12. No Benefit to Bailee, Coverage C.--The insurance afforded by this policy shall not inure directly or indirectly to the benefit of any carrier or bailee, other than the named insured, liable for loss to the property.

13. Subrogation.--In the event of any payment under this policy, the company shall be subrogated to all the insured's rights of recovery therefor against any person or organization and the insured shall execute and deliver instruments and papers and do whatever else is necessary to secure such rights. The insured shall do nothing after loss to prejudice such rights.

14. Application of Insurance.--The insurance afforded by this policy is primary insurance.

15. Three Year Policy.--A policy period of three years is comprised of three consecutive annual periods. Computation and adjustment of earned premium shall be made at the end of each annual period. Aggregate limits of liability as stated in this policy shall apply separately to each annual period.

16. Changes.--Notice to any agent or knowledge possessed by any agent or by any other person shall not effect a waiver or a change in any part of this policy or stop the company from asserting any right under the terms of this policy; nor shall the terms of this policy be waived or changed, except by endorsement issued to form a part of this policy.

17. Assignment.--Assignment of interest under this policy shall not bind the company until its consent is endorsed hereon.

18. Cancellation.--This policy may be canceled by the named insured by mailing to the company written notice stating when thereafter the cancellation shall be effective. This policy may be canceled by the company by mailing to the named insured, Contractor and governmental authority at the respective addresses shown in this policy written notice stating when not less than 30 days thereafter such cancellation shall be effective. The mailing of notice as aforesaid shall be sufficient proof of notice. The effective date and hour of cancellation stated in the notice shall become the end of the policy period. Delivery of such written notice either by the named insured or by the company shall be equivalent to mailing.

If the named insured cancels, earned premium shall be computed in accordance with the customary short rate table and procedure. If the company cancels, earned premium shall be computed pro rata. Premium adjustment may be made either at the time cancellation is effected or as soon as practicable after cancellation becomes effective, but payment or tender of unearned premium is not a condition of cancellation.

19. Declaration.--By acceptance of this policy the named insured agrees that such statements in the declarations as are made by him are his agreements and representations, that this policy is issued in reliance upon the truth of such representations and that this policy embodies all agreements existing between himself and the company or any of its agents relating to this insurance.

In witness whereof, the _____ Insurance Company has caused this policy to be signed by its president and a secretary at _____, and countersigned on the declaration page by a duly authorized agent of the company.

(Facsimile of Signature) (Facsimile of Signature)

_____ _____

Secretary President

CERTIFICATE OF INSURANCE
Exhibit "C"

This is to certify to: RAILROAD FILE NO.:

(1) Railroad Agreements Branch, MS #9-2/9G
Engineering Service Center
California Department of Transportation
State of California
1801 30th Street, Sacramento, California 95816

(2) and to the following Railroad Company

that such insurance as is afforded by the policy or policies described below for bodily injury liability and property damage liability is in full force and effect as of the date of this certificate and covers the following contractor as a named insured with respect to liability for damages arising out of operations performed by or for the named insured in connection with the contract or work described below.

1. Named Insured and Address

This is to certify that policies of insurance listed below have been issued to the insured named above and are in force at this time. Notwithstanding any requirement, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions and conditions of such policies.

2. Description of Work

Contract No. _____

3. Coverage's	Policy Expiration Date	Limits of Liability Each Occurrence	Aggregate
Contractor's Bodily Injury Liability and Property Damage Liability			
Umbrella or Excess Liability			

All of the coverages include coverage for the completed operations hazard, and X, C and U exposures.

Name of Insurance Company by Coverage

Coverage's	Company	Policy Number
Bodily Injury Liability		
Property Damage Liability		
Umbrella or Excess Liability		

4. The policy or policies described above will not be amended, altered, modified or cancelled until thirty (30) days after written notice thereof has been given by registered mail to the Railroad named as certificate holder in this certificate.

Certificate Date:

For _____
(Insurance Company)

By _____
(Authorized Agent or Representative)

State of California
Department of Transportation
DH-0S-A104(8-10-99)

CONTRACTOR'S ENDORSEMENT

A. As a condition to entering upon Railroad's right-of-way to perform work pursuant to this agreement, Licensee's contractor, _____, whose address is _____ (hereinafter "Contractor), agrees to comply with and be bound by all the terms and provisions of this agreement relating to the work to be performed and the insurance requirements set forth in Section 13 of the Contract Special Provisions.

