03

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

NOTICE TO BIDDERS

AND

SPECIAL PROVISIONS

FOR CONSTRUCTION ON STATE HIGHWAY IN SACRAMENTO COUNTY IN AND NEAR SACRAMENTO FROM 1.1 MILES SOUTH OF ELK GROVE BOULEVARD TO AMERICAN RIVER VIADUCT

In District 03 On Route 5

Under

***Bid* book dated June 18, 2018**	***Standard Specifications* dated 2015**
Project plans approved May 14, 2018	***Standard Plans* dated 2015**

Identified by

Contract No. 03-0H10U4

03-Sac-5-9.7/24.9

Project ID 0317000246

Federal-Aid Project
ACSB1IM-005-6(349)E

Bids open Thursday, August 9, 2018 **AADD**
Dated June 18, 2018 **OSD**

****

SPECIAL NOTICES

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- See sections 2 and 3 for contractors' registration requirements.
- The schedules for the submittal of DBE forms have been revised. See section 2-1.33 for the submittal schedules.
- This is a building-construction federal-aid project. You must perform at least 30 percent of the value of the total bid with your own forces. See section 5-1.13.
- See section 2-1.04 for mandatory prebid meeting requirements.
- The contract award period has been extended for this project. See section 3-1.04.

CONTRACT NO. 03-1H10U4

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

ROADWAY

Judy Mendez 5/28/18

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
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Exp. 12/31/19
CIVIL
STATE OF CALIFORNIA

ELECTRICAL (ROADWAY)

Prajakti Erande 5/24/18

REGISTERED ELECTRICAL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
P.S. ERANDE
No. E 21030
Exp. 03-31-19
ELECT.
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TRAFFIC

Jim Ferreira 3/15/2018

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
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No. C 48257
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STRUCTURES

5/29/2018

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TABLE OF CONTENTS

NOTICE TO BIDDERS 1
BID ITEM LIST 3
SPECIAL PROVISIONS 20
ORGANIZATION 20
DIVISION I GENERAL PROVISIONS 20
1 GENERAL 20
2 BIDDING 23
5 CONTROL OF WORK 25
6 CONTROL OF MATERIALS 30
7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC 31
8 PROSECUTION AND PROGRESS 32
9 PAYMENT 33
DIVISION II GENERAL CONSTRUCTION 34
10 GENERAL 34
12 TEMPORARY TRAFFIC CONTROL 34
13 WATER POLLUTION CONTROL 65
14 ENVIRONMENTAL STEWARDSHIP 69
15 EXISTING FACILITIES 82
DIVISION III EARTHWORK AND LANDSCAPE 83
17 GENERAL 83
19 EARTHWORK 83
21 EROSION CONTROL 84
DIVISION IV SUBBASES AND BASES 84
24 STABILIZED SOILS 84
28 CONCRETE BASES 85
DIVISION V SURFACINGS AND PAVEMENTS 85
36 GENERAL 85
37 BITUMINOUS SEALS 86
39 ASPHALT CONCRETE 94
40 CONCRETE PAVEMENT 102
41 EXISTING CONCRETE PAVEMENT 110
DIVISION VI STRUCTURES 118
46 GROUND ANCHORS AND SOIL NAILS 118

48 TEMPORARY STRUCTURES 120
49 PILING 120
51 CONCRETE STRUCTURES 127
52 REINFORCEMENT 131
56 OVERHEAD SIGN STRUCTURES, STANDARDS, AND POLES 135
58 SOUND WALLS 136
60 EXISTING STRUCTURES 136
DIVISION VII DRAINAGE FACILITIES 145
65 CONCRETE PIPE 145
71 EXISTING DRAINAGE FACILITIES 145
DIVISION VIII MISCELLANEOUS CONSTRUCTION 146
72 SLOPE PROTECTION 146
73 CONCRETE CURBS AND SIDEWALKS 146
74 PUMPING EQUIPMENT AND CONTROLS 147
75 MISCELLANEOUS METAL 169
77 LOCAL INFRASTRUCTURE 169
80 FENCES 173
DIVISION IX TRAFFIC CONTROL DEVICES 173
81 MISCELLANEOUS TRAFFIC CONTROL DEVICES 173
82 SIGNS AND MARKERS 174
83 RAILINGS AND BARRIERS 175
84 MARKINGS 185
DIVISION X ELECTRICAL WORK 186
86 GENERAL 186
87 ELECTRICAL SYSTEMS 187
DIVISION XI MATERIALS 241
90 CONCRETE 241
96 GEOSYNTHETICS 242
REVISED STANDARD SPECIFICATIONS APPLICABLE TO THE 2015 EDITION OF THE STANDARD SPECIFICATIONS 243

STANDARD PLANS LIST

The standard plan sheets applicable to this Contract include those listed below. The applicable revised standard plans (RSPs) listed below are included in the project plans.

A3A	Abbreviations (Sheet 1 of 3)
A3B	Abbreviations (Sheet 2 of 3)
A3C	Abbreviations (Sheet 3 of 3)
A10A	Legend - Lines and Symbols (Sheet 1 of 5)
RSP A10B	Legend - Lines and Symbols (Sheet 2 of 5)
A10C	Legend - Lines and Symbols (Sheet 3 of 5)
A10D	Legend - Lines and Symbols (Sheet 4 of 5)
A10E	Legend - Lines and Symbols (Sheet 5 of 5)
A10F	Legend - Soil (Sheet 1 of 2)
A10G	Legend - Soil (Sheet 2 of 2)
A10H	Legend - Rock
RSP A20A	Pavement Markers and Traffic Lines - Typical Details
RSP A20B	Pavement Markers and Traffic Lines - Typical Details
RSP A20C	Pavement Markers and Traffic Lines - Typical Details
RSP A20D	Pavement Markers and Traffic Lines - Typical Details
A24A	Pavement Markings - Arrows
A24B	Pavement Markings - Arrows and Symbols
A24C	Pavement Markings - Symbols and Numerals
A24D	Pavement Markings - Words
A24E	Pavement Markings - Words, Limit and Yield Lines
A24F	Pavement Markings - Crosswalks
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
A62F	Excavation and Backfill - Metal and Plastic Culverts
A63A	Portable Concrete Barrier (Type 60K)
A63B	Portable Concrete Barrier (Type 60K)
A73A	Object Markers
A73B	Markers

A73C	Delineators, Channelizers and Barricades
RSP A76A	Concrete Barrier Type 60M
RSP A76B	Concrete Barrier Type 60M
RSP A76BA	Concrete Barrier Type 60MP
RSP A76BB	Concrete Barrier Type 60PR
RSP A76C	Concrete Barrier Type 60MF
RSP A76D	Concrete Barrier Type 60MG
RSP A76E	Concrete Barrier Type 60MG
RSP A76F	Concrete Barrier Type 60MGF
RSP A77L1	Midwest Guardrail System - Standard Railing Section (Wood Post with Wood Block)
RSP A77L2	Midwest Guardrail System - Standard Railing Section (Steel Post with Notched Wood or Notched Recycled Plastic Block)
A77M1	Midwest Guardrail System - Standard Hardware
RSP A77N1	Midwest Guardrail System - Wood Post and Wood Block Details
RSP A77N2	Midwest Guardrail System - Steel Post and Notched Wood Block Details
RSP A77N3	Midwest Guardrail System - Typical Line Post Embedment and Hinge Point Offset Details
A77N4	Midwest Guardrail System - Typical Railing Delineation and Dike Positioning Details
RSP A77N5	Minor Concrete Vegetation Control - Guardrail System
RSP A77N5A	Minor Concrete Vegetation Control - Guardrail System - Narrow Vegetation Control Installation
RSP A77N6	Minor Concrete Vegetation Control - Guardrail System - For Terminal System End Treatments
RSP A77N7	Minor Concrete Vegetation Control - Guardrail System - At Structure Approach
RSP A77N8	Minor Concrete Vegetation Control - Guardrail System - At Fixed Object
RSP A77N9	Minor Concrete Vegetation Control - Guardrail System - At Fixed Object
RSP A77N10	Minor Concrete Vegetation Control - Guardrail System - At Fixed Object
RSP A77N11	Minor Concrete Vegetation Control - Guardrail System - Miscellaneous Details
RSP A77P1	Midwest Guardrail System - Typical Layouts for Embankments
RSP A77Q1	Midwest Guardrail System - Typical Layouts for Structure Approach
RSP A77Q2	Midwest Guardrail System - Typical Layouts for Structure Approach and Between Structures
A77Q5	Midwest Guardrail System - Typical Layouts for Structure Departure
RSP A77R2	Midwest Guardrail System - Typical Layouts for Fixed Objects Between Separate Roadbeds (One-Way Traffic)
RSP A77R3	Midwest Guardrail System - Typical Layouts for Roadside Fixed Objects
A77S1	Midwest Guardrail System - End Anchor Assembly (Type SFT)
RSP A77S2	Midwest Guardrail System - Rail Tensioning Assembly
A77S3	Metal Railing Anchor Cable and Anchor Plate Details

A77T1	Metal Railing End Anchor Assembly (Type CA)
A77U1	Midwest Guardrail System - Connections to Bridge Railings without Sidewalks Details No. 1
A77U2	Midwest Guardrail System - Connections to Bridge Railings without Sidewalks Details No. 2
A77U3	Midwest Guardrail System - Connections to Abutments and Walls
A77U4	Midwest Guardrail System - Transition Railing (Type WB-31)
A78B	Thrie Beam Barrier - Standard Barrier Railing Section (Steel Post with Notched Wood Block or Notched Recycled Plastic Block)
A78C1	Thrie Beam Barrier - Standard Hardware Details
A78C2	Thrie Beam Barrier - Post and Block Details
RSP A78C3	Minor Concrete Vegetation Control - Single Thrie Beam Barrier
RSP A78C4	Minor Concrete Vegetation Control - Double Thrie Beam Barrier
RSP A78C5	Minor Concrete Vegetation Control - Thrie Beam Barrier - At Fixed Objects in Median
A78D1	Thrie Beam Barrier at Fixed Objects in Median
A78F1	Double Thrie Beam Barrier - Connections to Bridge Railings without Sidewalks
A78F2	Single Thrie Beam Barrier - Connections to Bridge Railings without Sidewalks
RSP A78I	Double Thrie Beam Barrier - Connection to Concrete Barrier
A78K	Double Thrie Beam Barrier - Transition Railing (Type DTB)
RSP A85	Chain Link Fence
RSP A85A	Chain Link Fence Details
A85B	Chain Link Fence Details
A86	Barbed Wire and Wire Mesh Fences
A86A	Barbed Wire and Wire Mesh Fence Detail on Sharp Break in Grade
A86B	Barbed Wire and Wire Mesh Fence Details
A86C	Barbed Wire and Wire Mesh Fence Details at Ditch Crossing
A87A	Curbs and Driveways
RSP A87B	Hot Mix Asphalt Dikes
RSP A88A	Curb Ramp Details
RSP A88B	Curb Ramp and Island Passageway Details
P1	Jointed Plain Concrete Pavement - New Construction
P6	Spall Repair
P7	Dowel Bar Retrofit
P8	Individual Slab Replacement with Rapid Strength Concrete
P10	Concrete Pavement Dowel Bar Details
RSP P14	Continuously Reinforced Concrete Pavement - Transverse Construction Joint
P15	Concrete Pavement - Tie Bar Details

P18	Concrete Pavement - Lane Schematics and Isolation Joint Detail
P20	Joint Seals
P30	Concrete Pavement - End Panel Pavement Transitions
P33	Concrete Pavement - Lane Drop Paving Details No. 1
P34	Concrete Pavement - Lane Drop Paving Details No. 2
P35	Concrete Pavement - Ramp Transition Paving Details
P45	Concrete Pavement - Drainage Inlet Details No. 1
P46	Concrete Pavement - Drainage Inlet Details No. 2
P50	Pavement Structure - Drainage System Details
P70	Hot Mix Asphalt Paving (Longitudinal Tapered Notched Wedge Joint)
P74	Pavement Edge Treatments
P75	Pavement Edge Treatments - Overlays
P76	Pavement Edge Treatments - New Construction
D71	Drainage Inlet Markers
RSP D72B	CIP Drainage Inlets - Types G1, G2, G3, G4, G5 and G6
RSP D72C	CIP Drainage Inlets - Types G1, G2, G3, G4, G5 and G6
RSP D72E	CIP Drainage Inlets - Types GO and GDO
RSP D72F	CIP Drainage Inlets Notes
RSP D72G	CIP Drainage Inlets Tables
RSP D73B	Precast Drainage Inlets - Types G1, G2, G3, G4, G5 and G6
RSP D73C	Precast Drainage Inlets - Types G1, G2, G3, G4, G5 and G6
RSP D73E	Precast Drainage Inlets - Types GO and GDO
RSP D73F	Precast Drainage Inlets Notes
RSP D73G	Precast Drainage Inlets Tables
RSP D74	Drainage Inlet Details
D77A	Grate Details No. 1
D77B	Grate Details No. 2
D78A	Gutter Depressions
D78B	Inlet Depressions - Concrete Shoulders
D78C	Inlet Depressions - Hot Mix Asphalt Shoulders
D87A	Corrugated Metal Pipe Downdrain Details
D87D	Overside Drains
D88	Construction Loads on Culverts
D94A	Metal and Plastic Flared End Sections
D94B	Concrete Flared End Sections

D97A	Corrugated Metal Pipe Coupling Details No. 1 - Annular Coupling Band Bar and Strap and Angle Connections
D97C	Corrugated Metal Pipe Coupling Details No. 3 - Helical and Universal Couplers
D97D	Corrugated Metal Pipe Coupling Details No. 4 - Hugger Coupling Bands
D97E	Corrugated Metal Pipe Coupling Details No. 5 - Standard Joint
D97F	Corrugated Metal Pipe Coupling Details No. 6 - Positive Joint
D97G	Corrugated Metal Pipe Coupling Details No. 7 - Downdrain
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
RSP D98F	Slotted Pipe Grate Extension Details
RSP D98H	Grated Line Drain Details No. 2 - Inlet Connection Details (All Types Except 4" Nominal Width Polymer Concrete)
RSP D98I	Grated Line Drain Details No. 3 - (All Types Except 4" Nominal Width Polymer Concrete)
RSP D98J	Grated Line Drain Details No. 4 - Connection to Existing Drainage Structure
D102	Underdrains
RSP H1	Landscape and Erosion Control Symbols
RSP H2	Landscape Details
RSP H9	Landscape Details
RSP H51	Erosion Control Details - Fiber Roll and Compost Sock
H52	Rolled Erosion Control Product
T1A	Temporary Crash Cushion, Sand Filled (Unidirectional)
T1B	Temporary Crash Cushion, Sand Filled (Bidirectional)
T2	Temporary Crash Cushion, Sand Filled (Shoulder Installations)
T3A	Temporary Railing (Type K)
T3B	Temporary Railing (Type K)
RSP T4	Temporary Traffic Screen
RSP T9	Traffic Control System Tables for Lane and Ramp Closures
RSP T10	Traffic Control System for Lane Closure on Freeways and Expressways
RSP T11	Traffic Control System for Lane Closure on Multilane Conventional Highways
RSP T11A	Traffic Control System for Changeable Lane Closure on Multilane Conventional Highways and Expressways
RSP T12	Traffic Control System for Half Road Closure on Multilane Conventional Highways and Expressways
RSP T13	Traffic Control System for Lane Closure on Two Lane Conventional Highways
RSP T14	Traffic Control System for Ramp Closure
T15	Traffic Control System for Moving Lane Closure on Multilane Highways
T16	Traffic Control System for Moving Lane Closure on Multilane Highways

RSP T30	Temporary Pedestrian Access Routes - Typical Sidewalk Closure and Pedestrian Detour
RSP T31	Temporary Pedestrian Access Routes - Typical Sidewalk Diversion Within Roadbed
RSP T32	Temporary Pedestrian Access Routes - Typical Sidewalk/Crosswalk Closure and Pedestrian Detour
RSP T33	Temporary Pedestrian Access Routes - Ramp
RSP T34	Temporary Pedestrian Access Routes - Curb Ramp Options
T51	Temporary Water Pollution Control Details (Temporary Silt Fence)
T53	Temporary Water Pollution Control Details (Temporary Cover)
T54	Temporary Water Pollution Control Details (Temporary Erosion Control Blanket)
T55	Temporary Water Pollution Control Details (Temporary Erosion Control Blanket)
T56	Temporary Water Pollution Control Details (Temporary Fiber Roll)
T57	Temporary Water Pollution Control Details (Temporary Check Dam)
T58	Temporary Water Pollution Control Details (Temporary Construction Entrance)
T59	Temporary Water Pollution Control Details (Temporary Concrete Washout Facility)
T60	Temporary Water Pollution Control Details (Temporary Reinforced Silt Fence)
T61	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
T62	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
T63	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
T64	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
RSP T65	Temporary Water Pollution Control Details (Temporary High-Visibility Fence)
RSP T66	Temporary Water Pollution Control Details (Temporary Large Sediment Barrier)
B0-1	Bridge Details
RSP B0-3	Bridge Details
B0-5	Bridge Details
B0-13	Bridge Details
B2-5	Pile Details - Class 90 and Class 140
RSP B3-1A	Retaining Wall Type 1 (Case 1)
RSP B3-1B	Retaining Wall Type 1 (Case 2)
RSP B3-1C	Retaining Wall Type 1 (Case 3)
B3-3A	Retaining Wall Type 1A (Case 1)
B3-3B	Retaining Wall Type 1A (Case 2)
B3-4A	Retaining Wall Type 5 (Case 1)
B3-4B	Retaining Wall Type 5 (Case 2)
B3-4C	Retaining Wall Type 5 (Case 3)
B3-5	Retaining Wall Details No. 1

B3-6	Retaining Wall Details No. 2
B3-7A	Retaining Wall Type 6 (Case 1)
B3-7B	Retaining Wall Type 6 (Case 2)
B3-7C	Retaining Wall Type 6 Details
B6-1	T-Beam Details
B6-21	Joint Seals (Maximum Movement Rating = 2")
B7-1	Box Girder Details
B7-5	Deck Drains
B7-6	Deck Drains - Types D-1 and D-2
B7-8	Deck Drainage Details
B7-10	Utility Opening - Box Girder
RSP B7-11	Utility Details
RSP B9-2	Structure Approach - Type R (30)
RSP B9-5	Structure Approach - Slab Details
RSP B9-6	Structure Approach - Drainage Details
B11-47	Cable Railing
RSP B11-51	Tubular Handrailing
RSP B11-52	Chain Link Railing Type 7
B11-60	Concrete Barrier Type 80 (Sheet 1 of 2)
B11-61	Concrete Barrier Type 80 (Sheet 2 of 2)
B14-3	Communication and Sprinkler Control Conduits (Conduit Less Than 4")
B15-1	Sound Wall Masonry Block on Footing Details (1)
B15-2	Sound Wall Masonry Block on Footing Details (2)
B15-6	Sound Wall Masonry Block on Type 736S/SV Barrier Details (1)
B15-8	Sound Wall Masonry Block on Type 736S/SV Barrier Details (3)
B15-12	Sound Wall Masonry Block on Barrier - 5'-0" Access Gate Details (1)
B15-13	Sound Wall Masonry Block on Barrier - 5'-0" Access Gate Details (2)
B15-14	Sound Wall Masonry Block Access Gate Locking Details
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
S1	Overhead Signs - Truss, Instructions and Examples
S2	Overhead Signs - Truss, Single Post Type - Post Types II thru IX
S3	Overhead Signs - Truss, Single Post Type - Base Plate and Anchorage Details
S4	Overhead Signs - Truss, Single Post Type - Structural Frame Members Details No.