B. Before the Contractor commences any work, the Contractor will provide the Railroad with (1) a binder of insurance for the Railroad Protective Liability Insurance described in Section 13.2 of the Contract Special Provisions, and the original policy (or a certified duplicate original policy), and (2) a certificate issued by its insurance carrier providing the other insurance coverage required pursuant to Section 13.2 of the Contract Special Provisions in a policy or policies which contain the following type endorsement:

> UNION PACIFIC RAILROAD COMPANY is named as an additional insured with respect to all liabilities arising out of Insured's performance of work on behalf of the State.

C. This endorsement shall be completed and directed to:

James H. Smith
Manager Industry & Public Projects
10031 Foothills Boulevard
Roseville, California 95747
(916) 789-6352

_____
CONTRACTOR (print name on above line)

By: _____

Title: _____

SECTION 14. FEDERAL REQUIREMENTS FOR FEDERAL-AID CONSTRUCTION PROJECTS

GENERAL.—The work herein proposed will be financed in whole or in part with Federal funds, and therefore all of the statutes, rules and regulations promulgated by the Federal Government and applicable to work financed in whole or in part with Federal funds will apply to such work. The "Required Contract Provisions, Federal-Aid Construction Contracts, "Form FHWA 1273, are included in this Section 14. Whenever in said required contract provisions references are made to "SHA contracting officer", "SHA resident engineer", or "authorized representative of the SHA", such references shall be construed to mean "Engineer" as defined in Section 1-1.18 of the Standard Specifications.

PERFORMANCE OF PREVIOUS CONTRACT.—In addition to the provisions in Section II, "Nondiscrimination," and Section VII, "Subletting or Assigning the Contract," of the required contract provisions, the Contractor shall comply with the following:

The bidder shall execute the CERTIFICATION WITH REGARD TO THE PERFORMANCE OF PREVIOUS CONTRACTS OR SUBCONTRACTS SUBJECT TO THE EQUAL OPPORTUNITY CLAUSE AND THE FILING OF REQUIRED REPORTS located in the proposal. No request for subletting or assigning any portion of the contract in excess of $10,000 will be considered under the provisions of Section VII of the required contract provisions unless such request is accompanied by the CERTIFICATION referred to above, executed by the proposed subcontractor.

NON-COLLUSION PROVISION.—The provisions in this section are applicable to all contracts except contracts for Federal Aid Secondary projects.

Title 23, United States Code, Section 112, requires as a condition precedent to approval by the Federal Highway Administrator of the contract for this work that each bidder file a sworn statement executed by, or on behalf of, the person, firm, association, or corporation to whom such contract is to be awarded, certifying that such person, firm, association, or corporation has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the submitted bid. A form to make the non-collusion affidavit statement required by Section 112 as a certification under penalty of perjury rather than as a sworn statement as permitted by 28, USC, Sec. 1746, is included in the proposal.

PARTICIPATION BY MINORITY BUSINESS ENTERPRISES IN SUBCONTRACTING.—Part 23, Title 49, Code of Federal Regulations applies to this Federal-aid project. Pertinent sections of said Code are incorporated in part or in its entirety within other sections of these special provisions.

Schedule B—Information for Determining Joint Venture Eligibility

(This form need not be filled in if all joint venture firms are minority owned.)

1. Name of joint venture _____
2. Address of joint venture _____
3. Phone number of joint venture _____
4. Identify the firms which comprise the joint venture. (The MBE partner must complete Schedule A.) _____
   _____

   a. Describe the role of the MBE firm in the joint venture. _____
      _____
   b. Describe very briefly the experience and business qualifications of each non-MBE joint venturer: _____
      _____

5. Nature of the joint venture's business _____
   _____
6. Provide a copy of the joint venture agreement.
7. What is the claimed percentage of MBE ownership? _____
8. Ownership of joint venture: (This need not be filled in if described in the joint venture agreement, provided by question 6.).

   a. Profit and loss sharing.
   b. Capital contributions, including equipment.
   c. Other applicable ownership interests.

9. Control of and participation in this contract. Identify by name, race, sex, and "firm" those individuals (and their titles) who are responsible for day-to-day management and policy decision making, including, but not limited to, those with prime responsibility for:

   a. Financial decisions _____
   b. Management decisions, such as:

      (1) Estimating _____
      (2). Marketing and sales _____
      (3). Hiring and firing of management personnel _____
      _____
      (4) Purchasing of major items or supplies _____
      _____

   c. Supervision of field operations _____

Note.—If, after filing this Schedule B and before the completion of the joint venture's work on the contract covered by this regulation, there is any significant change in the information submitted, the joint venture must inform the grantee, either directly or through the prime contractor if the joint venture is a subcontractor.

Affidavit

"The undersigned swear that the foregoing statements are correct and include all material information necessary to identify and explain the terms and operation of our joint venture and the intended participation by each joint venturer in the undertaking. Further, the undersigned covenant and agree to provide to grantee current, complete and accurate information regarding actual joint venture work and the payment therefor and any proposed changes in any of the joint venture arrangements and to permit the audit and examination of the books, records and files of the joint venture, or those of each joint venturer relevant to the joint venture, by authorized representatives of the grantee or the Federal funding agency. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under Federal or State laws concerning false statements."

Name of Firm	Name of Firm
Signature	Signature
Name	Name
Title	Title
Date	Date

Date _____

State of _____

County of _____

On this ____ day of _____, 19 __, before me appeared (Name) _____, to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (Name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

Notary Public _____

Commission expires _____

[Seal]

Date _____

State of _____

County of _____

On this ___ day of _____, 19 __, before me appeared (Name) _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (Name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

Notary Public _____

Commission expires _____

[Seal]

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

1. 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.

2. Except as otherwise provided for in each section, the contractor shall insert in each subcontract all of the stipulations contained in these Required Contract Provisions, and further require their inclusion in any lower tier subcontract or purchase order that may in turn be made. The Required Contract Provisions shall not be incorporated by reference in any case. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with these Required Contract Provisions.

3. A breach of any of the stipulations contained in these Required Contract Provisions shall be sufficient grounds for termination of the contract.

4. A breach of the following clauses of the Required Contract Provisions may also be grounds for debarment as provided in 29 CFR 5.12:

   Section I, paragraph 2;
   Section IV, paragraphs 1, 2, 3, 4, and 7;
   Section V, paragraphs 1 and 2a through 2g.

5. Disputes arising out of the labor standards provisions of Section IV (except paragraph 5) and Section V of these Required Contract Provisions shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the U.S. Department of Labor (DOL) as set forth in 29 CFR 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 DOL, or the contractor's employees or their representatives.

6. **Selection of Labor:** During the performance of this contract, the contractor shall not:

   a. discriminate against labor from any other State, possession, or territory of the United States (except for employment preference for Appalachian contracts, when applicable, as specified in Attachment A), or

   b. employ convict labor for any purpose within the limits of the project unless it is labor performed by convicts who are on parole, supervised release, or probation.

II. NONDISCRIMINATION

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

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, and 41 CFR 60) 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 Equal Opportunity Construction Contract Specifications set forth under 41 CFR 60-4.3 and the provisions of the American 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 State highway agency (SHA) and the Federal Government in carrying out EEO obligations and in their review of his/her activities under the contract.

   b. The contractor will accept as his 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, preapprenticeship, and/or on-the-job training."

2. **EEO Officer:** The contractor will designate and make known to the SHA contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of EEO 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 minority group employees.

   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 minority groups 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 minority group applicants. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group 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, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with EEO contract provisions. (The DOL has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Executive Order 11246, as amended.)

   c. The contractor will encourage his present employees to refer minority group applicants for employment. Information and procedures with regard to referring minority group 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 his 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 his avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.

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. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision.

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 minority group and women employees 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 his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. 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 best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.

b. The contractor will use best 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 SHA 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 minority and women 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 minority group persons and women. (The DOL has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) 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 SHA.

8. **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.

   a. The contractor shall notify all potential subcontractors and suppliers of his/her EEO obligations under this contract.

   b. Disadvantaged business enterprises (DBE), as defined in 49 CFR 23, shall have equal opportunity to compete for and perform subcontracts which the contractor enters into pursuant to this contract. The contractor will use his best efforts to solicit bids from and to utilize DBE subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of DBE construction firms from SHA personnel.

   c. The contractor will use his best efforts to ensure subcontractor compliance with their EEO obligations.