	1
S5	Overhead Signs - Truss, Single Post Type - Structural Frame Members Details No. 2
S6	Overhead Signs - Truss, Gusset Plate Details
S8	Overhead Signs - Truss, Single Post Type - Round Pedestal Pile Foundation
S9	Overhead Signs - Truss, Two Post Type - Post Types I-S Through VII-S
S10	Overhead Signs - Truss, Two Post Type - Base Plate and Anchorage Details
S11	Overhead Signs - Truss, Two Post Type - Structural Frame Members
S12	Overhead Signs - Truss, Structural Frame Details
S13	Overhead Signs - Truss, Frame Juncture Details
S15	Overhead Signs - Truss, Two Post Type - Round Pedestal Pile Foundation
S16	Overhead Signs - Walkway Details No. 1
S17	Overhead Signs - Walkway Details No. 2
S17A	Overhead Signs - Walkway Details No. 3
S18	Overhead Signs - Walkway Safety Railing Details
S19	Overhead Signs - Truss, Sign Mounting Details - Laminated Panel - Type A
S81	Overhead Laminated Sign - Single or Multiple Panel (Type A, 1" Thick)
S85	Seam Closure, "H" Section Extrusion and Post Spacing Tables (Multi-Horizontal Laminated Panel Aluminum Signs)
S86	Laminated Panel Details (Extrusions for Type A, B and H Panels)
S87	Type A-1 Mounting Hardware for Overhead Laminated Type A Panel (Truss and Lightweight Sign Structures)
S88	Type A-2 Mounting Hardware for Overhead Laminated Type A Panel (Bridge Mounted and Tubular Sign Structures)
S93	Framing Details for Framed Single Sheet Aluminum Signs, Rectangular Shape
S94	Roadside Framed Single Sheet Aluminum Signs, Rectangular Shape
S95	Roadside Single Sheet Aluminum Signs, Diamond Shape
RSP ES-1A	Electrical Systems (Legend)
RSP ES-1B	Electrical Systems (Legend)
RSP ES-1C	Electrical Systems (Legend and Abbreviations)
ES-2A	Electrical Systems (Service Equipment)
ES-2C	Electrical Systems (Service Equipment Enclosure Notes, Type III Series)
RSP ES-2D	Electrical Systems (Service Equipment Enclosure and Typical Wiring Diagram, Type III - A Series)
RSP ES-3C	Electrical Systems (Controller Cabinet Foundation and Pad Details)
RSP ES-3C1	Electrical Systems (Controller Cabinet Foundation and Pad Details)
RSP ES-3C2	Electrical Systems (Controller Cabinet Foundation Details)
RSP ES-3E	Electrical Systems (Telephone Demarcation Cabinet, Type B)
ES-4A	Electrical Systems (Signal Heads and Mountings)

ES-4B	Electrical Systems (Pedestrian Signal Heads)
RSP ES-4C	Electrical Systems (Signal Heads and Mountings)
RSP ES-4D	Electrical Systems (Signal Head Mounting)
RSP ES-4E	Electrical Systems (Signal Heads and Optical Detector Mounting)
RSP ES-5A	Electrical Systems (Loop Detectors)
RSP ES-5B	Electrical Systems (Detectors)
ES-5C	Electrical Systems (Accessible Pedestrian Signal and Push Button Assemblies)
ES-5D	Electrical Systems (Curb and Shoulder Termination, Trench, and Handhole Details)
RSP ES-6A	Electrical Systems (Lighting Standard, Types 15 and 21)
RSP ES-6B	Electrical Systems (Electrolier Anchorage and Grouting for Type 15 and Type 21, Barrier Rail Mounted)
RSP ES-6E	Electrical Systems (Lighting Standard, Types 30 and 31)
ES-6F	Electrical Systems (Lighting Standard, Slip Base Plate)
RSP ES-6G	Electrical Systems (Lighting Standard, Type 32)
RSP ES-7A	Electrical Systems (Signal and Lighting Standard, Type TS, and Push Button Assembly Post)
RSP ES-7B	Electrical Systems (Signal and Lighting Standard, Type 1 and Equipment Identification Characters)
RSP ES-7C	Electrical Systems (Signal and Lighting Standard, Case 1 Signal Mast Arm Loading, Wind Velocity = 100 mph and Signal Mast Arm Lengths 15' to 30')
RSP ES-7D	Electrical Systems (Signal and Lighting Standard, Case 2 Signal Mast Arm Loading, Wind Velocity = 100 mph and Signal Mast Arm Lengths 15' to 30')
RSP ES-7E	Electrical Systems (Signal and Lighting Standard, Case 3 Signal Mast Arm Loading, Wind Velocity = 100 mph and Signal Mast Arm Lengths 15' to 45')
RSP ES-7F	Electrical Systems (Signal and Lighting Standard, Case 4 Signal Mast Arm Loading, Wind Velocity = 100 mph and Signal Mast Arm Lengths 25' to 45')
RSP ES-7G	Electrical Systems (Signal And Lighting Standard, Case 5 Signal Mast Arm Loading, Wind Velocity = 100 mph and Signal Mast Arm Lengths 50' to 55')
RSP ES-7H	Electrical Systems (Signal and Lighting Standard, Case 5 Signal Mast Arm Loading, Wind Velocity = 100 mph and Signal Mast Arm Lengths 60' to 65')
RSP ES-7J	Electrical Systems (Flashing Beacon on a Type 1, Type 15-FBS and Type 40 Standard)
RSP ES-7M	Electrical Systems (Signal and Lighting Standard - Detail No. 1)
RSP ES-7N	Electrical Systems (Signal and Lighting Standard - Detail No. 2)
ES-7O	Electrical Systems (Signal and Lighting Standard - Detail No. 3)
ES-7P	Electrical Systems (Internally Illuminated Street Name Sign)
ES-7R	Electrical Systems (Signal and Lighting, Miscellaneous Attachment)
RSP ES-8A	Electrical Systems (Non-Traffic Pull Box)
RSP ES-8B	Electrical Systems (Traffic Pull Box)
RSP ES-8C	Electrical Systems (Splice Vaults)
ES-9A	Electrical Systems (Structure Pull Box Installations)
ES-9B	Electrical Systems (Conduit Riser and Expansion Fitting, Structure Installations)
RSP ES-9C	Electrical Systems (Structure Pull Box)

RSP ES-9D	Electrical Systems (Structure Pull Box Installations)
RSP ES-10A	Electrical Systems (Isofootcandle Curves)
RSP ES-10B	Electrical Systems (Isofootcandle Curves)
RSP ES-11	Electrical Systems (Foundation Installations)
RSP ES-13A	Electrical Systems (Splice Insulation Methods Details)
RSP ES-13B	Electrical Systems (Fuse Rating, Kinking, and Banding Detail)
ES-14A	Electrical Systems (LED Extinguishable Message Sign, 10" Letters)
RSP ES-14B	Electrical Systems (Control Assembly Wiring Diagrams)
ES-15A	Electrical Systems (Sign Illumination Equipment)
ES-15C	Electrical Systems (Sign Illumination Equipment)
ES-15D	Electrical Systems (Lighting and Sign Illumination Control)
RSP ES-16B	Electrical Systems (Closed Circuit Television, 25' to 45' Pole)
RSP ES-16C	Electrical Systems (Closed Circuit Television - 50' to 90' High Mast Pole)
RSP ES-16D	Electrical Systems (Closed Circuit Television with Vehicle Detection System, 30' to 40' Pole)
RSP ES-17A	Electrical Systems (Fiber Optic Marker Details)
RSP ES-18A	Temporary Wood Poles General Notes
RSP ES-18B	Temporary Wood Poles Non-Guyed - No Signals on Spans
RSP ES-19A	Temporary Wood Poles Details No. 1
RSP ES-19B	Temporary Wood Poles Details No. 2
RSP ES-19C	Temporary Wood Poles Details No. 3
RSP ES-19D	Temporary Wood Poles Details No. 4
RSP ES-19E	Temporary Wood Poles Details No. 5

CANCELED STANDARD PLANS LIST

The standard plan sheets listed below are canceled and not applicable to this contract.

Plan No.	Date Canceled	Plan No.	Date Canceled	Plan No.	Date Canceled
D72	07-15-16				
D73	07-15-16				
D74A	07-15-16				
D74B	07-15-16				
D74C	07-15-16				
D98C	01-20-17				
RSP B11-54	01-20-17				
ES-15B	04-15-16				

NOTICE TO BIDDERS

Bids open Thursday, August 9, 2018

Dated June 18, 2018

General work description: HMA, Precast JCP, Construct POC, fiber optic and soundwalls

The Department will receive sealed bids for CONSTRUCTION ON STATE HIGHWAY IN SACRAMENTO COUNTY IN AND NEAR SACRAMENTO FROM 1.1 MILES SOUTH OF ELK GROVE BOULEVARD TO AMERICAN RIVER VIADUCT.

District-County-Route-Post Mile: 03-Sac-5-9.7/24.9

Contract No. 03-0H10U4

The Contractor must have either a Class A license or any combination of the following Class C licenses which constitutes a majority of the work: C-12, C-8, C-61D06.

The DBE Contract goal is 16 percent.

Federal-aid project no.:

ACSB1IM-005-6(349)E

For the Federal training program, the number of trainees or apprentices is 39.

Bids must be on a cost+time basis.

Complete the work within the number of working days bid.

Do not bid less than 380 working days and not more than 440 working days.

The estimated cost of the project is $280,000,000.

A mandatory prebid meeting is scheduled on July 10, 2018 at 10:00 a.m. at 703 B Street, Marysville, CA 95901.

The Department will receive bids until 2:00 p.m. on the bid open date via Bid Express website. Bids received after this time will not be accepted. For more information refer to the Electronic Bidding Guide at the Office Engineer's website.

The Department will open and publicly read the bids through webcast/teleconference services immediately after the specified closing time.

For bid results go to:

http://www.dot.ca.gov/des/oe/contractor-info.html

Select *Electronic Bidding* under the *Bidding* tab.

District office addresses are provided in the *Standard Specifications*.

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

http://www.dot.ca.gov/hq/esc/oe/inquiry/bid_inquiries.php

Questions about alleged patent ambiguity of the plans, specifications, or estimate must be asked before bid opening. After bid opening, the Department does not consider these questions as bid protests.

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

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

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

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

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

Caltrans and the Construction Industry are committed to making partnering the way we do business. For more information, go to http://www.dot.ca.gov/hq/construc/partnering.html.

Department of Transportation

D03JAM/SN

BID ITEM LIST

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
1	070030	LEAD COMPLIANCE PLAN	LS	LUMP SUM
2	080050	PROGRESS SCHEDULE (CRITICAL PATH METHOD)	LS	LUMP SUM
3	090105	TIME-RELATED OVERHEAD (LS)	LS	LUMP SUM
4	100100	DEVELOP WATER SUPPLY	LS	LUMP SUM
5	120090	CONSTRUCTION AREA SIGNS	LS	LUMP SUM
6	120100	TRAFFIC CONTROL SYSTEM	LS	LUMP SUM
7	120105	AUTOMATED WORK ZONE INFORMATION SYSTEM	LS	LUMP SUM
8	120120	TYPE III BARRICADE	EA	150
9	120149	TEMPORARY PAVEMENT MARKING (PAINT)	SQFT	630
10	120159	TEMPORARY TRAFFIC STRIPE (PAINT)	LF	1,670,000
11	120198	PLASTIC TRAFFIC DRUMS	EA	3,680
12	120300	TEMPORARY PAVEMENT MARKER	EA	33,900
13	124000	TEMPORARY PEDESTRIAN ACCESS ROUTE	LS	LUMP SUM
14	128652	PORTABLE CHANGEABLE MESSAGE SIGN (LS)	LS	LUMP SUM
15	129000	TEMPORARY RAILING (TYPE K)	LF	173,000
16	035490	QUICKCHANGE MOVEABLE BARRIER SYSTEM	LF	909,000
17	035491	ALTERNATIVE TEMPORARY CRASH CUSHION MODULE	EA	140
18	129150	TEMPORARY TRAFFIC SCREEN	LF	150,000
19	130100	JOB SITE MANAGEMENT	LS	LUMP SUM
20	130300	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	LUMP SUM

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
21	130310	RAIN EVENT ACTION PLAN	EA	95
22	130320	STORM WATER SAMPLING AND ANALYSIS DAY	EA	150
23	130330	STORM WATER ANNUAL REPORT	EA	6
24	130500	TEMPORARY EROSION CONTROL BLANKET	SQYD	10,400
25	130505	MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)	EA	18
26	130530	TEMPORARY HYDRAULIC MULCH (BONDED FIBER MATRIX)	SQYD	74,600
27	130570	TEMPORARY COVER	SQYD	74,600
28	130610	TEMPORARY CHECK DAM	LF	1,480
29	130620	TEMPORARY DRAINAGE INLET PROTECTION	EA	270
30	130640	TEMPORARY FIBER ROLL	LF	15,000
31	130650	TEMPORARY GRAVEL BAG BERM	LF	11,600
32	130680	TEMPORARY SILT FENCE	LF	15,000
33	130710	TEMPORARY CONSTRUCTION ENTRANCE	EA	15
34	130730	STREET SWEEPING	LS	LUMP SUM
35	130900	TEMPORARY CONCRETE WASHOUT	LS	LUMP SUM
36	131103	WATER QUALITY SAMPLING AND ANALYSIS DAY	EA	100
37	131104	WATER QUALITY MONITORING REPORT	EA	100
38	131201	TEMPORARY CREEK DIVERSION SYSTEMS	LS	LUMP SUM
39	140003	ASBESTOS COMPLIANCE PLAN	LS	LUMP SUM
40	141103	REMOVE YELLOW THERMOPLASTIC TRAFFIC STRIPE (HAZARDOUS WASTE)	LF	73,800

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
41	141120	TREATED WOOD WASTE	LB	325,000
42	146002	CONTRACTOR-SUPPLIED BIOLOGIST (LS)	LS	LUMP SUM
43	148005	NOISE MONITORING	LS	LUMP SUM
44	153120	REMOVE CONCRETE (LF)	LF	3,060
45	153121	REMOVE CONCRETE (CY)	CY	6,550
46	153248	REMOVE CONCRETE (MISCELLANEOUS) (SQFT)	SQFT	6,860
47	160110	TEMPORARY HIGH-VISIBILITY FENCE	LF	12,000
48	170103	CLEARING AND GRUBBING (LS)	LS	LUMP SUM
49	190101	ROADWAY EXCAVATION	CY	345,000
50	190105	ROADWAY EXCAVATION (TYPE Z-2) (AERIALLY DEPOSITED LEAD)	CY	450
51	190185	SHOULDER BACKING	TON	2,440
52(F)	192003	STRUCTURE EXCAVATION (BRIDGE)	CY	3,317
53(F)	192037	STRUCTURE EXCAVATION (RETAINING WALL)	CY	4,314
54(F)	192060	STRUCTURE EXCAVATION (GROUND ANCHOR WALL)	CY	295
55(F)	193003	STRUCTURE BACKFILL (BRIDGE)	CY	1,947
56(F)	193013	STRUCTURE BACKFILL (RETAINING WALL)	CY	1,884
57(F)	193027	STRUCTURE BACKFILL (GROUND ANCHOR WALL)	CY	49
58	198209	SUBGRADE ENHANCEMENT GEOTEXTILE, CLASS B2	SQYD	133,000
59	200002	ROADSIDE CLEARING	LS	LUMP SUM
60	210010	MOVE-IN/MOVE-OUT (EROSION CONTROL)	EA	8

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
61	210212	DRY SEED (SQFT)	SQFT	597,000
62	210252	BONDED FIBER MATRIX (SQFT)	SQFT	7,090,000
63	210280	ROLLED EROSION CONTROL PRODUCT (BLANKET)	SQFT	597,000
64	210350	FIBER ROLLS	LF	36,900
65	210420	STRAW	SQFT	1,740
66	210610	COMPOST (CY)	CY	8,200
67	210630	INCORPORATE MATERIALS	SQFT	5,770,000
68	220101	FINISHING ROADWAY	LS	LUMP SUM
69	240105	LIME STABILIZED SOIL	SQYD	113,000
70	250201	CLASS 2 AGGREGATE SUBBASE	CY	13,300
71	260203	CLASS 2 AGGREGATE BASE (CY)	CY	122,000
72	280015	LEAN CONCRETE BASE RAPID SETTING	CY	25,900
73	280200	REPLACE BASE	CY	2,230
74	305000	CRACK AND SEAT	SQYD	368,000
75	035492	HIGH FRICTION SURFACE TREATMENT	SQYD	13,900
76	390095	REPLACE ASPHALT CONCRETE SURFACING	CY	300
77	390100	PRIME COAT	TON	810
78	035493	HOT MIX ASPHALT (TYPE A) (LONG LIFE)	TON	388,000
79	390132	HOT MIX ASPHALT (TYPE A)	TON	84,100
80	390135	HOT MIX ASPHALT (LEVELING)	TON	47,500

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
81	390136	MINOR HOT MIX ASPHALT	TON	27
82	390401	HOT MIX ASPHALT-OPEN GRADED (OPEN GRADED FRICTION COURSE)	TON	7,220
83	390402	RUBBERIZED HOT MIX ASPHALT-OPEN GRADED (OPEN GRADED FRICTION COURSE)	TON	64,600
84	393004	GEOSYNTHETIC PAVEMENT INTERLAYER (PAVING FABRIC)	SQYD	691,000
85	394060	DATA CORE	LS	LUMP SUM
86	035494	PLACE HOT MIX ASPHALT DIKE	LF	22,000
87	394090	PLACE HOT MIX ASPHALT (MISCELLANEOUS AREA)	SQYD	2,940
88	397005	TACK COAT	TON	1,250
89	398100	REMOVE ASPHALT CONCRETE DIKE	LF	22,000
90	398200	COLD PLANE ASPHALT CONCRETE PAVEMENT	SQYD	295,000
91	035495	PRECAST JOINTED CONCRETE PAVEMENT	CY	33,200
92	411105	INDIVIDUAL SLAB REPLACEMENT (RSC)	CY	4,180
93	418002	REMOVE CONCRETE PAVEMENT AND BASE	CY	43,700
94	420201	GRIND EXISTING CONCRETE PAVEMENT	SQYD	24,800
95	420203	GRIND EXISTING BRIDGE DECK	SQYD	310
96	460210	GROUND ANCHOR (SUBHORIZONTAL)	EA	99
97	046189	FURNISH STEEL PIPE PILING (PP 30 X 1.0)	LF	10,566
98	046190	DRIVE STEEL PIPE PILE (PP 30 X 1.0)	EA	132
99	046191	FURNISH 18" PRECAST PRESTRESSED CONCRETE PILING	LF	5,438
100	046192	DRIVE 18" PRECAST PRESTRESSED CONCRETE PILE	EA	84

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
101	490601	16" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	6,800
102	035496	24" CAST-IN-DRILLED HOLE CONCRETE PILING (WET POUR)	LF	7,610
103	046193	FURNISH PILING (CLASS 140) (ALTERNATIVE X)	LF	10,007
104	046194	DRIVE PILE (CLASS 140) (ALTERNATIVE X)	EA	222
105	495106	FURNISH 18" CAST-IN-STEEL SHELL CONCRETE PILING	LF	8,690
106	495107	DRIVE 18" CAST-IN-STEEL SHELL CONCRETE PILE	EA	358
107	495115	FURNISH 24" CAST-IN-STEEL SHELL CONCRETE PILING	LF	150
108	495116	DRIVE 24" CAST-IN-STEEL SHELL CONCRETE PILE	EA	6
109	498022	24" CAST-IN-DRILLED-HOLE CONCRETE PILING (SOUND WALL)	LF	7,310
110	035497	60" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION) (WET POUR)	LF	1,830
111(F)	510051	STRUCTURAL CONCRETE, BRIDGE FOOTING	CY	1,476
112(F)	510053	STRUCTURAL CONCRETE, BRIDGE	CY	2,362
113(F)	510054	STRUCTURAL CONCRETE, BRIDGE (POLYMER FIBER)	CY	2,417
114(F)	046195	STRUCTURAL CONCRETE, GROUND ANCHOR WALL	CY	121
115(F)	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	1,431
116(F)	510061	STRUCTURAL CONCRETE, SOUND WALL	CY	15
117(F)	046196	STRUCTURAL CONCRETE, SOUND WALL PILE CAP	CY	10
118(F)	510069	STRUCTURE CONCRETE (PUMPING PLANT)	CY	2
119(F)	510072	STRUCTURAL CONCRETE, BARRIER SLAB	CY	10,034
120	510081	AGGREGATE BASE (APPROACH SLAB)	CY	30

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
121(F)	510086	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	CY	334
122	510087	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE R)	CY	310
123(F)	510094	STRUCTURAL CONCRETE, DRAINAGE INLET	CY	267
124(F)	510502	MINOR CONCRETE (MINOR STRUCTURE)	CY	37
125(F)	035498	MINOR CONCRETE (COLLAR)	CY	4.6
126(F)	510526	MINOR CONCRETE (BACKFILL)	CY	5.5
127	510800	PAVING NOTCH EXTENSION	CF	37
128(F)	511064	FRACTURED RIB TEXTURE	SQFT	3,190
129(F)	046197	FRACTURED RIB TEXTURE WITH RIBBON PATTERN	SQFT	1,351
130(F)	046198	FRACTURED RIB TEXTURE WITH CURVE PATTERN	SQFT	450
131	511106	DRILL AND BOND DOWEL	LF	2,633
132	511111	DRILL AND BOND DOWEL (CHEMICAL ADHESIVE)(LF)	LF	1,230
133	511118	CLEAN EXPANSION JOINT	LF	2,137
134	046199	FURNISH PRECAST CONCRETE RECTANGULAR GIRDER (30'-40')	EA	12
135	046200	FURNISH PRECAST CONCRETE RECTANGULAR GIRDER (40'-50')	EA	60
136(F)	512401	ERECT PRECAST CONCRETE GIRDER	EA	72
137	519081	JOINT SEAL (MR 1/2")	LF	1,310
138	519088	JOINT SEAL (MR 1")	LF	1,411
139	519100	JOINT SEAL (MR 2")	LF	24
140	046201	BONDED JOINT SEAL (MR 2")	LF	699

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
141	046202	BONDED JOINT SEAL (MR 2 1/2")	LF	178
142(F)	520101	BAR REINFORCING STEEL	LB	269,217
143(F)	520102	BAR REINFORCING STEEL (BRIDGE)	LB	2,081,159
144(F)	520103	BAR REINFORCING STEEL (RETAINING WALL)	LB	84,013
145(F)	046203	BAR REINFORCING STEEL (GROUND ANCHOR WALL)	LB	62,628
146(F)	520113	BAR REINFORCING STEEL (PUMPING PLANT)	LB	108
147(F)	046204	BAR REINFORCING STEEL (SOUND WALL PILE)	LB	241,781
148(F)	520120	HEADED BAR REINFORCEMENT	EA	10,498
149(F)	530200	STRUCTURAL SHOTCRETE	CY	165
150(F)	560203	FURNISH SIGN STRUCTURE (BRIDGE MOUNTED WITH WALKWAY)	LB	12,200
151(F)	560204	INSTALL SIGN STRUCTURE (BRIDGE MOUNTED WITH WALKWAY)	LB	12,200
152(F)	560218	FURNISH SIGN STRUCTURE (TRUSS)	LB	942,000
153(F)	560219	INSTALL SIGN STRUCTURE (TRUSS)	LB	942,000
154	568046	REMOVE SIGN STRUCTURE (EA)	EA	20
155	568050	REMOVE BRIDGE MOUNTED SIGN	EA	10
156	568056	RELOCATE SIGN STRUCTURE	EA	2
157	568062	PEDESTRIAN BARRICADE	EA	1
158(F)	582001	SOUND WALL (MASONRY BLOCK)	SQFT	303
159(F)	046205	SOUND WALL (MASONRY BLOCK) (MODIFIED)	SQFT	41,105
160	600001	PUBLIC SAFETY PLAN	LS	LUMP SUM

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
161	600011	RAPID SETTING CONCRETE (PATCH)	CF	775
162	600029	REMOVE ASPHALT CONCRETE SURFACING	SQFT	19,814
163	600033	REMOVE UNSOUND CONCRETE	CF	775
164	600037	PREPARE CONCRETE BRIDGE DECK SURFACE	SQFT	103,353
165	600041	FURNISH POLYESTER CONCRETE OVERLAY	CF	7,008
166(F)	600043	PLACE POLYESTER CONCRETE OVERLAY	SQFT	80,257
167(F)	046206	HIGH FRICTION SURFACE TREATMENT (BRIDGE)	SQYD	2,566
168	600068	CORE CONCRETE (6")	LF	25
169	046207	CORE CONCRETE (18")	LF	9
170	600091	ACCESS OPENING, SOFFIT	EA	14
171	600097	BRIDGE REMOVAL	LS	LUMP SUM
172	600115	BRIDGE REMOVAL (PORTION), LOCATION A	LS	LUMP SUM
173	600116	BRIDGE REMOVAL (PORTION), LOCATION B	LS	LUMP SUM
174	600117	BRIDGE REMOVAL (PORTION), LOCATION C	LS	LUMP SUM
175	600118	BRIDGE REMOVAL (PORTION), LOCATION D	LS	LUMP SUM
176	600119	BRIDGE REMOVAL (PORTION), LOCATION E	LS	LUMP SUM
177	600120	BRIDGE REMOVAL (PORTION), LOCATION F	LS	LUMP SUM
178	600121	BRIDGE REMOVAL (PORTION), LOCATION G	LS	LUMP SUM
179	600122	BRIDGE REMOVAL (PORTION), LOCATION H	LS	LUMP SUM
180	046208	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 1)	LB	255

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
181	046209	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 2)	LB	535
182	046210	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 3)	LB	42
183	046211	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 4)	LB	301
184	046213	SALVAGE PUMPING PLANT EQUIPMENT	LS	LUMP SUM
185	046212	PUMPING PLANT REMOVAL (PORTION)	LS	LUMP SUM
186(F)	046218	MISCELLANEOUS METAL (PIPE SHEAR KEY)	LB	730
187	650010	12" REINFORCED CONCRETE PIPE	LF	70
188	650014	18" REINFORCED CONCRETE PIPE	LF	3,960
189	650018	24" REINFORCED CONCRETE PIPE	LF	290
190	650022	30" REINFORCED CONCRETE PIPE	LF	230
191	650026	36" REINFORCED CONCRETE PIPE	LF	570
192	665012	12" CORRUGATED STEEL PIPE (.079" THICK)	LF	99
193	665018	18" CORRUGATED STEEL PIPE (.109" THICK)	LF	110
194	665718	18" SLOTTED CORRUGATED STEEL PIPE (.168" THICK)	LF	8,550
195	680405	8" PERFORATED STEEL PIPE UNDERDRAIN (.064" THICK)	LF	137
196(F)	035499	CLASS 1 PERMEABLE MATERIAL (TYPE B)	CY	2.4
197	690105	8" CORRUGATED STEEL PIPE DOWNDRAIN (.064" THICK)	LF	258
198	692301	ANCHOR ASSEMBLY	EA	11
199	700617	DRAINAGE INLET MARKER	EA	2
200	703233	GRATED LINE DRAIN	LF	5,150

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
201	046219	10" WELDED STEEL PIPE CASING (BRIDGE)	LF	117
202	705007	12" STEEL FLARED END SECTION	EA	1
203	705011	18" STEEL FLARED END SECTION	EA	1
204	705204	18" CONCRETE FLARED END SECTION	EA	6
205	705206	24" CONCRETE FLARED END SECTION	EA	2
206	705208	30" CONCRETE FLARED END SECTION	EA	2
207	705210	36" CONCRETE FLARED END SECTION	EA	4
208	710102	ABANDON CULVERT (LF)	LF	1,160
209	035500	REMOVE GRATED LINE DRAIN	LF	4,570
210	710132	REMOVE CULVERT (LF)	LF	1,930
211	035501	REMOVE SLOTTED CORRUGATED STEEL PIPE	LF	4,650
212	710150	REMOVE INLET	EA	97
213	710167	REMOVE FLARED END SECTION (EA)	EA	18
214	710196	ADJUST INLET	EA	50
215	710240	MODIFY INLET	EA	22
216	710262	CAP INLET	EA	1
217	710368	CULVERT SLURRY-CEMENT BACKFILL	CY	180
218	720008	REMOVE SLOPE PAVING (SQYD)	SQYD	1,497
219	721810	SLOPE PAVING (CONCRETE)	CY	833
220	723095	ROCK SLOPE PROTECTION (20 LB, CLASS I, METHOD B) (CY)	CY	140

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
221	729011	ROCK SLOPE PROTECTION FABRIC (CLASS 8)	SQYD	390
222	730040	MINOR CONCRETE (GUTTER) (LF)	LF	919
223	730070	DETECTABLE WARNING SURFACE	SQFT	940
224	731502	MINOR CONCRETE (MISCELLANEOUS CONSTRUCTION)	CY	2,700
225	731530	MINOR CONCRETE (TEXTURED PAVING)	CY	1,780
226	731710	REMOVE CONCRETE CURB (LF)	LF	21,100
227	731770	REMOVE CONCRETE SIDEWALK (LF)	LF	9,470
228	733000	PRE/POST CONSTRUCTION SURVEYS	EA	24
229	740500	DRAINAGE PUMPING EQUIPMENT	LS	LUMP SUM
230	741001	PUMPING PLANT ELECTRICAL EQUIPMENT	LS	LUMP SUM
231(F)	750001	MISCELLANEOUS IRON AND STEEL	LB	52,900
232(F)	750501	MISCELLANEOUS METAL (BRIDGE)	LB	1,142
233(F)	750505	BRIDGE DECK DRAINAGE SYSTEM	LB	8,509
234(F)	046230	PUMPING PLANT METAL WORK (LOCATION 1)	LB	255
235(F)	046231	PUMPING PLANT METAL WORK (LOCATION 2)	LB	535
236(F)	046232	PUMPING PLANT METAL WORK (LOCATION 3)	LB	42
237(F)	046233	PUMPING PLANT METAL WORK (LOCATION 4)	LB	301
238	035502	REMOVE CITY MANHOLE	EA	1
239	035503	REMOVE 24" STORM DRAIN	LF	15
240	035504	REMOVE 60" STORM DRAIN	LF	110

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
241	035505	60" CITY STORM DRAIN	LF	120
242	035506	CITY MANHOLE	EA	2
243	800051	FENCE (TYPE WM, METAL POST)	LF	790
244	800360	CHAIN LINK FENCE (TYPE CL-6)	LF	900
245	802620	16' CHAIN LINK GATE (TYPE CL-6)	EA	2
246	803040	REMOVE FENCE (TYPE WM)	LF	730
247	803050	REMOVE CHAIN LINK FENCE	LF	990
248	803060	REMOVE GATE	EA	3
249	803100	RECONSTRUCT FENCE	LF	140
250	035507	CONCRETE BARRIER DELINEATOR (16-INCH)	EA	5
251	810170	DELINEATOR (CLASS 1)	EA	130
252	035508	DELINEATOR (CLASS 1, SURFACE MOUNTED)	EA	13
253	810230	PAVEMENT MARKER (RETROREFLECTIVE)	EA	18,900
254	035509	CONCRETE BARRIER MARKER (NON-IMPACTABLE)	EA	1,230
255	820110	MILEPOST MARKER	EA	75
256	820141	OBJECT MARKER (TYPE K-1)	EA	12
257	820151	OBJECT MARKER (TYPE L-1)	EA	9
258	820250	REMOVE ROADSIDE SIGN	EA	250
259	820530	RESET ROADSIDE SIGN	EA	92
260	820610	RELOCATE ROADSIDE SIGN	EA	13

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
261	820710	FURNISH LAMINATED PANEL SIGN (1"-TYPE A)	SQFT	160
262	035510	FURNISH LAMINATED PANEL SIGN (1"-TYPE A) FOR RETROREFLECTIVE SHEETING (TYPE XI)	SQFT	12,400
263	820750	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-UNFRAMED)	SQFT	600
264	035511	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-UNFRAMED) FOR RETROREFLECTIVE SHEETING (TYPE XI)	SQFT	890
265	820760	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-UNFRAMED)	SQFT	170
266	035512	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-UNFRAMED) FOR RETROREFLECTIVE SHEETING (TYPE XI)	SQFT	1,060
267	820780	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-FRAMED)	SQFT	2,050
268	035513	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-FRAMED) FOR RETROREFLECTIVE SHEETING (TYPE XI)	SQFT	510
269	820790	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-FRAMED)	SQFT	780
270	035514	RETROREFLECTIVE SHEETING (TYPE XI)	SQFT	14,900
271	035515	ROADSIDE SIGN (BARRIER MOUNTED)	EA	44
272	820840	ROADSIDE SIGN - ONE POST	EA	210
273	820850	ROADSIDE SIGN - TWO POST	EA	15
274	820860	INSTALL SIGN (STRAP AND SADDLE BRACKET METHOD)	EA	66
275	820890	INSTALL SIGN PANEL ON EXISTING FRAME	SQFT	1,690
276	832005	MIDWEST GUARDRAIL SYSTEM	LF	6,920
277	832070	VEGETATION CONTROL (MINOR CONCRETE)	SQYD	300
278	035516	VEGETATION CONTROL (ASPHALT COMPOSITE)	SQYD	8,480
279	035517	REMOVE VEGETATION CONTROL (MINOR CONCRETE)	SQYD	1,050
280(F)	046234	DECORATIVE RAILING (BRIDGE)	LF	2,435

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
281	839221	DOUBLE MIDWEST GUARDRAIL SYSTEM (WOOD POST)	LF	50
282	839303	SINGLE THRIE BEAM BARRIER (STEEL POST)	LF	830
283	839312	DOUBLE THRIE BEAM BARRIER (STEEL POST)	LF	9,870
284(F)	839521	CABLE RAILING	LF	919
285	839543	TRANSITION RAILING (TYPE WB-31)	EA	16
286	839576	END CAP (TYPE A)	EA	2
287	839578	END CAP (TYPE TC)	EA	17
288	839581	END ANCHOR ASSEMBLY (TYPE SFT)	EA	44
289	839584	ALTERNATIVE IN-LINE TERMINAL SYSTEM	EA	52
290	035518	ALTERNATIVE CRASH CUSHION	EA	13
291	839640	CONCRETE BARRIER (TYPE 60M)	LF	42
292	839641	CONCRETE BARRIER (TYPE 60MA)	LF	940
293	839642	CONCRETE BARRIER (TYPE 60MC)	LF	3,020
294	839643	CONCRETE BARRIER (TYPE 60MD)	LF	916
295	839644	CONCRETE BARRIER (TYPE 60MF)	LF	130
296	839645	CONCRETE BARRIER (TYPE 60MG)	LF	23,300
297	839646	CONCRETE BARRIER (TYPE 60MGA)	LF	1,256
298	839647	CONCRETE BARRIER (TYPE 60MGC)	LF	24,200
299	839648	CONCRETE BARRIER (TYPE 60MGF)	LF	3,930
300	839653	CONCRETE BARRIER (TYPE 60MP)	LF	12

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
301	035519	CONCRETE BARRIER (TYPE 60M MODIFIED)	LF	7,900
302	839695	CONCRETE BARRIER (TYPE 60PR)	LF	36
303	046235	CONCRETE BARRIER (TYPE 60MGA MODIFIED)	LF	617
304	035520	CONCRETE BARRIER (TYPE 60MGF MODIFIED)	LF	25
305	035521	CONCRETE BARRIER (TYPE 842A)	LF	1,690
306(F)	839745	CONCRETE BARRIER TRANSITION	LF	20
307(F)	046236	CONCRETE BARRIER (TYPE 842)	LF	4,009
308(F)	046237	CONCRETE BARRIER (TYPE 842 MODIFIED)	LF	18,062
309(F)	046238	CONCRETE BARRIER (TYPE 842SV MODIFIED)	LF	3,785
310	839752	REMOVE GUARDRAIL	LF	25,500
311	839774	REMOVE CONCRETE BARRIER	LF	50,100
312	839782	REMOVE CRASH CUSHION	EA	6
313	840516	THERMOPLASTIC PAVEMENT MARKING (ENHANCED WET NIGHT VISIBILITY)	SQFT	15,400
314	840617	6" THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY) (BROKEN 6-1)	LF	1,170
315	840621	6" THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY) (BROKEN 17-7)	LF	21,400
316	840623	6" THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY) (BROKEN 36-12)	LF	446,000
317	035522	6" PERMANENT TAPE TRAFFIC STRIPE	LF	18,700
318	035523	8" PERMANENT TAPE TRAFFIC STRIPE	LF	540
319	846007	6" THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY)	LF	374,000
320	846009	8" THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY)	LF	81,800

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
321	846020	REMOVE PAINTED TRAFFIC STRIPE	LF	1,220,000
322	846025	REMOVE PAINTED PAVEMENT MARKING	SQFT	420
323	846030	REMOVE THERMOPLASTIC TRAFFIC STRIPE	LF	415,000
324	846035	REMOVE THERMOPLASTIC PAVEMENT MARKING	SQFT	490
325	870009	MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION	LS	LUMP SUM
326	035524	LOCATING UNDERGROUND FACILITIES	LS	LUMP SUM
327	871200	CHANGEABLE MESSAGE SIGN SYSTEM	LS	LUMP SUM
328	871812	INTERCONNECTION CONDUIT AND CABLE (LS)	LS	LUMP SUM
329	872000	TEMPORARY LIGHTING SYSTEM	LS	LUMP SUM
330	872130	MODIFYING EXISTING ELECTRICAL SYSTEM	LS	LUMP SUM
331	999990	MOBILIZATION	LS	LUMP SUM

SPECIAL PROVISIONS

ORGANIZATION

Special provisions are under headings that correspond with the main-section headings of the *Standard Specifications*. A main-section heading is a heading shown in the table of contents of the *Standard Specifications*.