9. **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 completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the SHA and the FHWA.

   a. The records kept by the contractor shall document the following:

      (1) The number 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;

      (3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees; and

      (4) The progress and efforts being made in securing the services of DBE subcontractors or subcontractors with meaningful minority and female representation among their employees.

   b. The contractors will submit an annual report to the SHA 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. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data.

III. NONSEGREGATED FACILITIES

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

   a. By submission of this bid, the execution of this contract or subcontract, or the consummation of this material supply agreement or purchase order, as appropriate, the bidder, Federal-aid construction contractor, subcontractor, material supplier, or vendor, as appropriate, certifies that the firm does not maintain or provide for its employees any segregated facilities at any of its establishments, and that the firm does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The firm agrees that a breach of this certification is a violation of the EEO provisions of this contract. The firm further certifies that no employee will be denied access to adequate facilities on the basis of sex or disability.

   b. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive, or are, in fact, segregated on the basis of race, color, religion, national origin, age or disability, because of habit, local custom, or otherwise. The only exception will be for the disabled when the demands for accessibility override (e.g. disabled parking).

c. The contractor agrees that it has obtained or will obtain identical certification from proposed subcontractors or material suppliers prior to award of subcontracts or consummation of material supply agreements of $10,000 or more and that it will retain such certifications in its files.

IV. PAYMENT OF PREDETERMINED MINIMUM WAGE

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural minor collectors, which are exempt.)

1. General:

a. All mechanics and laborers 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 (29 CFR 3)] issued by the Secretary of Labor under the Copeland Act (40 U.S.C. 276c) the full amounts of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment. The payment shall be computed at wage rates not less than those contained in the wage determination of the Secretary of Labor (hereinafter "the wage determination") which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor or its subcontractors and such laborers and mechanics. The wage determination (including any additional classifications and wage rates conformed under paragraph 2 of this Section IV and the DOL poster (WH-1321) or Form FHWA-1495) 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. For the purpose of this Section, contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act (40 U.S.C. 276a) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of Section IV, paragraph 3b, hereof. Also, for the purpose of this Section, 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 paragraphs 4 and 5 of this Section IV.

b. 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.

c. All rulings and interpretations of the Davis-Bacon Act and related acts contained in 29 CFR 1, 3, and 5 are herein incorporated by reference in this contract.

2. Classification:

a. The SHA contracting officer shall require that any class of laborers or mechanics employed under the contract, which is not listed in the wage determination, shall be classified in conformance with the wage determination.

b. The contracting officer shall approve an additional classification, wage rate and fringe benefits only when the following criteria have been met:

(1) the work to be performed by the additional classification requested is not performed by a classification in the wage determination;

(2) the additional classification is utilized in the area by the construction industry;

(3) the proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and

(4) with respect to helpers, when such a classification prevails in the area in which the work is performed.

c. If the contractor or subcontractors, as appropriate, the laborers and mechanics (if known) to be employed in the additional classification 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 DOL, Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, D.C. 20210. The Wage and Hour 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.

d. In the event the contractor or subcontractors, as appropriate, the laborers or mechanics to be employed in the additional 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. Said 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

e. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph 2c or 2d of this Section IV shall be paid to all workers performing work in the additional classification from the first day on which work is performed in the classification.

3. Payment of Fringe Benefits:

a. 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 or subcontractors, as appropriate, shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly case equivalent thereof.

b. If the contractor or subcontractor, as appropriate, does not make payments to a trustee or other third person, he/she may consider as a 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.

4. Apprentices and Trainees (Programs of the U.S. DOL) and Helpers:

a. Apprentices:

(1) 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 DOL, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau, or if a person is employed in his/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 Bureau of Apprenticeship and Training or a State apprenticeship agency (where appropriate) to be eligible for probationary employment as an apprentice.

(2) The allowable ratio of apprentices to journeyman-level employees 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 employee 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 listed in 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 or subcontractor 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-level hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

(3) 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 journeyman-level 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 for the Wage and Hour Division determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

(4) In the event the Bureau of Apprenticeship and Training, or a State apprenticeship agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor or subcontractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the comparable work performed by regular employees until an acceptable program is approved.

b. Trainees:

(1) 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 DOL, Employment and Training Administration.

(2) The ratio of trainees to journeyman-level employees on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. 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.

(3) Every trainee must be paid at not less than the rate specified in the approved program for his/her level of progress, expressed as a percentage of the journeyman-level 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-level wage rate on the wage determination which provides for less than full fringe benefits for apprentices, in which case such trainees shall receive the same fringe benefits as apprentices.

(4) In the event the Employment and Training Administration withdraws approval of a training program, the contractor or subcontractor 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. Helpers**:**

Helpers will be permitted to work on a project if the helper classification is specified and defined on the applicable wage determination or is approved pursuant to the conformance procedure set forth in Section IV.2. Any worker listed on a payroll at a helper wage rate, who is not a helper under an approved definition, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed.

5. 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.

6. Withholding:
The SHA shall upon its own action or upon written request of an authorized representative of the DOL withhold, or cause to be withheld, from the contractor or subcontractor 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, as 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 SHA contracting officer 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.

7. **Overtime Requirements:**
No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers, mechanics, watchmen, or guards (including apprentices, trainees, and helpers described in paragraphs 4 and 5 above) shall require or permit any laborer, mechanic, watchman, or guard in any workweek in which he/she is employed on such work, to work in excess of 40 hours in such workweek unless such laborer, mechanic, watchman, or guard receives compensation at a rate not less than one-and-one-half times his/her basic rate of pay for all hours worked in excess of 40 hours in such workweek.

8. **Violation:**
Liability for Unpaid Wages; Liquidated Damages: In the event of any violation of the clause set forth in paragraph 7 above, the contractor and any subcontractor responsible thereof shall be liable to the affected employee for his/her 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, mechanic, watchman, or guard employed in violation of the clause set forth in paragraph 7, in the sum of $10 for each calendar day on which such employee was required or permitted to work in excess of the standard work week of 40 hours without payment of the overtime wages required by the clause set forth in paragraph 7.

9. **Withholding for Unpaid Wages and Liquidated Damages:**
The SHA shall upon its own action or upon written request of any authorized representative of the DOL withhold, or cause to be withheld, from any monies 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 8 above.

V. STATEMENTS AND PAYROLLS

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural collectors, which are exempt.)

1. Compliance with Copeland Regulations (29 CFR 3):

   The contractor shall comply with the Copeland Regulations of the Secretary of Labor which are herein incorporated by reference.

2. Payrolls and Payroll Records:

   a. Payrolls and basic records relating thereto shall be maintained by the contractor and each subcontractor during the course of the work and preserved for a period of 3 years from the date of completion of the contract for all laborers, mechanics, apprentices, trainees, watchmen, helpers, and guards working at the site of the work.

   b. The payroll records shall contain the name, social security number, and address of each such employee; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalent thereof 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. In addition, for Appalachian contracts, the payroll records shall contain a notation indicating whether the employee does, or does not, normally reside in the labor area as defined in Attachment A, paragraph 1. Whenever the Secretary of Labor, pursuant to Section IV, paragraph 3b, has found 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 and each subcontractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible,

that the plan or program has been communicated in writing to the laborers or mechanics affected, and show the cost anticipated or the actual cost incurred in providing benefits. Contractors or subcontractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprentices and trainees, and ratios and wage rates prescribed in the applicable programs.

c. Each contractor and subcontractor shall furnish, each week in which any contract work is performed, to the SHA resident engineer a payroll of wages paid each of its employees (including apprentices, trainees, and helpers, described in Section IV, paragraphs 4 and 5, and watchmen and guards engaged on work during the preceding weekly payroll period). The payroll submitted shall set out accurately and completely all of the information required to be maintained under paragraph 2b of this Section V. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal stock number 029-005-0014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

d. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his/her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) that the payroll for the payroll period contains the information required to be maintained under paragraph 2b of this Section V and that such information is correct and complete;

(2) that such 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 the Regulations, 29 CFR 3;

(3) that each laborer or mechanic has been paid not less that the applicable wage rate and fringe benefits or cash equivalent for the classification of worked performed, as specified in the applicable wage determination incorporated into the contract.

e. 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 2d of this Section V.

f. The falsification of any of the above certifications may subject the contractor to civil or criminal prosecution under 18 U.S.C. 1001 and 31 U.S.C. 231.

g. The contractor or subcontractor shall make the records required under paragraph 2b of this Section V available for inspection, copying, or transcription by authorized representatives of the SHA, the FHWA, or the DOL, 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 SHA, the FHWA, the DOL, or all may, after written notice to the contractor, sponsor, applicant, or owner, take such actions 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.