Each special provision begins with a revision clause that describes or introduces a revision to the *Standard Specifications* as revised by any revised standard specification.

Any paragraph added or deleted by a revision clause does not change the paragraph numbering of the *Standard Specifications* for any other reference to a paragraph of the *Standard Specifications*.

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DIVISION I GENERAL PROVISIONS

1 GENERAL

Add to section 1-1.01:

Bid Items and Applicable Sections

Item code	Item description	Applicable section
035490	QUICKCHANGE MOVEABLE BARRIER SYSTEM	12
035491	ALTERNATIVE TEMPORARY CRASH CUSHION MODULE	12
035492	HIGH FRICTION SURFACE TREATMENT	37
035493	HOT MIX ASPHALT (TYPE A) (LONG LIFE)	39
035494	PLACE HOT MIX ASPHALT DIKE	39
035495	PRECAST JOINTED CONCRETE PAVEMENT	40
046189	FURNISH STEEL PIPE PILING (PP 30 X 1.0)	49
046190	DRIVE STEEL PIPE PILE (PP 30 X 1.0)	49
046191	FURNISH 18" PRECAST PRESTRESSED CONCRETE PILING	49
046192	DRIVE 18" PRECAST PRESTRESSED CONCRETE PILE	49
035496	24" CAST-IN-DRILLED HOLE CONCRETE PILING (WET POUR)	49
046193	FURNISH PILING (CLASS 140) (ALTERNATIVE X)	49
046194	DRIVE PILE (CLASS 140) (ALTERNATIVE X)	49
035497	60" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION) (WET POUR)	49
046195	STRUCTURAL CONCRETE, GROUND ANCHOR WALL	51
046196	STRUCTURAL CONCRETE, SOUND WALL PILE CAP	51
035498	MINOR CONCRETE (COLLAR)	51
046197	FRACTURED RIB TEXTURE WITH RIBBON PATTERN	51
046198	FRACTURED RIB TEXTURE WITH CURVE PATTERN	51
046199	FURNISH PRECAST CONCRETE RECTANGULAR GIRDER (30'-40')	51
046200	FURNISH PRECAST CONCRETE RECTANGULAR GIRDER (40'-50')	51
046201	BONDED JOINT SEAL (MR 2")	51
046202	BONDED JOINT SEAL (MR 2 1/2")	51
046203	BAR REINFORCING STEEL (GROUND ANCHOR WALL)	52
046204	BAR REINFORCING STEEL (SOUND WALL PILE)	52
046205	SOUND WALL (MASONRY BLOCK) (MODIFIED)	58
046206	HIGH FRICTION SURFACE TREATMENT(BRIDGE)	60
046207	CORE CONCRETE (18")	60
046208	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 1)	60
046209	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 2)	60
046210	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 3)	60
046211	PUMPING PLANT METAL WORK (REMOVAL) (LOCATION 4)	60
046212	PUMPING PLANT REMOVAL (PORTION)	60
046213	SALVAGE PUMPING PLANT EQUIPMENT	60
046218	MISCELLANEOUS METAL (PIPE SHEAR KEY)	60
035499	CLASS 1 PERMEABLE MATERIAL (TYPE B)	68
046219	10" WELDED STEEL PIPE CASING (BRIDGE)	70
035500	REMOVE GRATED LINE DRAIN	71
035501	REMOVE SLOTTED CORRUGATED STEEL PIPE	71
046230	PUMPING PLANT METAL WORK (LOCATION 1)	75
046231	PUMPING PLANT METAL WORK (LOCATION 2)	75
046232	PUMPING PLANT METAL WORK (LOCATION 3)	75
046233	PUMPING PLANT METAL WORK (LOCATION 4)	75
035502	REMOVE CITY MANHOLE	77
035503	REMOVE 24" STORM DRAIN	77
035504	REMOVE 60" STORM DRAIN	77
035505	60" CITY STORM DRAIN	77
035506	CITY MANHOLE	77
035507	CONCRETE BARRIER DELINEATOR (16-INCH)	81
035508	DELINEATOR (CLASS 1, SURFACE MOUNTED)	81

Bid Items and Applicable Sections

Item code	Item description	Applicable section
035509	CONCRETE BARRIER MARKER (NON-IMPACTABLE)	82
035510	FURNISH LAMINATED PANEL SIGN (1 "-TYPE A) FOR RETROREFLECTIVE SHEETING (TYPE XI)	82
035511	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-UNFRAMED) FOR RETROREFLECTIVE SHEETING (TYPE XI)	82
035512	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080 "-UNFRAMED) FOR RETROREFLECTIVE SHEETING (TYPE XI)	82
035513	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080 "-UNFRAMED) FOR RETROREFLECTIVE SHEETING (TYPE XI)	82
035514	RETROREFLECTIVE SHEETING (TYPE XI)	82
035515	ROADSIDE SIGN (BARRIER MOUNTED)	82
035516	VEGETATION CONTROL (ASPHALT COMPOSITE)	83
035517	REMOVE VEGETATION CONTROL (MINOR CONCRETE)	83
046234	DECORATIVE RAILING (BRIDGE)	83
035518	ALTERNATIVE CRASH CUSHION	83
035519	CONCRETE BARRIER (TYPE 60M MODIFIED)	83
046235	CONCRETE BARRIER (TYPE 60MGA MODIFIED)	83
035520	CONCRETE BARRIER (TYPE 60 MGF MODIFIED)	83
035521	CONCRETE BARRIER (TYPE 842A)	83
046236	CONCRETE BARRIER (TYPE 842)	83
046237	CONCRETE BARRIER (TYPE 842 MODIFIED)	83
046238	CONCRETE BARRIER (TYPE 842SV MODIFIED)	83
035522	6" PERMANENT TAPE TRAFFIC STRIPE	84
035523	8" PERMANENT TAPE TRAFFIC STRIPE	84
035524	LOCATING UNDERGROUND FACILITIES	87

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2 BIDDING

Add between the 1st and 2nd paragraphs of section 2-1.06B:

The Department makes the following supplemental project information available:

Supplemental Project Information

Means	Description

Included in the *Information Handout*	Central Valley Regional water quality control board- 401, March 30, 2017 Central Valley Regional water quality control board- 401, Jan. 12, 2018 Central Valley Flood Protection Board Permits, May 7, 2018 US Army Corps of Engineers, 404 Nationwide CA Dept. of Fish and wildlife, Streambed Alteration Agreement, Notification No. 1600-2016-02440-R2 National Marine Fisheries Service, Letter of Concurrence, Biological Opinion conditions United States Fish and Wildlife Services, Letter of Concurrence City of Sacramento Department of Public works and Transportation, Utility Agreement / Permit Revised Foundation Report (RFR) for Structures (46 OHS & 2 CMS), Feb. 6, 2018 .Foundation Report for Route 5/160 Separation & OH (Widen) (Bridge no. 24-0296R/Ldated 08/12/2016 Foundation Report for Beach Lake Bridge (Widen) (Bridge no. 24-0262R/L) dated 10/27/2016 Revised Foundation Report for Casilada Way POC (Replace (Bridge no. 24-0388) dated 02/13/2017, Foundation Report for Sound Walls 1, 2 & 3, Retaining Wall dated 02/13/2018Foundation Report for NB and SB at Gloria Drive Overcrossing dated 08/15/2016 Foundation Report for NB and SB walls at S. Land Park Drive Overcrossing Foundation Report for ERS on southbound I-5 at Land Park Underpass dated 8/12/16 EA change for various Foundation Reports for Route 5 (Widen) Existing TMS Facilities/TMS elements operational status Asbestos and Lead-Containing Paint Survey Report Beach Lake Bridge (#24-0262L) Dec. 14, 2016 Asbestos and Lead-Containing Paint Survey Report Beach Lake Bridge (#24-0262R) Dec. 14, 2016 Asbestos and Lead-Containing Paint Survey Report Interstate 5/State Route 160 Separation (#24-0296L) Dec. 14, 2016 Asbestos and Lead-Containing Paint Survey Report Interstate 5/State Route 160 Separation (#24-0296R) Dec. 14, 2016 Asbestos and Lead-Containing Paint Survey Report Casilada Way Pedestrian Overcrossing (#24-0254), Dec. 14, 2016 Asbestos and Lead-Containing Paint Survey Report Riverside Boulevard Undercrossing (#24-0255), Dec. 14, 2016 Aerially Deposited Lead Site Investigation Report, Interstate 5, Post mile 13.0 to 17.2, Task Order No. 127, EA No. 03-0F5901, May 2010. Division of Occupational Safety and Health Mining and Tunneling, Underground Classification C152-067-10T thru C158-067-10T QMB price quote Crash cushion price quotes FHWA Asphalt Technology Guidance Program Pamplet Asphalt Testing Trailer Program Pamplet

Available as specified in the *Standard Specifications*	As-built drawings Cross section: Mainline:B1- Line Ramps-Lines: EGSBOF1, COSBON1, CONBOF1, COSBON2, CONBON1, CONBON2, COSBOF1,POSBON1, POSBON2, POSBON3, POSBOF1, POSBOF2, FLSBCD1, FLNBCD1, FLNBOF1, FLSBON1, FLSBON4, FLSBOF1, FLSBON2, FLSBON3, FLSBOF2, FLNBON2, 43NBON1, 43NBON2, 43SBOF1, SESBON1, SENBON1, SESBOF1, SUNBOF1, SUSBON1, SUNBON1, SUSBOF1, 50NBOF1, 50NBOF2, BWNBOF1, QSTOFF1, WSBON1, 50SBON1, RISBON1, RINBOF1
Included with the project plans	Log of test borings for Bridge Numbers: 24-0262R/L, 24-0296R/L, 24-0388, 24E0018, 24E0019, 24E0020, 24E0021, and 24E0022 Log of Test Borings for Sound wall 1 and Sound wall 2

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5 CONTROL OF WORK

Add to the end of section 5-1.09A:

The Department encourages the project team to exhaust the use of partnering in dispute resolution before engagement of an objective third party.

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

To afford the project team enough time to plan and hold the session, a maximum of 20 days may be added to the DRB referral time following the Engineer's response to a Supplemental Potential Claim Record.

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

If the session is not held, the DRB referral time remains in effect as specified in section 5-1.43.

Add to the end of section 5-1.20C:

This project includes work on railroad property. There are Sacramento Southern Railroad tracks within the project limits that will require the contractor to attain an Encroachment Permit from the City of Sacramento.

Replace section 5-1.24 with:

5-1.24 CONSTRUCTION SURVEYS

5-1.24A General

The Department places stakes and marks under Chapter 12, "Construction Surveys," of the Department's *Surveys Manual*.

Submit your request for Department-furnished stakes:

1. Once the staking area is ready for stakes
2. On a Request for Construction Staking form

After your submittal, the Department starts staking within 2 business days.

Preserve stakes and marks placed by the Department. If the stakes or marks are destroyed, the Department replaces them at the Department's earliest convenience and deducts the cost.

5-1.24B Department Construction Surveys for Automated Machine Guidance

The Department sets control points to a minimum of 0.07 foot local horizontal accuracy and third order vertical accuracy standards.

For slope stakes and rough grade stakes, the Department sets 6 survey control points or 2 control points per mile, whichever is greater.

The Department sets slope stakes and rough grade stakes at:

1. Conform stations
2. Beginning and end of each alignment
3. Midpoint or every 200 feet, whichever is greater, on a curve
4. Every 500 feet on tangents

For final grade stakes, the Department sets survey control points under Chapter 12, "Construction Surveys," section 12.1-6, "Automated Machine Guidance (AMG)," and figure 12-2 of the Department's *Surveys Manual*. The Department sets final grade stakes at:

1. Conform stations
2. Beginning and end of each alignment
3. Midpoint or every 100 feet, whichever is greater, on a curve with a radius of 1,200 feet or less
4. Midpoint or every 200 feet, whichever is greater, on a curve with a radius of more than 1,200 feet
5. Every 200 feet on a tangent

Upon your request and under Chapter 12, "Construction Surveys," of the Department's *Surveys Manual*, the Department provides (1) staking for intersections, clearing, fencing, drainage, curbs, structures, abutment fill, wall, and miscellaneous areas and (2) additional survey control or staking for earthwork in areas where global navigation satellite system (GNSS) coverage is inadequate for automated machine guidance.

Replace section 5-1.25 with:

5-1.25 AUTOMATED MACHINE GUIDANCE

5-1.25A General

You may use automated machine guidance (AMG) if the AMG meets or exceeds the staking tolerances described in section 12.5, "Typical Department-Furnished Construction Stakes," of the Department's *Surveys Manual*.

You are responsible for determining whether the work and site conditions are practical for AMG use.

Furnish a GNSS rover compatible with your GNSS base station or the GNSS correction service you subscribe to. The Department returns the GNSS rover upon work completion. This is change order work.

At the preconstruction conference, be prepared to discuss survey control points, site and equipment calibration, inspection methods, conflict resolution, and staking.

5-1.25B Definitions

automated machine guidance (AMG): Technology that uses positioning devices, singly or in combination, such as global navigation satellite systems (GNSS), total stations, or rotating laser levels, to determine and control the real-time position of construction equipment using onboard computer equipment.

California Coordinate System of 1983 (CCS83): CCS83 as defined in Pub Res Code § 8801.

digital construction model (DCM): Three-dimensional model used by the Contractor's AMG equipment.

digital design model: Three-dimensional model consisting of roadway design alignments, profiles, and cross sections representing the finished grade.

digital terrain model: Three-dimensional model representing the original ground before job site activities start.

global navigation satellite system (GNSS): Satellite system used to pinpoint the geographic location of a user's receiver anywhere in the world. Two GNSS systems are in operation: the US GPS and the Russian Federation's GLONASS. Each of the GNSS systems uses a constellation of orbiting satellites working in conjunction with a network of ground stations.

GNSS base station: Single ground-based system consisting of a GNSS receiver, antenna, and telemetry equipment that provides differential GNSS correction signals to other GNSS receivers or rovers. Multiple base stations can be combined into a GNSS network.

GNSS correction service subscription: Subscription service to receive differential GNSS correction signals for higher accuracy GNSS positioning without the need of a GNSS base station. Signals are normally received via cellular wireless data services.

GNSS rover: Portable GNSS antenna, receiver, rod, and data collector with telemetry equipment for real-time point measurements.

grid: Cartesian coordinate system of Northing (y) and Easting (x) coordinates using CCS83.

robotic total station: Survey instrument capable of tracking an optical target and providing real-time coordinates of the target to the equipment operator and AMG equipment. A robotic total station unit can provide AMG if site conditions do not allow GNSS receivers to be used and if a higher accuracy is required than the GNSS provides.

site calibration or localization: Process that establishes the relationship between the observed control point coordinates and the site coordinate system, which is usually grid. The term applies to both GNSS and robotic total station equipment.

5-1.25C Electronic Files

Electronic design files include:

1. Digital terrain model in 3-D DGN or LandXML format
2. Roadway design alignments and profiles in LandXML format
3. Cross sections in 2-D DGN and PDF
4. Digital design model in LandXML format

The Department makes electronic design files available as supplemental project information.

You must create the digital construction models.

Convert the electronic design files to a format compatible with your AMG system. Manipulation of the electronic design files is at your own risk.

Submit copies of the digital construction model files and any updates to them in LandXML format.

Digital design model information may not exist for contour grading and some drainage areas. The Department places stakes for these areas.

The Department provides you with updated electronic data whenever the Engineer determines a plan change materially affects the finished grade. For minor grade changes, the Department places stakes and marks.

5-1.25D Quality Control Plan

Submit an AMG QC plan at least 15 days before starting work requiring AMG. The plan must include the following information:

1. Contract number
2. Name and contact information of the AMG QC technician
3. Limits of the area for which the AMG will be used
4. Scope of work to be completed using AMG for the following work categories:
    - 4.1. Clearing and grubbing
    - 4.2. Earthwork
    - 4.3. Trench excavation
    - 4.4. Rough grading
    - 4.5. Subgrade
    - 4.6. Subbase
    - 4.7 Base
    - 4.8. Curb and gutter
    - 4.9. Cold planning or milling existing pavement
    - 4.10. Paving
    - 4.11. Intelligent compaction
    - 4.12. Concrete barrier
    - 4.13. Finishing roadway
5. Project control plan sheet detailing control points covering the job site
6 List of GNSS equipment, including:
    - 6.1. Type
    - 6.2. Manufacturer
    - 6.3. Model
    - 6.4. Software version
7. Description of GNSS site calibration or localization checking, including:
    - 7.1. List of equipment requiring calibration or localization checking
    - 7.2. Site calibration or localization procedures
    - 7.3. Frequency of calibration or localization
    - 7.4. Format for recording calibrations or localizations, including:
        - 7.4.1. Date
        - 7.4.2. Locations where calibration or localization was performed
        - 7.4.3. GNSS equipment manufacturer and model
        - 7.4.4. Range of required tolerance
        - 7.4.5. Name and signature of the person performing calibration or localization
    - 7.5. Reporting time for submitting records of calibration or localization
8. Description of daily GNSS equipment or robotic total station equipment check-testing procedures, including the format for recording daily check testing
9. List of AMG onboard computer equipment, including:
    - 9.1. Type
    - 9.2. Manufacturer
    - 9.3. Software version
    - 9.4. List of AMG-controlled equipment, including:
        - 9.4.1. Type, such as loader or grader
        - 9.4.2. Manufacturer
        - 9.4.3 Model
10. Procedures for AMG-controlled equipment calibration, including:
    - 10.1. Description of equipment calibration procedures
    - 10.2. Frequency of calibration
    - 10.3. Format for recording calibration information
11. Electronic data file control, including:
    - 11.1. Name and contact information of the person responsible for the electronic files
    - 11.2. DCM file-naming convention
    - 11.3. Description of the process that will be used to upload the DCM to the AMG equipment
    - 11.4. Description of the process that will be used whenever updated DCM files are required to be uploaded to the AMG equipment

If QC procedures or personnel change, submit a QC plan supplement describing the change.