VI. RECORD OF MATERIALS, SUPPLIES, AND LABOR

1. On all Federal-aid contracts on the National Highway System, except those which provide solely for the installation of protective devices at railroad grade crossings, those which are constructed on a force account or direct labor basis, highway beautification contracts, and contracts for which the total final construction cost for roadway and bridge is less than $1,000,000 (23 CFR 635) the contractor shall:

a. Become familiar with the list of specific materials and supplies contained in Form FHWA-47, "Statement of Materials and Labor Used by Contractor of Highway Construction Involving Federal Funds," prior to the commencement of work under this contract.

b. Maintain a record of the total cost of all materials and supplies purchased for and incorporated in the work, and also of the quantities of those specific materials and supplies listed on Form FHWA-47, and in the units shown on Form FHWA-47.

c. Furnish, upon the completion of the contract, to the SHA resident engineer on Form FHWA-47 together with the data required in paragraph 1b relative to materials and supplies, a final labor summary of all contract work indicating the total hours worked and the total amount earned.

2. At the prime contractor's option, either a single report covering all contract work or separate reports for the contractor and for each subcontract shall be submitted.

VII. SUBLETTING OR ASSIGNING THE CONTRACT

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 State. 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).

   a. "Its own organization" shall be construed to include only workers employed and paid directly 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, assignee, or agent of the prime contractor.

   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 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 VII 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 SHA 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 SHA 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 SHA has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

VIII. SAFETY: ACCIDENT PREVENTION

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 SHA 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. 333).

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. 333).

IX. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

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, the following notice 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:

Notice To All Personnel Engaged On Federal-Aid Highway Projects

18 U.S.C. 1020 READS AS FOLLOWS:

"Whoever being an officer, agent, or employee of the United States, or 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 not more that $10,000 or imprisoned not more than 5 years or both."

X. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $100,000 or more.)

By submission of this bid or the execution of this contract, or subcontract, as appropriate, the bidder, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any facility that is or will be utilized in the performance of this contract, unless such contract is exempt under the Clean Air Act, as amended (42 U.S.C. 1857 et seq., as amended by Pub.L. 91-604), and under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq., as amended by Pub.L. 92-500), Executive Order 11738, and regulations in implementation thereof (40 CFR 15) is not listed, on the date of contract award, on the U.S. Environmental Protection Agency (EPA) List of Violating Facilities pursuant to 40 CFR 15.20.

2. That the firm agrees to comply and remain in compliance with all the requirements of Section 114 of the Clean Air Act and Section 308 of the Federal Water Pollution Control Act and all regulations and guidelines listed thereunder.

3. That the firm shall promptly notify the SHA of the receipt of any communication from the Director, Office of Federal Activities, EPA, indicating that a facility that is or will be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

4. That the firm agrees to include or cause to be included the requirements of paragraph 1 through 4 of this Section X in every nonexempt subcontract, and further agrees to take such action as the government may direct as a means of enforcing such requirements.

XI. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

1. Instructions for Certification - Primary Covered Transactions:

(Applicable to all Federal-aid contracts - 49 CFR 29)

a. By signing and submitting this proposal, the prospective primary 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 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 primary 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 department or agency determined to enter into this transaction. If it is later determined that the prospective primary participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause of default.

d. The prospective primary participant shall provide immediate written notice to the department or agency to whom this proposal is submitted if any time the prospective primary 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," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the department or agency to which this proposal is submitted for assistance in obtaining a copy of those regulations.

f. The prospective primary 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 primary 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 Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

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 may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the nonprocurement portion of the "Lists of Parties Excluded From Federal Procurement or Nonprocurement Programs" (Nonprocurement List) which is compiled by the General Services Administration.

i. 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.