5-1.25E Quality Control Technician

During AMG activities, provide a QC technician to be responsible for:

1. GNSS site calibration or localization and upload to all GNSS receivers
2. Maintenance of GNSS and AMG equipment
3. Documentation of the calibration or localization and maintenance of GNSS equipment
4. Daily calibration and documentation of AMG equipment
5. Daily setup and takedown of GNSS and robotic total station components

5-1.25F Just-in-Time Training

Provide at least 8 hours of JIT training on the GNSS rover for up to 3 Department employees. Provide training materials and equipment.

The JIT training must cover the following topics:

1. Background information for the GNSS to be used
2. Setup and calibration checks for:
   - 2.1. GNSS receiver
   - 2.2. GNSS base station
   - 2.3. GNSS rovers
   - 2.4. Machinery
3. Operation of the GNSS rover, including:
   - 3.1. Setup data collection
   - 3.2. Settings for alignments and profiles
   - 3.3. Onboard display options
4. Demonstration of grade checking using the rover

The training is change order work.

5-1.25G Construction

5-1.25G(1) General

If you find a discrepancy in any survey control point, survey stake, or in the electronic data provided, immediately, submit an RFI.

5-1.25G(2) GNSS Site Calibration or Localization

Perform GNSS site calibration or localization to the survey control points at least 5 business days before starting work requiring AMG.

Check each survey control point for accuracy. Submit the GNSS site calibration or localization results within 1 business day of the calibration or localization testing. Allow 3 business days for the review of the results

5-1.25G(3) GNSS Check Testing

Before starting daily work requiring AMG, conduct check testing for the proper setup of the GNSS or robotic total station equipment. Ensure the GNSS or robotic total station equipment achieves accuracies within:

1. 0.10 foot in both horizontal and vertical directions for rough grading
2. 0.05 foot in horizontal directions and 0.02 foot in vertical directions for final grades

Before starting daily production, conduct check testing of the AMG equipment and the GNSS rovers.

Within 1 business day after check testing, submit the check-testing results as informational submittals.

5-1.25G(4) Grade Verification

If requested, provide a GNSS rover and personnel to operate it for the Engineer's use in verifying grades. This is change order work.

Replace section 5-1.26 with:

5-1.26 GRADE QUALITY CONTROL

Use a GNSS rover, robotic total station equipment, or a level to check the grades at the frequencies shown in the following table:

Grade Checking Requirements

Type of work	Area or distance represented by the grade checking	Frequency (number of grade points)
Earthwork for cut and fill slopes ≤15 feet	200 feet	2
Earthwork for cut and fill slopes >15 feet	1,000 sq yd	1
Rough grading	1,000 sq yd	1
Trenching	100 feet	6
Subgrade	1 mi	30
Subbase layer	1 mi	50
Base layer	1 mi	100
Curb and gutter	100 feet	6
Concrete barrier	100 feet	5
Finishing roadway	1,000 sq yd	2

Increase the frequency of grade checking of a roadway:

1. Wherever its curve radius is 500 feet or less
2. In areas of a superelevation transition
3. At intersections

Notify the Engineer when an area is ready for line and grade inspection. Submit the grade checking results on a Grade Checking Report form as an informational submittal.

Add between the 2nd and 3rd paragraphs of the RSS for section 5-1.36C(3):

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

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

Utility	Location
24" DRAINAGE RCP	SW1, Sta 14+23.55
36" DRAINAGE CSP	SW1, Sta 14+36.76
24" DRAINAGE RCP	SW2, Sta 21+10.00
24" DRAINAGE RCP	SW2, Sta 24+83.01
18" DRAINAGE RCP	SW2, Sta 31+16.29
24" DRAINAGE RCP	SW2, Sta 34+50.21

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6 CONTROL OF MATERIALS

Add to the beginning of section 6-1.02:

The Department furnishes you with:

- Model 2070 controller assembly, including controller unit, and a completely wired Type 342LX controller cabinet
- Sign panels for the Changeable Message Sign Model 700 series and Type 334L controller cabinet,
- Components of battery backup system

The Department furnishes you with completely wired Type 342LX controller cabinets and controller unit at Sunrise Electric Maintenance Shop, 11325 Sanders Drive, Rancho Cordova, CA 94742. At least 48 hours before you pick up the materials, inform the Engineer of what you will pick up and when you will pick it up.

The Department furnishes you with a Model 700 changeable message sign, wiring harness, and controller assembly, including the controller unit and completely wired cabinet, at Sunrise Electric Maintenance Shop, 11325 Sanders Drive, Rancho Cordova, CA 95742. At least 48 hours before you pick up the materials, inform the Engineer of what you will pick up and when you will pick it up.

^^

7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

Replace *Reserved* in section 7-1.02K(6)(j)(iii) with:

Section 7-1.02K(6)(j)(iii) includes specifications for handling, removing, and disposing of earth material containing lead below hazardous waste concentrations. Manage earth material containing hazardous waste concentrations of lead under section 14-11.08.

Lead is present in earth material on the job site. Management of this material exposes workers to health hazards that must be addressed in your lead compliance plan. From post mile 9.7 to post mile 24.0, the average lead concentrations are below 1,000 mg/kg total lead and below 5 mg/L soluble lead. This material:

1. Is not a hazardous waste
2. Does not require disposal at a permitted landfill or solid waste disposal facility

From post mile 9.7 to post mile 24.0, lead has been detected to a depth of 36 inches in unpaved areas of the highway. Levels of lead found range from less than 5 to 160 mg/kg total lead with an average concentration of 11.6 mg/kg total lead as analyzed by EPA test method 6010 or EPA test method 7000 series and based upon a 95 percent upper confidence limit. Levels of lead found have a predicted average soluble concentration of less than 2.5 mg/L as analyzed by the California Waste Extraction Test and based upon a 95 percent upper confidence limit.

Handle the material under all applicable laws, rules, and regulations, including those of the following agencies:

1. Cal/OSHA
2. CA RWQCB, Region 5 - Central Valley
3. CA Department of Toxic Substances Control

Manage the material as shown in the following table.

Earth Material Management

Location	Depth	Management requirements
From PM 9.7 to PM 24.0	0 to 1 ft.	Excavate to total depth. Do not excavate in lifts

If the material is disposed of:

1. Disclose the lead concentration of the material to the receiving property owner when obtaining authorization for disposal on the property
2. Obtain the receiving property owner's acknowledgment of lead concentration disclosure in the written authorization for disposal
3. You are responsible for any additional sampling and analysis required by the receiving property owner

If you choose to dispose of the material at a commercial landfill:

1. Transport it to a Class III or Class II landfill appropriately permitted to receive the material
2. You are responsible for identifying the appropriately permitted landfill to receive the material and for all associated trucking and disposal costs, including any additional sampling and analysis required by the receiving landfill.

^^

8 PROSECUTION AND PROGRESS

Replace *Reserved* in section 8-1.04C with:

Section 8-1.04B does not apply.

Start job site activities within 55 days after receiving notice that the Contract has been approved by the Attorney General or the attorney appointed and authorized to represent the Department.

Do not start job site activities until the Department authorizes or accepts your submittal for:

1. Contractor-supplied biologist
2. CPM baseline schedule
3. WPCP or SWPPP, whichever applies
4. Notification of DRA or DRB nominee and disclosure statement
5. Contingency plan for opening closures to traffic
6. SSPC QP certifications

If the submittals for Contractor-supplied biologist is authorized, you may enter the job site only to measure controlling field dimensions and locate utilities.

You may enter the job site only to measure controlling field dimensions and locate utilities.

Do not start other job site activities until all the submittals from the above list are authorized or accepted and the following information is received by the Engineer:

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

You may start job site activities before the 55th day after Contract approval if you:

1. Obtain specified authorization or acceptance for each submittal before the 55th day
2. Receive authorization to start

Submit a notice 72 hours before starting job site activities. If the project has more than 1 location of work, submit a separate notice for each location.

Replace the 3rd paragraph of section 8-1.10A:

Liquidated damages for all work except plant establishment is $63,600 per day.

^^

9 PAYMENT

Add to the end of section 9-1.16C:

The following items are eligible for progress payment even if they are not incorporated into the work:

1. Access Gate
2. Barriers (Except Concrete Barrier)
3. Bridge Conduit
4. Camera Assemblies
5. Corrugated Steel Pipe Underdrain
6. Corrugated Steel Pipe Downdrain
7. Crash Cushion
8. Culvert Pipe
9. Fence and Gates
10. Fiber Optic Cable
11. Fiber Optic Conduit
12. Filter Fabric
13. Ground Anchors
14. Lighting Fixtures
15. Luminaires
16. Metal Sign Structures (including contractor furnished sign panels and changeable message sign structure)
17. Miscellaneous Bridge Metal
18. Miscellaneous Drainage Facilities
19. Miscellaneous Iron and Steel
20. Miscellaneous Metal
21. Pavement Dowels
22. Pavement Markers
23. Pavement Reinforcing Fabric
24. Plastic Pipe
25. Piling (Except CIDH Piling)
26. Precast Concrete Members
27. Pumping Plant Equipment
28. Pumping Plant Metal Work
29. Railing
30. Reinforcement
31. Rock Slope Protection Fabric
32. Signal and Lighting Standards
33. Signal Cabinets
34. Signal Heads and Mounting Brackets
35. Splice vaults
36. Sound Wall (Masonry Block)
37. Subgrade Enhancement Geotextile
38. Type B Joint Seals

^^^

Replace "Reserved" in section 12-3.19 of the RSS for section 12-3.19:

12-3.19 QUICKCHANGE MOVEABLE BARRIER SYSTEM

12-3.19A General

12-3.19A(1) Summary

Section 12-3.19 includes specifications for furnishing, installing, and repositioning Quickchange Moveable Barrier system (QMB).

12-3.19A(2) Submittals

Submit the following as informational submittals:

1. Statement from the vendor that the order for the QMB has been received and accepted by the vendor
2. Copy of the manufacturer's plan and parts list for installation and a training certificate for the operation of the Barrier Transfer Machine (BTM)

Submit a certificate of compliance for the QMB.

Submit a detailed contingency plan for reopening closures to traffic by the required lane closure times in the event that the BTM fails during the work shift. Obtain authorization for the contingency plan before installing the QMB.

12-3.19B Materials

Quickchange Moveable Barrier System manufactured by Barrier Systems, Inc, consist of the following components:

1. Quickchange Moveable Concrete Barrier Series 200 and ABSORB 350 Test Level 3 crash cushion 8 element system at all unprotected ends of QMB placed within 15 feet from the edge of an open traffic lane on the approach to the QMB.
2. Quickchange Barrier Transfer Machine (BTM)

The price quoted by the manufacturer for the rental of the Quickchange Moveable Barrier is $11.80 per linear foot per month, not including taxes, insurance nor the ABSORB 350.

The price quoted by the manufacturer for the rental of the Quickchange Barrier Transfer Machine is $223,200 per each unit for a period of 12 months.

The above price is firm for orders placed on or before December 31, 2018, provided you accept delivery within 90 days after you place the order.

Reflectors must be temporary railing (Type K) reflectors on the Authorized Materials List for signing and delineation materials.

12-3.19C Construction

Install the QMB under the manufacturer's instructions.

Install a reflector on top of barrier placed within 10 feet of a traffic lane. Mount the reflectors with an adhesive complying with the manufacturer's instructions. .

If the Engineer orders a move of the QMB and the repositioning is not shown on the plans, the move is change order work. QMB placed in excess of the length shown will not be paid for.

Move the QMB to the edge of travel way when not in use, but reposition to its original location whenever construction activities are not actively in progress or whenever the full width of the traveled way is open for use by traffic.

12-3.19D Payment

Not Used

Replace section 12-3.20 of the RSS for section 12-3 with:

12-3.20 ALTERNATIVE TEMPORARY CRASH CUSHION

12-3.20A General

Section 12-3.20 includes specifications for installing and maintaining an alternative temporary crash cushion at each location as shown.

Submit a copy of the manufacturer's plan and parts list as an informational submittal.

Submit a certificate of compliance for each temporary crash cushion used.

12-3.20B Materials

Alternative temporary crash cushion must be a non-redirective, gating type, and must conform to the descriptions as follows:

Contract Item Description	Manufacturer's Protect Description
ABSORB-350	ABSORB 350 TL-3 (9 element) CRASH CUSHION
ACZ-350	ACZ-350 (Anchorless Crash Cushion CZ System), TL-3
SLED	Sentry Longitudinal Energy Dissipater, TL-3

The successful bidder can obtain alternative temporary crash cushions from the following distributors:

1. ABSORB 350: Barrier Systems, Inc.

   Statewide Safety and Signs
   130 Grobric Court
   Fairfield, CA 94533
   Telephone: 1-707-864-9952 or 1-800-770-2644
   Fax: 1-707-864-9956

   Statewide Safety and Signs
   522 Lindon Lane
   Nipomo, CA 93444
   Telephone: 1-800-559-7080
   Fax: -805-929-5786

2. ACZ-350: Energy Absorption Systems, Inc.

   National Trench Safety
   7849 Stockton Blvd
   Sacramento, CA 95823
   916-387-6300

   National Trench Safety
   45945 Warm Springs Blvd.
   Fremont, CA 94539
   510-490-2140

3. SLED: TrafFix Devices Inc.
   Capitol Barricade
   6001 Elvas Ave
   Sacramento, CA 95819
   925-580-2013

12-3.20C Construction

Install the crash cushion under the manufacturer's installation instructions.

Attach a Type R or Type P marker panel to the front of the alternative temporary crash cushion if the closest point of the crash cushion array is within 12 feet of the traveled way. Firmly fasten the marker panel to the crash cushion with commercial quality hardware or by other authorized methods.

12-3.20D Maintenance

Immediately repair alternative temporary crash cushions damaged due to your activities. Remove and replace any crash cushions damaged beyond repair. Replace and repair of alternative temporary crash cushions damaged by traffic is change order work.

Remove alternative temporary crash cushions, including marker panels, no later than Contract acceptance.

12-3.20E Payment

Not Used

Add to the beginning of the RSS for section 12-3.32C:

Place PCMSs at the locations shown and in advance of the 1st warning sign for each:

1. Stationary lane closure
2. Ramp closure
3. Connector closure
4. Shoulder closure

Add to the end of section 12-3.35A(1):

Use an AWIS for the following construction stages or activities:

1. Traffic Handling

Add to the beginning of the RSS for section 12-3.32C:

Place PCMSs at the locations shown and in advance of the 1st warning sign for each:

1. Stationary lane closure
2. Ramp closure
3. Connector closure
4. Shoulder closure

Add to the end of section 12-3.35A(1):

Use an AWIS for the following construction stages or activities:

1. Traffic Handling

Add between the 9th and 10th paragraphs of the RSS for section 12-3.32C:

Start displaying the message on the sign 15 minutes before closing the lane or shoulder or when directed by the Engineer.

Add between the 1st and 2nd paragraphs of section 12-4.02A(3)(c):

Submit a contingency plan for each of the following activities:

1. Activity requiring a complete roadway closure
2. Rapid set concrete activities, including concrete slab replacements
3. Roadway excavations encroaching on the traveled way not protected by Type K railing
4. Cold planing asphalt concrete for depths of 2 inches or greater

5. HMA paving
6. Asphalt or concrete grinding
7. Bridge work
8. Placement of bar reinforcing steel or structural members
9. Falsework erection or removal, including adjustments
10. Bridge demolition
11. Striping
12. Approach Slab Replacement
13. Polyester Concrete Overlay

Add to the end of section 12-4.02C(1):

Keep the full width of the traveled way open to traffic when no active construction activities are occurring in the traveled way or within 6 feet of the traveled way.

Keep the full width of the ramp traveled way open for use by traffic on designated holidays.

For each 10-minute interval or fraction thereof past the time specified to open the closure, the amount for liquidated damages per interval shown in the table below is deducted. Liquidated damages are limited to 5 percent of the total bid per occurrence. Liquidated damages are not assessed if the Engineer orders the closure to remain in place beyond the scheduled pickup time.

Type of facility	Route	Direction or segment	Period	Liquidated damages/interval
Mainline	5	SB-NB	1st half hour 2nd half hour 2nd hour and beyond	$2,734/10 minutes $4,101/10 minutes $5,468/10 minutes
Connector	5	SB-NB	1st half hour 2nd half hour 2nd hour and beyond	$1,257/10 minutes $1,885/10 minutes $2,514/10 minutes

Add to the list in the 1st paragraph of section 12-4.02C(3)(a):

3. Work is on the traveled way but within 6 feet of the adjacent traffic lane

Add to the end of section 12-4.02C(3)(a):

If you use an impact attenuator vehicle as a shadow vehicle, you are not required to close the adjacent traffic lane for the following activities:

1. Grinding
2. Saw cutting of concrete slabs
3. Installing loop detectors

If work vehicles or equipment are parked on the shoulder within 6 feet of a traffic lane of a freeway or expressway, close the shoulder area as shown.

You may close the following ramps for an extended period of time beginning at 2200 Friday through 0500 the following Monday instead of the hours shown in charts nos. J1–J12. When the ramp or connector is closed, place a PCMS for the duration of the closure at least 1,500 feet in advance of the off-ramp upstream from the ramp being closed. Place a PCMS at a location on the ramp for 7 days before the date of the planned closure.

Southbound
EB Florin Rd on-ramp to SB 5, PM 17.037
WB Florin Rd loop on-ramp to SB 5, PM 17.038
SB loop off-ramp to EB Florin Rd, PM 17.239
SB 5 off-ramp to WB Florin Rd, PM 17.240
SB 5 off-ramp to 43rd Ave, PM 18.819
Seamas Ave on-ramp to SB 5, PM 19.186
SB 5 off-ramp to Seamas Ave, PM 19.473
Sutterville Rd on-ramp to SB 5, PM 20.388
SB 5 off-ramp to Sutterville Rd, PM 20.726
5th St on-ramp to SB 5/WB 50
WB "P" St on ramp to 50/SB 5, PM 22.976

Northbound
EB Pocket Rd loop on-ramp to NB 5, PM 16.081
WB Pocket Rd on ramp to NB 5, PM 16.287
NB 5 loop off-ramp to WB Florin Rd, PM 17.006
NB 5 off-ramp to EB Florin Rd, PM 17.007
EB Florin Rd loop on-ramp to NB 5, PM 17.265
WB Florin Rd on-ramp to NB 5, PM 17.467
EB & WB 43rd St on-ramp to NB 5, PM 18.801
NB 5 off-ramp to Seamas Ave, PM 19.177
Seamas Ave on-ramp to NB 5, PM 19.467
NB 5 off-ramp to Sutterville Rd, PM 20.417
Sutterville Rd on-ramp to NB 5, PM 20.686
NB 5 off-ramp to 3rd and Broadway, PM 22.286
NB 5/EB 50 off-ramp to EB "Q" St. PM 22.876

Replace *Reserved* in section 12-4.02C(3)(b) with:

You may close Route 5 to traffic at 1 location in one direction of travel at a time as shown on charts no. H1 – H6.

A complete freeway or expressway closure is allowed for the following activities:

1. Falsework erection and removal
2. Girder erection
3. Bridge demolition
4. Installation and removal of a 2-post overhead sign
5. Installation of a loop detector

Erect and remove falsework at 1 location and at 1 span at a time. During falsework erection and removal, detour the traffic in the lanes over which falsework is being erected or removed.

Replace *Reserved* in section 12-4.02C(3)(d) with:

You may close city-street lanes using a one-way-reversing traffic-control lane closure on Broadway as shown on chart no. M2, Mondays through Fridays.

Replace *Reserved* in section 12-4.02C(3)(f) with:

Closure restrictions for designated holidays and special days are shown in the following table:

Lane Closure Restrictions For Designated Holidays And Special Days											
Thu	Fri	Sat	Sun	Mon	Tues	Wed	Thu	Fri	Sat	Sun	Mon
x	**H** xx	xx	xx								
	SD xx										
x	xx	**H** xx	xx								
		SD xx									
	x	xx	**H** xx	xx							
			SD xx								
	x	xx	xx	**H** xx	xxx						
	x	xx	xx	**SD** xx	xxx						
				x	**H** xx						
				x	**SD** xx						
					x	**H** xx					
						SD xx					
						x	**H** xx	xx	xx	xx	
							SD xx				

Legend:

	Refer to lane requirement charts.
X	The full width of the traveled way must be open for use by traffic after 0500.
xx	The full width of the traveled way must be open for use by traffic.
xxx	The full width of the traveled way must be open for use by traffic until 2400.
H	Designated holiday
SD	Special day

Replace *Reserved* in section 12-4.02C(3)(g) with:

freeway lane closures must comply with the requirements shown in the following charts:

Chart No. G1
Freeway Lane Requirements

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 9.7/11.8

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	1	1															1	1	1	1
Fri	1	1	1	1	1	1																1	1	1
Sat	1	1	1	1	1	1	1																1	1
Sun	1	1	1	1	1	1	1	1															1	1

Legend:

1 Provide at least 1 through freeway lane open in the direction of travel.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 2 existing freeway lanes in the direction of travel.

Chart No. G2
Freeway Lane Requirements

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 11.8/17.1

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	1	2	2																2	1	1
Fri	1	1	1	1	1	2	2																2	2	1
Sat	1	1	1	1	1	1	1	2	2														2	2	2
Sun	1	1	1	1	1	1	1	2	2														2	2	1

Legend:

1 Provide at least 1 through freeway lane open in the direction of travel.

2 Provide at least 2 adjacent through freeway lanes open in the direction of travel.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 3 existing freeway lanes in the direction of travel.

Chart No. G3
Freeway Lane Requirements

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 17.1/22.1

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	1	2	2																2	2	1
Fri	1	1	1	1	1	2	2																2	2	2
Sat	1	1	1	1	1	1	1																2	2	2
Sun	1	1	1	1	1	1	1	1															2	2	1

Legend:

1 Provide at least 1 through freeway lane open in the direction of travel.

2 Provide at least 2 adjacent through freeway lanes open in the direction of travel.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 4 existing freeway lanes in the direction of travel.

Chart No. G4
Freeway Lane Requirements

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 22.1/23.4

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	1	2	2																2	2	1
Fri	1	1	1	1	1	2	2																		2
Sat	1	1	1	1	1	1	1	2	2																2
Sun	1	1	1	1	1	1	1	1	2															2	1

Legend:

1 Provide at least 1 through freeway lane open in the direction of travel.

2 Provide at least 2 adjacent through freeway lanes open in the direction of travel.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 3 existing freeway lanes in the direction of travel.

Chart No. G5
Freeway Lane Requirements

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 23.4/24.9

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	1																	3	3	3	2
Fri	1	1	1	1	1																	3	3	3	2
Sat	1	1	1	1	1	1	2															3	3	3	3
Sun	1	1	1	1	1	1	1															3	3	2	2

Legend:

1	Provide at least 1 through freeway lane open in the direction of travel.
2	Provide at least 2 adjacent through freeway lanes open in the direction of travel.
3	Provide at least 3 adjacent through freeway lanes open in the direction of travel.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 4 existing freeway lanes in the direction of travel.

Chart No. G6
Freeway Lane Requirements

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 9.7/11.6

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Wed	1	1	1	1	1																		1	1	1
Thur	1	1	1	1	1																			1	1
Fri	1	1	1	1	1																				1
Sat	1	1	1	1	1	1	1																		1
Sun	1	1	1	1	1	1	1	1																	1

Legend:

1	Provide at least 1 through freeway lane open in the direction of travel.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 2 existing freeway lanes in the direction of travel.

Chart No. G7
Freeway Lane Requirements

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits:PM 11.6/17.4

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Wed	1	1	1	1	1	2																2	1	1	1
Thur	1	1	1	1	1	2																2	2	1	1
Fri	1	1	1	1	1	2																2	2	2	1
Sat	1	1	1	1	1	1	2															2	2	2	1
Sun	1	1	1	1	1	1	1	1														2	2	2	1

Legend:

1	Provide at least 1 through freeway lane open in the direction of travel.
2	Provide at least 2 adjacent through freeway lanes open in the direction of travel.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 3 existing freeway lanes in the direction of travel.

Chart No. G8
Freeway Lane Requirements

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 17.4/22.4

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Wed	1	1	1	1	2	2																2	2	1	1
Thur	1	1	1	1	2	2																2	2	2	1
Fri	1	1	1	1	2	2																2	2	2	2
Sat	1	1	1	1	1	1	2															2	2	2	2
Sun	1	1	1	1	1	1	1	2														2	2	2	1

Legend:

1	Provide at least 1 through freeway lane open in the direction of travel.
2	Provide at least 2 adjacent through freeway lanes open in the direction of travel.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 4 existing freeway lanes in the direction of travel.

Chart No. G9
Freeway Lane Requirements

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 22.4/23.0

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Wed	1	1	1	1	1																		2	1	1
Thur	1	1	1	1	1																		2	2	1
Fri	1	1	1	1	1																			2	2
Sat	1	1	1	1	1	1																	2	2	2
Sun	1	1	1	1	1	1	1															2	2	2	1

Legend:

1	Provide at least 1 through freeway lane open in the direction of travel.
2	Provide at least 2 adjacent through freeway lanes open in the direction of travel.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 3 existing freeway lanes in the direction of travel.

Chart No. G10
Freeway Lane Requirements

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 23.0/24.9

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	2																		3	2	2
Fri	1	1	1	1	2																			3	2
Sat	1	1	1	1	1	1	2	2															3	3	2
Sun	1	1	1	1	1	1	1	2	2													3	3	2	2

Legend:

1	Provide at least 1 through freeway lane open in the direction of travel.
2	Provide at least 2 adjacent through freeway lanes open in the direction of travel.
3	Provide at least 3 adjacent through freeway lanes open in the direction of travel.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 4 existing freeway lanes in the direction of travel.

Replace *Reserved* in section 12-4.02C(3)(h) with:

Comply with the requirements for the complete freeway closure shown in the following charts:

Chart No. H1
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 16.5/18.6

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway may be closed completely.
	No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Chart No. H2
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 17.9/20.0

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway may be closed completely.
	No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Chart No. H3
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 19.0/21.0

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C Freeway may be closed completely.

No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Chart No. H4
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: PM 20.0/23.0

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C Freeway may be closed completely.

No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Chart No. H5
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 16.5/18.6

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway may be closed completely.
	No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Chart No. H6
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 17.9/20.0

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway may be closed completely.
	No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Chart No. H7
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 19.0/21.0

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway may be closed completely.
	No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Chart No. H8
Complete Freeway Closure Hours

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: PM 20.0/23.0

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	C	C	C	C	C																				
Tue-Thur																									
Fri																								C	C
Sat	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sun	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway may be closed completely.
	No complete closure is allowed.

REMARKS:

1. Before the 55-hour freeway closure, the crossover detour must be in place and in use by public traffic. See "Traffic Handling Plans" for details.
2. The freeway closure and crossover detour may only be used twice at this location during the life of the project.

Replace *Reserved* in section 12-4.02C(3)(i) with:

Comply with the requirements for the complete connector closure shown in the following charts:

Chart No. I1
Complete Connector Closure Hours

County: Sac | Route/Direction: 5/SB-NB | Post Mile: 9.7/24.9

Closure limits: EB 50 connector to SB 5, PM 22.347
EB 50 connector to NB 5, PM 22.646

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C	C																	C	C	C
Fri	C	C	C	C	C	C																	C	C	C
Sat	C	C	C	C	C	C	C																C	C	C
Sun	C	C	C	C	C	C	C																C	C	C

Legend:

C Connector may be closed completely.

No work is allowed.

REMARKS:

1. Only 1 connector may be closed at a time except as shown on the traffic handling details.
2. Before a connector is closed, public traffic must be detoured in accordance with the traffic handling plans or motorist information plans.

Chart No. I2
Complete Connector Closure Hours

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: SB 5 connector to EB and WB 50, PM 22.375
SB 5 conector to X-St
P-St to SB 5

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																				C
Fri	C	C	C	C	C																				
Sat	C	C	C	C	C	C																			
Sun	C	C	C	C	C	C																			C

Legend:

C Connector may be closed completely.

No work is allowed.

REMARKS:

1. Only 1 connector may be closed at a time except as shown on the traffic handling details.
2. Before a connector is closed, public traffic must be detoured in accordance with the traffic handling plans or motorist information plans.
3. Connector closures are prohibited before or during any sports, music, or other event taking place at the Golden 1 Center in Sacramento. Connector closures are allowed 1 hour after an event ends. The contractor is responsible for knowing the dates and times of all scheduled events at the Golden 1 Center.

Chart No. I3
Complete Connector Closure Hours

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: NB 5 connector to EB 50 and Broadway, PM 22.173

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																				C
Fri	C	C	C	C	C																				C
Sat	C	C	C	C	C	C																			C
Sun	C	C	C	C	C	C	C																		C

Legend:

C Connector may be closed completely.

No work is allowed.

REMARKS:

1. Only 1 connector may be closed at a time except as shown on the traffic handling details.
2. Before a connector is closed, public traffic must be detoured in accordance with the traffic handling plans or motorist information plans.

Chart No. I4
Complete Connector Closure Hours

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: NB connector to WB 50, PM 22.172

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																			C	C
Fri	C	C	C	C	C																			C	C
Sat	C	C	C	C	C	C																		C	C
Sun	C	C	C	C	C	C																		C	C

Legend:

C Connector may be closed completely.

No work is allowed.

REMARKS:

1. Only 1 connector may be closed at a time except as shown on the traffic handling details.
2. Before a connector is closed, public traffic must be detoured in accordance with the traffic handling plans or motorist information plans.

Chart No. I5
Complete Connector Closure Hours

County: Sac	Route/Direction: 5/SB-NB	Post Mile: 9.7/24.9

Closure limits: WB 50/W-St connector to NB 5, PM 22.878
WB 50 connectors to NB and SB 5
W-St to WB 50

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																				
Fri	C	C	C	C	C																				
Sat	C	C	C	C	C	C																			
Sun	C	C	C	C	C	C																			

Legend:

C	Connector may be closed completely.
	No work is allowed.

REMARKS:

1. Only 1 connector may be closed at a time except as shown on the traffic handling details.
2. Before a connector is closed, public traffic must be detoured in accordance with the traffic handling plans or motorist information plans.
3. W-St on-ramp to SB 5 is to remain open during the above closures.

Replace *Reserved* in section 12-4.02C(3)(j) with:

Comply with the requirements for the complete ramp closure shown in the following charts:

Chart No. J1
Complete Ramp Closure Hours

County: Sac	Route/Direction: 5/SB-NB	Post Mile: 9.7/24.9

Closure limits: SB loop on-ramp from WB Elk Grove Blvd, PM 10.882
SB on-ramp from EB Pocket Rd, PM 16.025
SB loop on-ramp from WB Pocket Rd, PM 16.201
SB loop on-ramp from WB Florin Rd, PM 17.038
Segment SB to 3rd St, PM 22.376
NB off-ramp to Elk Grove Blvd, PM 10.627
NB off-ramp to EB Florin Rd, PM 17.007

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																		C	C	C
Fri	C	C	C	C	C																		C	C	C
Sat	C	C	C	C	C	C	C																C	C	C
Sun	C	C	C	C	C	C	C																C	C	C

Legend:

C	Ramp may be closed completely.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J2
Complete Ramp Closure Hours

County: Sac	Route/Direction: 5/SB-NB	Post Mile: 9.7/24.9

Closure limits: SB off-ramp to Elk Grove Blvd, PM 11.057
SB on-ramp from Cosumnes River Blvd
SB off-ramp to Cosumnes River Blvd
SB on-ramp from EB Florin Rd, PM 17.037
SB loop off-ramp to EB Florin Rd, PM 17.239
SB off ramp to Sutterville Rd, PM 20.726
NB off-ramp to Cosumnes River Blvd
NB on-ramp to Cosumnes River Blvd

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																		C	C	C
Fri	C	C	C	C	C																			C	C
Sat	C	C	C	C	C	C	C																	C	C
Sun	C	C	C	C	C	C	C																C	C	C

Legend:

C	Ramp may be closed completely.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J3
Complete Ramp Closure Hours

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: SB loop on-ramp from WB Laguna Blvd, PM 12.188
SB off-ramp to EB Laguna Blvd, PM 12.372
SB off-ramp to Pocket Rd, PM 16.350

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C	C																			C
Fri	C	C	C	C	C	C																			
Sat	C	C	C	C	C	C	C																		
Sun	C	C	C	C	C	C	C	C																	C

Legend:

C Ramp may be closed completely.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J4
Complete Ramp Closure Hours

County: Sac | Route/Direction: 5/SB | Post Mile: 9.7/24.9

Closure limits: SB off-ramp to WB Florin Rd, PM 17.240
SB off-ramp to 43rd Ave, PM 18.819
SB on-ramp from WB "P" St to Route 50/5, PM 22.976

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																				C
Fri	C	C	C	C	C																				
Sat	C	C	C	C	C	C	C	C																	
Sun	C	C	C	C	C	C	C	C																	C

Legend:

C Ramp may be closed completely.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J5
Complete Ramp Closure Hours

County: Sac	Route/Direction: 5/SB-NB	Post Mile: 9.7/24.9

Closure limits: SB on-ramp from Seamas Ave, PM 19.186
SB off-ramp to Seamas Ave, PM 19.473
SB on-ramp from Sutterville Rd, PM 20.388
SB 5/WB 50 on-ramp from 5th St
NB off-ramp to Laguna Blvd, PM 11.877
NB off-ramp to Sutterville Rd, PM 20.417
NB on-ramp from WB "P" St, PM 22.302

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																	C	C	C	C
Fri	C	C	C	C	C																	C	C	C	C
Sat	C	C	C	C	C	C	C	C														C	C	C	C
Sun	C	C	C	C	C	C	C	C														C	C	C	C

Legend:

C	Ramp may be closed completely.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J6
Complete Ramp Closure Hours

County: Sac | Route/Direction: 5/SB-NB | Post Mile: 9.7/24.9

Closure limits: SB on-ramp from WB "I" St, PM 23.640
SB off-ramp to EB "J" St, PM 23.893
SB on-ramp from Richards Blvd, PM 24.509
NB on-ramp from WB "L" St, PM 23.731

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																				C
Fri	C	C	C	C	C																				
Sat	C	C	C	C	C	C																			
Sun	C	C	C	C	C	C	C																		C

Legend:
C Ramp may be closed completely.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:
1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J7
Complete Ramp Closure Hours

County: Sac | Route/Direction: 5/SB-NB | Post Mile: 9.7/24.9

Closure limits: SB off-ramp to Richards Blvd, PM 24.788
NB loop on-ramp from EB Pocket Rd, PM 16.081
NB loop on-ramp from EB Florin Rd, PM 17.265
NB on-ramp from WB Florin Rd, PM 17.467

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																	C	C	C	C
Fri	C	C	C	C	C																	C	C	C	C
Sat	C	C	C	C	C	C	C	C														C	C	C	C
Sun	C	C	C	C	C	C	C	C	C											C	C	C	C	C	C

Legend:C
C Ramp may be closed completely.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:
1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J8
Complete Ramp Closure Hours

County: Sac	Route/Direction: 5/NB	Post Mile: 9.7/24.9

Closure limits: NB on-ramp from Elk Grove Blvd, PM 11.112
NB on ramp from WB Elk Grove Blvd, PM 11.112
NB on-ramp from 43rd St, PM 18.801

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																	C	C	C	C
Fri	C	C	C	C	C																	C	C	C	C
Sat	C	C	C	C	C	C	C																	C	C
Sun	C	C	C	C	C	C	C	C																C	C

Legend:

C	Ramp may be closed completely.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J9
Complete Ramp Closure Hours

County: Sac	Route/Direction: 5/NB	Post Mile: 9.7/24.9

Closure limits: NB on-ramp from WB Laguna Blvd, PM 12.190
NB on-ramp from WB Pocket Rd, PM 16.287
NB off-ramp to "J" St, PM 23.511

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																				C
Fri	C	C	C	C	C																				C
Sat	C	C	C	C	C	C																			C
Sun	C	C	C	C	C	C	C																	C	C

Legend:

C	Ramp may be closed completely.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J10
Complete Ramp Closure Hours

County: Sac	Route/Direction: 5/NB	Post Mile: 9.7/24.9

Closure limits: NB off-ramp to Pocket Rd, PM 15.947
NB loop off-ramp to Florin Rd, PM 17.006
NB off-ramp to Seamas Ave, PM 19.177
NB on-ramp from Seamas Ave, PM 19.467
NB on-ramp from Sutterville Rd, PM 20.686
NB off-ramp to 3rd and Broadway, PM 22.286

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																	C	C	C	C
Fri	C	C	C	C	C																	C	C	C	C
Sat	C	C	C	C	C	C	C	C	C													C	C	C	C
Sun	C	C	C	C	C	C	C	C	C											C	C	C	C	C	C

Legend:

C	Ramp may be closed completely.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:
1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J11
Complete Ramp Closure Hours

County: Sac	Route/Direction: 5/NB	Post Mile: 9.7/24.9

Closure limits: NB on-ramp from WB "W" St to SB 5/WB 50, PM 22.594

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C																					
Fri	C	C	C	C																					
Sat	C	C	C	C																					
Sun	C	C	C	C	C																				

Legend:

C	Ramp may be closed completely.
	Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:
1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Chart No. J12
Complete Ramp Closure Hours

County: Sac | Route/Direction: 5/NB | Post Mile: 9.7/24.9

Closure limits: NB 5/EB 50 off-ramp to EB "Q" St, PM 22.876

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C																				
Fri	C	C	C	C	C																				
Sat	C	C	C	C	C	C																			
Sun	C	C	C	C	C	C																			

Legend:

C Ramp may be closed completely.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS:

1. Before a ramp is closed, public traffic must be detoured to the preceding ramp or to the next ramp and a detour must be available and in place.
2. Adjacent ramps in the same direction of travel must not be closed simultaneously except as shown on the traffic handling details.