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.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion — Primary Covered Transactions

1. The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

    a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

    b. Have not within a 3-year period preceding this proposal been convicted of or had a civil judgement 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;

    c. 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 1b of this certification; and

    d. Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

2. Where the prospective primary 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 Covered Transactions:

(Applicable to all subcontracts, purchase orders and other lower tier transactions of $25,000 or more - 49 CFR 29)

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," "primary covered transaction," "participant," "person," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

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.

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 may decide the method and

frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.

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 Covered Transactions

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 participation in this transaction 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.

XII. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

(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 his or her bid or proposal that he or she 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.

FEDERAL-AID FEMALE AND MINORITY GOALS

In accordance with Section II, "Nondiscrimination," of "Required Contract Provisions Federal-aid Construction Contracts" the following are the goals for female utilization:

Goal for Women (applies nationwide).....(percent) 6.9

The following are goals for minority utilization:

CALIFORNIA ECONOMIC AREA

		Goal (Percent)
174	**Redding, CA:**	
	Non-SMSA Counties	6.8
	CA Lassen; CA Modoc;CA Plumas;CA Shasta; CA Siskiyou; CA Tehama.	
175	**Eureka, CA**	
	Non-SMSA Counties	6.6
	CA Del Norte; CA Humboldt; CA Trinity.	
176	**San Francisco-Oakland-San Jose, CA:**	
	SMSA Counties:	
	7120 Salinas-Seaside-Monterey, CA	28.9
	CA Monterey.	
	7360 San Francisco-Oakland	25.6
	CA Alameda; CA Contra Costa; CA Marin; CA San Francisco; CA San Mateo.	
	7400 San Jose, CA	19.6
	CA Santa Clara.	
	7485 Santa Cruz, CA.	14.9
	CA Santa Cruz.	
	7500 Santa Rosa, CA	9.1
	CA Sonoma.	
	8720 Vallejo-Fairfield- Napa, CA	17.1
	CA Napa; CA Solano	
	Non-SMSA Counties	23.2
	CA Lake; CA Mendocino; CA San Benito	
177	**Sacramento, CA**:	
	SMSA Counties:	
	6920 Sacramento, CA	16.1
	CA Placer; CA Sacramento; CA Yolo.	
	Non-SMSA Counties	14.3
	CA Butte; CA Colusa; CA El Dorado; CA Glenn; CA Nevada; CA Sierra; CA Sutter; CA Yuba.	
178	**Stockton-Modesto, CA:**	
	SMSA Counties:	
	5170 Modesto, CA	12.3
	CA Stanislaus.	
	8120 Stockton, CA	24.3
	CA San Joaquin.	
	Non-SMSA Counties	19.8
	CA Alpine; CA Amador; CA Calaveras; CA Mariposa;CA Merced; CA Tuolumne.	

		Goal (Percent)
179	**Fresno-Bakersfield, CA**	
	SMSA Counties:	
	0680 Bakersfield, CA	19.1
	CA Kern.	
	2840 Fresno, CA	26.1
	CA Fresno.	
	Non-SMSA Counties	23.6
	CA Kings; CA Madera; CA Tulare.	
180	**Los Angeles, CA:**	
	SMSA Counties:	
	0360 Anaheim-Santa Ana-Garden Grove, CA	11.9
	CA Orange.	
	4480 Los Angeles-Long Beach, CA	28.3
	CA Los Angeles.	
	6000 Oxnard-Simi Valley-Ventura, CA	21.5
	CA Ventura.	
	6780 Riverside-San Bernardino-Ontario, CA.	19.0
	CA Riverside; CA San Bernardino.	
	7480 Santa Barbara-Santa Maria-Lompoc, CA	19.7
	CA Santa Barbara.	
	Non-SMSA Counties	24.6
	CA Inyo; CA Mono; CA San Luis Obispo.	
181	**San Diego, CA:**	
	SMSA Counties	
	7320 San Diego, CA.	16.9
	CA San Diego.	
	Non-SMSA Counties	18.2
	CA Imperial.	