Replace *Reserved* in section 12-4.02C(3)(k) with:

Comply with the requirements for the conventional highway lane closures shown in the following chart:

Chart No. K1
Conventional Highway Lane Requirements

County: Sac | Route/Direction: 5/SB-NB | Post Mile: 9.7/24.9

Closure limits: Pocket Rd OC, PM 16.1
Florin Rd OC, PM 17.2
Sutterville Rd OC, PM 20.5

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	1																			1	1
Fri	1	1	1	1	1																			1	1
Sat	1	1	1	1	1	1																		1	1
Sun	1	1	1	1	1	1	1																	1	1

Legend:

1 Provide at least 1 through traffic lane open in the direction of travel.

Work is allowed within the highway where a shoulder or lane closure is not required.

REMARKS: There are 2 existing through traffic lanes in each direction of travel, except that the WB #2 lane for Sutterville Road over the overcrossing is not a through lane but is a delineated shoulder wider than 12 feet wide and can act as a through lane during closure of the WB #1 lane.

Replace *Reserved* in section 12-4.02C(3)(l) with:

Comply with the requirements for the complete closure on a conventional highway shown in the following chart:

Chart No. L1
Complete Conventional Highway Closure Hours

County: Sac | Route/Direction: 5/SB-NB | Post Mile: 9.7/24.9

Closure limits: Route 160 (Freeport Blvd), PM 15.6

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	C	C	C	C	C	C																C	C	C	C
Fri	C	C	C	C	C	C																C	C	C	C
Sat	C	C	C	C	C	C																C	C	C	C
Sun	C	C	C	C	C	C																C	C	C	C

Legend:

C — Conventional highway may be closed completely.

( ) — No complete conventional highway closure is allowed.

REMARKS:

1. Before closing Freeport Blvd, public traffic must be detoured in accordance with the traffic handling plans or motorist information plans, and the detour must be available and in place.
2. Coordinate full closure with the City of Sacramento before closing Freeport Blvd.

Replace *Reserved* in section 12-4.02C(3)(m) with:

Comply with the requirements for a city street lane closure shown in the following charts:

Chart No. M1
City Street Lane Requirements and Hours of Work

Location: Sac | Direction: 5/SB-NB

Closure limits: 43rd Ave
3rd St
J St
P St
Q St
Richards Blvd

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	1	1	1	1	1																			1	1
Fri	1	1	1	1	1																			1	1
Sat	1	1	1	1	1	1																		1	1
Sun	1	1	1	1	1	1	1																	1	1

Legend:

1 — Provide at least 1 city street lane open in the direction of travel.

( ) — No work is allowed.

REMARKS: The number of through traffic lanes in each direction of travel is 2.

Chart No. M2
City Street Lane Requirements and Hours of Work

Location: Sac | Direction: Var

Closure limits: Broadway

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon–Thu	R	R	R	R	R																			R	R
Fri	R	R	R	R	R																				
Sat																									
Sun																									

Legend:

	No work is allowed.
R	Provide at least 1 through traffic lane not less than 11 feet in width for use by both directions of travel. (Reversing Control)

REMARKS: The number of through traffic lanes in each direction of travel is 1.

Add to the end of the 1st paragraph of section 12-4.02C(7)(a):

except you may use a moving closure during traffic striping and pavement marker placement using a bituminous adhesive. Do not use a moving lane closure when grinding for recessed striping and recessed markers.

Add to the end of section 12-4.02C(7)(a):

Do not use an impact attenuator vehicle to place, remove, or place and remove components of a stationary traffic control system on multi-lane freeways, connectors, or ramps where the useable shoulder width is less than 8 feet within 300 feet of the start of and through the taper as shown.

Except where prohibited, use an impact attenuator vehicle:

1. To follow behind equipment and workers who are placing and removing components of a closure. Operate the flashing arrow sign in the arrow or caution mode during this activity, whichever applies. Follow at a distance that prevents intrusion into the work space from passing traffic. Each vehicle used to place, maintain, and remove components of a traffic control system must have cellular phone and radio contact with personnel in the area.
2. As a shadow vehicle in a moving lane closure.

After placing components of a stationary traffic control system, you may place the impact attenuator vehicle in advance of the work area or at another authorized location to protect traffic and workers.

Add to the end of section 12-4.02C(7)(b):

All flaggers must have cellular phone and radio contact with personnel in the work area

Except for one-way-reversing traffic-control lane closures, the maximum length of the work area inside a closure is 2 miles.

Not more than 2 stationary closures are allowed in each direction of travel at one time.

Concurrent stationary closures in the same direction of travel must be spaced no closer than 2 miles apart. Closures in the same direction of travel on alternating inside lanes and outside lanes must be spaced by an additional 2 miles.

Closure spacing is the distance between the last cone of the upstream closure and the temporary sign W20-1 of the downstream closure. The number of lanes open in the upstream closures must be less than or equal to the number of lanes open in the downstream closures. For multiple closures in each direction of travel, pick up the downstream closures first.

For a stationary one-way-reversing traffic-control lane closure, you may stop traffic in 1 direction for periods not to exceed 10 minutes. After each stoppage, all accumulated traffic for that direction must pass through the work zone before another stoppage is made. Delays to public traffic must not exceed a total of 20 minutes.

The maximum length of a single stationary one-way-reversing traffic-control lane closure is 100 feetbetween flaggers.

Transport bicyclists through the one-way-reversing traffic-control work zone.

You may use a pilot car to control traffic. If a pilot car is used to control traffic, the cones shown along the centerline are not required. Pilot cars must have cellular or radio contact with other pilot cars and personnel in the work zone. The maximum speed of the pilot cars convoying or controlling traffic through the traffic control zone is 25 mph. Pilot cars must only use traffic lanes open to traffic.

Replaced *Reserved* in section 12-4.03 with:

12-4.03A General

Section 12-4.03 includes specifications for providing falsework openings.

12-4.03B Materials

Not Used

12-4.03C Construction

At each location where falsework is constructed over a street or route shown in the following table, provide openings through the bridge falsework. The type, minimum width, height, and number of openings at each location, and the location and maximum spacing of the falsework lighting if required for each opening, must comply with the requirements shown in the following table. The width of vehicular openings is the clear width between temporary railings or other protective work.

Bridge No. 24-0388 (South Bound)

	Number	Width (feet)	Height (feet)
Vehicle openings	2	61	16

Bridge No. 24-0388 (North Bound)

	Number	Width (feet)	Height (feet)
Vehicle openings	2	70	16

Bridge No. 24-0296

	Number	Width (feet)	Height (feet)
Vehicle openings	1	24	16.5
	Location	Spacing[a] (feet)	
Falsework pavement lighting	R&L	30 staggered 1/2 space	

NOTE:
R = Right side of traffic
L = Left side of traffic
C = Centered overhead
[a]Spacing is the maximum distance from center to center between fixtures.

Temporary railing is not required at the railroad at bridge no. 24-0296. In addition to the falsework pavement lighting shown, illuminate each side of each vehicular passageway between portals with a string of yellow 25 W lamps spaced at 12-foot intervals, mounted at a height from 8 to 8-1/2 feet above the pavement.

Bridge No. 24-0296

	Number	Width (feet)	Height (feet)
Vehicle openings	1	15	18
	Location	Spacing[a] (feet)	
Falsework pavement lighting	R	22.5	

NOTE:
R = Right side of traffic
L = Left side of traffic
[a]Spacing is the maximum distance from center to center between fixtures.

Bridge No. 24-0254 (South Bound)

	Number	Width (feet)	Height (feet)
Vehicle openings	2	61	16

	Number	Width (feet)	Height (feet)
Vehicle openings	2	70	16
	Location	Spacing[a] (feet)	
Falsework pavement lighting	R&L	30 staggered 1/2 space	

NOTE:
R = Right side of traffic
L = Left side of traffic
C = Centered overhead
[a]Spacing is the maximum distance from center to center between fixtures.

The Engineer determines the exact location of the openings.

12-4.03D Payment

Not Used

Delete the second paragraph of section 12-6.03D(3).

Delete the second paragraph of section 12-6.03D(5).

^^

13 WATER POLLUTION CONTROL

Add to the end of section 13-3.01A:

This project's risk level is 2.

Add between the 4th and 5th paragraphs of section 13-3.01C(2)(a):

The following RWQCBs will review the authorized SWPPP:

1. Central Valley RWQCB

Add between the 1st and 2nd paragraphs of section 13-4.03G:

Dewatering must comply with the provisions of Order No. 2003-0003-DWQ adopted by the State Water Resource Control Board (Statewide General Waste Discharge Requirements for Discharge To Land With A Low Threat To Water Quality) or Resolution R5-2013-0145 adopted by the Central Valley RWQCB (Waiver Of Reports Of Waste Discharge And Waste Discharge Requirements For Specific Types Of Discharge Within The Central Valley Region), whichever is applicable. This permit or resolution is available at the State Water Resource Control Board or Central Valley RWQCB Web site.

Replace the 2nd sentence of the 1st paragraph of section 13-6.03C with:

The drainage inlet protection must be Type 2 as appropriate for the conditions around the drainage inlet.

Replace section 13-12 with:

13-12 TEMPORARY CREEK DIVERSION SYSTEMS

13-12.01 GENERAL

13-12.01A Summary

Section 13-12 includes specifications for constructing, maintaining, reconstructing, and removing temporary creek diversion system (TCDS), and restoring creek bed to original condition. The temporary diversion system is used to divert upstream water flows to allow construction in a dry or dewatered location.

13-12.01B Definitions

Not Used

13-12.01C Submittals

Submit a certificate of compliance for:

1. Pump system
2. Pipe material
3. Minor coffer dam material
4. Gravel bags
5. Plastic sheeting
6. Seepage pump

13-12.01C(1) Temporary Creek Diversion System Plan

Within 20 days of Contract approval, submit 3 copies of the Temporary Creek Diversion System Plan (TCDSP). The TCDSP must include:

1. Installation and removal process, including equipment, platforms for equipment, and access locations.
2. Anticipated flow rates.
3. Calculations supporting the sizing of piping, channels, pumps, or other conveyance by using FHWA HY-8 or other equivalent method. Calculate the discharge water flow rate and velocity anticipated where it discharges on any erodible surface, so its conveyance does not cause erosion within the project or at the discharge to the water body. Temporary culverts attached to banks, walls, or other locations must be designed to hold the full weight of the culvert at capacity and restrain the culvert for any expected hydraulic forces.
4. Plans showing locations of diversion, including layouts, cross sections, and elevations.
5. Materials proposed for use, including MSDS if applicable.
6. Operation and maintenance procedures for the TCDS.
7. Restoration plans showing before and after conditions, including photos of existing conditions for areas disturbed during the installation, operation, and removal of the TCDS.
8. Monitoring and reporting plan to ensure applicable water quality objectives are met. This includes schedule of work including Temporary BMP implementation as part of the Construction Site BMP strategy, and SWPPP or WPCP as applicable. Use with section 13-3.01A.
9. Details of the pumping system, if used, including power source, debris handling, fish screens, and monitoring requirements.
10. Fish passage plan, following the Caltrans Fish Passage Design for Road Crossings, CA Department of Fish and Wildlife (CDFW), CA Salmonid Stream Habitat Restoration Manual, and National Marine Fisheries Service (NMFS), Guidelines for Salmonid Passage at Stream Crossings, as required by the applicable PLACs.
11 The TCDS design must demonstrate how it will comply with section 13-12.03A, water tightness, and prevent seepage.
12. Contingency plan to remove workers, equipment, materials, fuels, and any other work items that will cause pollution or violation of PLACs during a rain event out of the flow area. Develop the contingency plan for when a 12-inch freeboard cannot be maintained and overtopping of the coffer dams may occur.

If revisions are required, the Engineer notifies you of the date when the review stopped and provides comments. Submit a revised TCDSP within 15 days of receiving the comments. The Department's review resumes when a complete TCDSP has been resubmitted.

Submit an electronic copy on a read-only CD, DVD, or other Engineer-authorized data storage device and 4 printed copies of the authorized TCDSP.

If the RWQCB or other regulatory agency requires review of the authorized TCDSP, the Engineer submits it to the RWQCB for review and comment. If the Engineer orders changes to the TCDSP based on the RWQCB's comments, submit a revised TCDSP within 10 days.

All submittals which include plans, specifications, and calculations must be sealed and signed by a civil engineer registered in the State.

13-12.01D Quality Assurance

Not Used

13-12.02 MATERIALS

13-12.02A Gravel

Gravel must:

1. Be river run gravel obtained from a river or creek bed with gradation of 100 percent passing a 3/4 inch sieve and 0% passing a 3/8 inch sieve
2. Be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, thin, elongated or laminated pieces, disintegrated material, organic matter, or other deleterious substances
3. Be composed entirely of particles that have no more than 1 fractured face
4. Have a cleanliness value of at least 85, as determined by California Test 227

13-12.02B Impermeable Plastic Membrane

Impermeable plastic membrane must be:

1. Single ply, commercial quality, polyethylene with a minimum thickness of 10 mils complying with ASTM D2103. You must use stronger plastic membrane if required as part of design to resist hydraulic forces.
2. Free of holes, punctures, tears or other defects that compromise the impermeability of the material.
3. Suitable for use as an impermeable membrane.
4. Resistant to UV light, retaining a minimum grab breaking load of 70 percent after 500 hours under ASTM D4355.

13-12.02C Gravel-Filled Bags

Gravel-filled bags must comply with section 13-5.02G.

The 2nd paragraph of section 13-5.02G does not apply.

13-12.02D Plastic Pipes

Plastic pipe must comply with section 61-3.01 and must:

1. Be clean, uncoated, in good condition free of rust, paint oil dirt or other residues that could potentially contribute to water pollution
2. Be adequately supported for planned loads
3. Use watertight joints under section 61-2.01.
4 Be made of a material or combination of materials that are suitable for clean water and which do not contain banned, hazardous or unlawful substances
5. For temporary pipes not reused on the project you may use the following materials:
   - 5.1. PVC closed-profile wall pipe must comply with ASTM F1803
   - 5.2. PVC solid wall pipe must comply with ASTM D3034, ASTM F679, AWWA C900, AWWA C905, or ASTM D2241 and cell class 12454 defined by ASTM D1784
   - 5.3. HDPE solid wall pipe must comply with AASHTO M 326 and ASTM F714
   - 5.4. Polyethylene large-diameter-profile wall sewer and drain pipe must comply with ASTM F894

13-12.02E Rock

Rock layer must comply with the table titled *Rock Gradation for 7-inch-thick Layer* in section 72-4.02.

13-12.02F Pumping System

Pumping system must:

1. Comply with section 74-2.02B
2. Be equipped with secondary containment
3. Be free of fuel and oil leaks
4. Meet intake screen regulatory requirements

13-12.02G Seepage Pumping System

If seepage occurs in the dewatered work area, the water must be removed by sump pumps as part of the TCDS.

Seepage pumping system must:

1. Comply with section 74-2.02B
2. Ensure discharge water conform with PLACs or is treated on site
3. Be free of fuel and oil leaks

13-12.02H Discharge Water Energy Dissipation and Erosion Control

Discharge water from pumps, pipes, ditches, or other conveyances must have BMPs to dissipate the flows and velocity of water discharged from the temporary diversion system if erosion would otherwise occur.

Energy dissipation measures:

1. May be plastic sheeting, flared end sections, rubber matting, or other materials appropriate for the design hydraulics
2. Must be anchored to prevent movement by expected flows
3. Must be removed when the TCDS is removed

13-12.03 CONSTRUCTION

13-12.03A General

Construction, use and removal of the TCDS is restricted to the time period from June 15 to October 15. If the work cannot be completed during the initial restricted time period , remove TCDS, restore the creek to original flow condition, and reconstruct the TCDS after June 15 of the following year. No work is allowed within the stream except during the restricted time period.

Do not use motorized equipment or vehicles in areas of flowing or standing water for the construction or removal of the TCDS in compliance with section 13-4.03.

Remove vegetation to ground level and clear away debris.

Place temporary or permanent fill as allowed by PLACs.

Place rock at outlet of diversion pipe under section 72-4.03, except motorized vehicles and equipment must not be used in areas of flowing or standing water.

Do not construct or reconstruct TCDS if the 72-hour forecasts predict a 50 percent or greater chance of rain in the project area.

Stop allwork and remove all material and equipment from the creek between upstream and downstream cofferdams if the 72-hour forecasts predict a 50 percent or greater chance of rain in the project area and the predicted rainfall is estimated to produce a flow rate exceeding the design capacity of the TCDS.

If the required freeboard cannot be maintained and overtopping may occur, implement contingency plan to remove all workers, equipment, and potential sources of pollution from the dry working area of the creek bed.