In addition to the reporting requirements set forth elsewhere in this contract the Contractor and subcontractors holding subcontracts, not including material suppliers, of $10,000 or more, shall submit for every month of July during which work is performed, employment data as contained under Form FHWA PR-1391 (Appendix C to 23 CFR, Part 230), and in accordance with the instructions included thereon.

FEDERAL REQUIREMENT TRAINING SPECIAL PROVISIONS

As part of the Contractor's equal employment opportunity affirmative action program, training shall be provided as follows:

The Contractor shall provide on-the-job training to develop full journeymen in the types of trades or job classification involved.

The goal for the number of trainees or apprentices to be trained under the requirements of this special provision will be 23.

In the event the Contractor subcontracts a portion of the contract work, he shall determine how many, if any, of the trainees or apprentices are to be trained by the subcontractor, provided however, that the Contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The Contractor shall also insure that this Training Special Provision is made applicable to such subcontract. Where feasible, 25 percent of trainees or apprentices in each occupation shall be in their first year of apprenticeship or training.

The number of trainees or apprentices shall be distributed among the work classifications on the basis of the Contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment. Prior to commencing work, the Contractor shall submit to the Department for approval the number of trainees or apprentices to be trained in each selected classification and training program to be used. Furthermore, the Contractor shall specify the starting time for training in each of the classifications. The Contractor will be credited for each trainee or apprentice employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees or apprentices as provided hereinafter.

Training and upgrading of minorities and women toward journeymen status is a primary objective of this Training Special Provision. Accordingly, the Contractor shall make every effort to enroll minority and women trainees or apprentices (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees or apprentices) to the extent such persons are available within a reasonable area of recruitment. The Contractor will be responsible for demonstrating the steps that he has taken in pursuance thereof, prior to a determination as to whether the Contractor is in compliance with this Training Special Provision. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

No employee shall be employed as a trainee or apprentice in any classification in which he has successfully completed a training course leading to journeyman status or in which he has been employed as a journeyman. The Contractor should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used the Contractor's records should document the findings in each case.

The minimum length and type of training for each classification will be as established in the training program selected by the Contractor and approved by both the Department and the Federal Highway Administration. The Department and the Federal Highway Administration will approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the Contractor and to qualify the average trainee or apprentice for journeyman status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with the State of California, Department of Industrial Relations, Division of Apprenticeship Standards recognized by the Bureau and training programs approved but not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training shall also be considered acceptable provided it is being administered in a manner consistent with the equal employment obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from the State prior to commencing work on the classification covered by the program. It is the intention of these provisions that training is to be provided in the construction crafts rather than clerk-typists or secretarial-type positions. Training is permissible in lower level management positions such as office engineers, estimators, timekeepers, etc., where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the division office. Some offsite training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

Except as otherwise noted below, the Contractor will be reimbursed 80 cents per hour of training given an employee on this contract in accordance with an approved training program. As approved by the Engineer, reimbursement will be made for training of persons in excess of the number specified herein. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the Contractor from receiving other reimbursement. Reimbursement for offsite training indicated above may only be made to the Contractor where he does one or more of the following and the trainees or apprentices are concurrently employed on a Federal-aid project; contributes to the cost of the training, provides the instruction to the trainee or apprentice or pays the trainee's or apprentice's wages during the offsite training period.

No payment shall be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee or apprentice as a journeyman, is caused by the Contractor and evidences a lack of good faith on the part of the Contractor in meeting the requirements of this Training Special Provision. It is normally expected that a trainee or apprentice will begin his training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training opportunities exist in his work classification or until he has completed his training program. It is not required that all trainees or apprentices be on board for the entire length of the contract. A Contractor will have fulfilled his responsibilities under this Training Special Provision if he has provided acceptable training to the number of trainees or apprentices specified. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period.

Only trainees or apprentices registered in a program approved by the State of California's State Administrator of Apprenticeship may be employed on the project and said trainees or apprentices shall be paid the standard wage specified under the regulations of the craft or trade at which they are employed.

The Contractor shall furnish the trainee or apprentice a copy of the program he will follow in providing the training. The Contractor shall provide each trainee or apprentice with a certification showing the type and length of training satisfactorily completed.

The Contractor will provide for the maintenance of records and furnish periodic reports documenting his performance under this Training Special Provision.