The TCDS must be constructed within the temporary impact footprint as described in the environmental commitments.

Lap and join joints between the edges of impermeable plastic membrane with commercial-quality waterproof tape with minimum 4-inch lapping at the edges.

Seal openings or penetrations through the impermeable plastic membrane with commercial quality waterproof tape.

The TCDS must be water tight to keep the work area dry for construction and prevent the creation of pollutants. Maintain all portions of the TCDS and fix leaks as soon as they are discovered.

Contact water agencies that discharge to the construction area to ensure that unexpected water is not discharged during construction which could compromise the TCDS.

13-12.03B Maintenance

Maintain the TCDS to provide a minimum freeboard of 12 inches between the water surface and the impermeable top of the cofferdams.

Do not discharge runoff from existing or proposed drainage systems into the dry work area between the cofferdams. Runoff from these systems may be connected to the diversion pipe or conveyed by pipes downstream of the cofferdam.

Prevent leaks in the TCDS. Provide seepage pumps as necessary and keep the work area dry to prevent the creation of sediment-laden water.

Repair holes, rips and voids in the impermeable plastic membrane with commercial-quality waterproof tape. Replace impermeable plastic membrane when patches or repairs compromise the impermeability of the material.

Repair TCDS within 24 hours after the damage occurs.

Prevent debris from entering the TCDS and receiving water.

Remove and immediately replace gravel, gravel-filled bags, impermeable plastic membrane, or plastic pipes contaminated by construction activities.

Remove sediment deposits and debris from the TCDS as needed. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water, under sections 19-1.01 and 19-2.03 B.

13-12.03C Removal

When no longer required, remove all components of TCDS. Return the creek bed and banks to the original condition.

Do not excavate the native creek material. Backfill ground disturbance, including holes and depressions caused by the installation and removal of the TCDS with gravel. Maintain the original line and grade of the creek bed.

13-12.04 PAYMENT

Not Used

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14 ENVIRONMENTAL STEWARDSHIP

Add to the end of section 14-1.02:

An ESA exists on this project.

Before starting job site activities, install temporary high-visibility fence to protect the ESA and mark its boundaries.

Access to an ESA other than that described is prohibited.

Add to section 14-2.03B:

The locations of archaeological monitoring areas within, near, or straddling the job site are shown in the following table:

Archaeological Monitoring Areas

Designation and description	Post mile limits
AMA 1-All ground disturbing work on both sides of I-5 and adjacent residential streets. Map layout sheets L-41 to L-43.	PM 19.28 to 19.95 on both sides of I-5 and adjacent residential streets
AMA 2-All ground disturbing work associated with the Casilada pedestrian overcrossing replacement (Bridge No. 240253). Map layout sheet L-42.	PM 19.5 to 19.62 on both sides of I-5 and adjacent residential streets

The archaeologist and a Native American tribe-authorized monitor to observe work activities within each AMA. Do not work within the area unless the archaeologist and the tribe-authorized monitor are present.

The Engineer, archaeologist, and tribe-authorized monitor will conduct a field review with you at least 5 business days before the start of job site activities. The Department marks the exact boundaries of each archaeological monitoring area on the ground.

Submit a schedule showing the days and hours that work will be performed in an AMA at least 5 business days before starting work in the monitoring area. Submit an updated schedule at least 5 business days before any changed work day.

Add to the 1st paragraph of section 14-6.03A:

This project is within or near habitat for the regulated species shown in the following table:

Regulated Species

Pond Turtle
Migratory and Nongame Birds
Sanford's Arrowhead
Giant Garter Snake

This project includes the sensitive habitats shown in the following table:

Sensitive Habitats

Wetlands
Riparian Zone
Waters of the State
Waters of the US

Replace item 1 in the 2nd paragraph of section 14-6.03A with:

Add to section 14-6.03A:

Species protection areas within the project limits are as specified in the following table:

Species Protection Areas

Identification name	Location
Species Protection Area 1 (SPA1)	Entire Project Limits
Species Protection Area 2 (SPA2)	Morrison Creek area

Use the protocols for the corresponding regulated species shown in the following table:

Regulated species name	Protocol
Migratory and non-game birds	(SPA1) Pre-construction nesting surveys where vegetation or tree removal occurs at specific locations during the nesting season February 1 to September 30. Bridges that will have new conduit attached to it will be surveyed for nesting birds prior to work being done. Surveys shall be done no more than 10 days prior vegetation removal or conduit attachment to any bridges. If work is done outside of the nesting season October 1 to January 31 no surveys are needed.
Migratory and non-game birds	(SPA2) At least 30 days prior to construction, survey Morrison Creek bridges for nesting birds. Provide species of birds present on bridges and propose exclusion measures in bird exclusionary plan. Contractor shall Install exclusion devices outside the nesting season October 1 to January 31. Contractor must maintain exclusion devices throughout the life of the project. Maintenance includes but is not limited to the following: repair or replace damaged exclusionary devices and components thereof; seal any newly discovered openings susceptible to use by nesting birds or other wildlife; collect and properly dispose of debris and excess material from damaged devices or maintenance activity. Contractor shall either re-use or provide new materials for exclusionary devices for all structures if exclusionary devices are needed for multiple bird nesting seasons. During the nesting season February 1 to September 30 ten days prior to any vegetation or tree removal perform nesting bird surveys. If vegetation and tree removal is done outside the nesting season no surveys are required.
Western Pond Turtle	(SPA2) As required by PLAC's
Sanford's Arrowhead	(SPA2) As required by PLAC's
Elderberry Shrubs	(SPA1 & SPA2) Install high visibility fence (type ESA) around all elderberry shrubs shown on plans.
Giant Garter Snake (GGS)	(SPA2) 1. When feasible, avoid construction activities within 200 feet from the banks of GGS aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance. 2. Construction activity within habitat should be conducted between May 1 and October. This is the active period for GGS and direct mortality is lessened, because snakes are expected to be actively move and avoid danger. Between October 2 and April 30 contact the Service's Sacramento Fish and Wildlife office to determine if additional measures are necessary to minimize and avoid take 3. Confine clearing to minimal area necessary to

	facilitate construction activities. Flag and designate avoided GGS habitat within or adjacent to the project area as ESAs. These areas should be avoided by all construction personnel 4. 24-hours prior to construction activities, the ESL will be surveyed for GGS. Surveys of the ESL will be repeated if a lapse in construction activity of two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. Report any sightings and any incidental take to the U.S. Fish and Wildlife Service immediately by telephone at 916-414-6600 5. Any dewatered habitat should remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat

Replace the 2nd paragraph of section 14-6.03B with:

The Department anticipates nesting or attempted nesting by migratory and nongame birds from February 1 to September 30.

Replace the 2nd and 3rd paragraphs of section 14-6.03D(1) with:

The Contractor-supplied biologist must implement monitoring and reporting requirements described in the natural resources protection plan.

Add to section 14-6.03D(1):

A Contractor-supplied biologist who performs specialized activities must have demonstrated field experience working with the regulated species or performing the specialized task. The biologist must have experience that complies with the requirements shown in the following table:

Specialized activity/species	Requirements
Nesting Surveys, monitoring and excluding birds	Must have at least 2 years' experience.
Western Pond Turtle surveys	Must have at least 2 years' experience.
botanical surveys	Must have a degree in Botany or at least 5 years' experience in botanical surveys.
Installation of water diversion/Fresh water fish species	Must be able to identify fresh water fish species. Must have Fisheries degree or at least 5 years' experience of fish identification.
Giant Garter Snake Surveys	Must have at least 3 years' experience doing Giant Garter Snake surveys.

As required by PLAC's before starting job site activities, submit protocols for species protection surveys. Use protocols required in the PLACs.

Survey the job site for regulated species and submit a preconstruction survey report as required by PLAC's before starting work.

The preconstruction survey report must include one of the following:

1. Detailed observations and locations where regulated species were observed
2. Statement that no regulated species were observed

Submit monitoring reports according to the following schedule:

Monitoring type	Report schedule
Nesting bird surveys	At least 3 days after performed survey

Submit a biological resource incident report within 12 hours of the incident.

The incident report must include:

1. Description of any take of regulated species or any violation of a biological resource PLAC
2. Species name and number taken
3. Details of required notifications with contact information
4. Corrective actions proposed or taken
5. Disposition of taken species

Submit an annual monitoring report no later than January 15 during each year of construction.

The annual monitoring report must include:

1. Start and end dates of construction
2. Project impacts on the regulated species
3. Species protection measures and implementation details
4. Incidental take details, including species name, number taken, people contacted, contact information, and disposition of taken species
5. Assessment of the effectiveness of the species protection measures in mitigating project impacts
6. Recommendations for improving species protection measures

Submit a final monitoring report no later than 20 days after completion of the project. If the report requires revisions, the Department provides comments. Submit a revised report within 7 days of receiving comments. The final monitoring report must be a cumulative report including:

1. Start and end dates of construction
2. Project impacts on the regulated species
3. Species protection measures and implementation details
4. Incidental take details, including species name, number taken, people contacted, contact information, and disposition of taken species
5. Assessment of the effectiveness of the species protection measures in mitigating project impacts
6. Recommendations for improving species protection measures

Add after the 1st sentence of the 3rd paragraph of section 14-6.03D(2):

Allow 15 days for review.

Replace section 14-6.06 with:

14-6.06 BIRD EXCLUSION DEVICES

14-6.06A General

14-6.06A(1) Summary

Section 14-6.06 includes specifications for installing bird exclusion devices on bridges to prevent nesting of migratory birds or nongame birds.

Remove nests and install bird exclusion devices during the non-nesting season from October 1 to January 31. Do not allow nest materials to fall into public roadways, rivers, streams, or drainage systems.

14-6.06A(2) Definitions

Not Used

14-6.06A(3) Submittals

Submit a bird exclusion plan 20 days before starting work at the jobsite.

The bird exclusion plan must include:

1. Title Sheet
2. Table of Contents
3. Description of exclusion devices to be used
4. Location and schedule for installation, monitoring, maintenance, and removal of the exclusion devices
5. Removal and disposal methods for partially constructed and unoccupied nests

14-6.06A(4) Quality Assurance

Not Used

14-6.06B Materials

Bird exclusion devices must be one or a combination of the following materials:

1. Plastic sheeting that is thick enough to withstand the elements
2. Weather-resistant polypropylene netting with 0.25-inch or smaller openings
3. Metal mesh or galvanized hardware cloth with opening of 0.05-inch or smaller
4. Bird wire system
5. Other materials approved by the Department

14-6.06C Construction

Install bird exclusion devices at the following bridges:

Bridge Name	Bridge Number	County-Route-Post Mile
Beach Lake Bridge	# 24 0262L	SAC-5-PM 12.92
Beach Lake Bridge	#24 0262R	SAC-5-PM 12.93

Install exclusion devices to the underside of the bridge, including exterior girders, so that bird access is completely blocked. The contractor-supplied biologist or Department biologist must be present during installation.

Remove bird waste or debris from the contact surface of the bridge before installing the exclusion devices.

Monitor the devices daily for effectiveness. Maintain and immediately repair defective devices.

Remove and dispose of bird exclusion devices when they are no longer needed for the work.

14-6.06D Payment

Not Used

Replace *Reserved* in section 14-7.04 with:

Section 14-7.04 includes specifications for coordinating and working with a paleontological resources mitigation team provided by the Department.

The Department performs paleontological resources mitigation during construction activities involving subsurface disturbance under Pub Res Code § 5097.5 and the California Environmental Quality Act (CEQA). Do not start subsurface-disturbing activities until the paleontological mitigation team, consisting of a principal paleontologist and paleontological monitors, is present at the job site.

Fossils within or excavated from the highway remain the property of the Department.

Submit a schedule of subsurface-disturbing activities at least 15 days before starting job site activities. Submit an updated schedule at least 3 business days before implementing any changes.

Attend a preconstruction meeting with the paleontological resources mitigation team and the Engineer to establish procedures for coordination, cooperation, and worker safety during mitigation activities.

Within the project limits, do not perform subsurface-disturbing activities unless authorized. Notify the Engineer 15 days before starting subsurface-disturbing activities.

The paleontological mitigation team monitors and salvages fossils discovered during excavation.

The Engineer may order you to:

1. Divert or stop construction activities in the vicinity of fossils
2. Avoid disturbing an area pending the removal of fossils
3. Perform additional excavation
4. Modify an excavation to facilitate in-place stabilization of fossils by the mitigation team

Additional excavation and modification of an excavation to facilitate in-place stabilization of fossils if ordered are change order work.

Add to the end of section 14-9.02:

The US EPA has established the National Emission Standards for Hazardous Air Pollutants (NESHAP). Under the Health & Safety Code § 39658(b)(1), your demolition and rehabilitation activities must comply with 40 CFR 61, Subpart M (National Emission Standard for Asbestos).

The asbestos survey and sampling report for this project is included in the *Information Handout*.

If you discover unanticipated asbestos-containing material during the demolition or rehabilitation activities, immediately stop work in that area and notify the Engineer. The Department will use other forces to remove and dispose of the material. Do not resume work in the area until authorized.

Notify the SMAQMD of a change to your demolition or rehabilitation activities, including a revised work plan or the discovery of unanticipated asbestos-containing materials, within 2 days of the change or discovery.

Add to the list in the 2nd paragraph of section 14-11.08A:

9. RWQCB, Region 5 - Central Valley
10. Sacramento Metropolitan Air Quality Management District (SMAQMD)

Add to the end of section 14-11.08A:

Hazardous waste concentrations of ADL are present within the project limits from post mile (PM) 24.01 to PM 24.71. Management of this material exposes workers to health hazards that must be addressed in a lead compliance plan.

Add to section 14-11.08C:

Type Z-2 material exists between post mile (PM) 24.01 and PM 24.71 and from a depth of 0 to 1.5 feet below existing grade as shown.

Replace the 1st paragraph of section 14-11.08D(2) with:

Within 15 days of Contract approval, submit 3 copies of an excavation and transportation plan for material containing hazardous waste concentrations of ADL. Allow 8 days for review.

Add after the 2nd paragraph of section 14-11.08D(2):

The excavation and transportation plan must include:

1. Procedures for excavating, stockpiling, transporting, placing and disposing of the material
2. Excavation schedule by location and date
3. Locations for temporary stockpiles if stockpiling is ordered
4. Dust control measures
5. Transportation equipment and routes
6. Method for preventing spills and tracked material onto public roads
7. Truck waiting and staging areas
8. Name and address of the hazardous waste disposal facility
9. Spill contingency plan for material containing ADL

Replace *Reserved* in section 14-11.08G with:

Transport excavated Type Z-2 material using:

1. Hazardous waste manifest
2. Hazardous waste transporter with current DTSC registration certificate and CA Highway Patrol (CHP) Basic Inspection of Terminals (BIT) Program compliance documentation with a satisfactory rating.

Add to section 14-11.08J:

Analyze surplus excavated material for which the lead content is unknown before removing it from the job site. The analysis must be performed by a laboratory certified by the SWRCB ELAP. Submit a sampling and analysis plan and the name of the laboratory at least 15 days before beginning sampling and analysis. Sample at a minimum rate of 2 samples for each 200 cu yd of surplus material and test for lead using US EPA Method 6010B or 7000 series. Sampling, analyses, and reporting of results for surplus material not previously sampled is change order work.

Add to the 1st paragraph of section 14-11.14A:

Wood removed from roadside signs and guardrail is treated wood waste.

Replace "Reserved" in section 14-11.15 with:

14-11.15A General

Section 14-11.15 includes specifications for disposing of electrical equipment containing hazardous materials.

14-11.15B Submittals

14-11.15B(1) General

Not Used

14-11.15B(2) Identification of Disposal Facilities

Thirty days before starting work submit the name and address of the appropriately permitted facilities where universal wastes will be taken to dispose of them.

14-11.15C Waste Management

14-11.15C(1) Universal Waste

Batteries as described in 22 CA Code Regs § 66273.2, light bulbs, mercury lamps, and fluorescent tubes, bulbs, and lamps are universal waste. Manage universal waste under 22 CA Code Regs § 66261.9.

Transport batteries, light bulbs, mercury lamps and fluorescent tubes, bulbs, and lamps to an appropriately permitted recycling or disposal facility.

Vehicle sensor nodes (VSN) contain lithium thionyl chloride (LTC) batteries. Thionyl chloride is designated as an extremely hazardous waste under 22 CA Code of Regs, Div 4.5, Ch 11, Art 5, App 10. Each VSN includes 1 integral LTC battery.

Package removed VSNs containing undamaged LTC batteries and place the packages in US DOT approved sealed shipping containers. Transport the containers to a recycling or disposal facility. Notify the receiving facility 48 hours before delivery. Affix a label to containers of intact VSNs identifying the contents as "Universal Waste: Lithium Thionyl Chloride Batteries."

Ship VSN batteries that are separated from a VSN to a recycling or disposal facility under 49 CFR 173.185. Package the batteries such that contact between them and resulting short circuits are avoided. Prevent accidental contact between batteries by:

1. Covering terminal ends to prevent them from touching each other
2. Placing batteries in a sealed plastic bag packed with loose fill, such as vermiculite

The outer packaging must comply with 49 CFR 173.24 and 173.24a. Transport LTC batteries to an approved hazardous waste recycling or disposal facility. For a partial list of facilities, go to:

http://www.dtsc.ca.gov/HazardousWaste/upload/LIST_HWM_Commercial_Facilities.pdf

or

http://www.calrecycle.ca.gov/Electronics/Recovery/Approved/Default.htm

14-11.15C(2) Fluorescent Light Ballasts Containing PCBs

Not Used

14-11.15D Damaged Electrical Equipment

Damaged electrical equipment containing thionyl chloride is designated as extremely hazardous waste.

Electrical equipment containing thionyl chloride found damaged is a Department-generated hazardous waste. Use a hazardous waste manifest to transport this damaged equipment to an appropriately permitted disposal facility. Management of Department-generated hazardous waste is change order work.

You are the generator of hazardous waste produced by damage of electrical equipment through your own mishandling. You are responsible for cleanup, management, and disposal of this hazardous waste and the associated costs for this work.

Replace section 14-11.17 with:

14–11.17 ASBESTOS-CONTAINING MATERIALS

14-11.17A General

Section 14-11.17 includes specifications for removing and managing asbestos-containing material (ACM).

This project involves the removal and management of ACM.

The removal and management of asbestos must comply with:

1. Health and Safety Code Div 20 Ch 6.5, Hazardous Waste Control
2. 8 CA Code of Regs § 5208
3. 8 CA Code of Regs §§ 1529 and 341.6–341.17
4. 22 CA Code of Regs Div 4.5
5. 29 CFR 1926
6. 40 CFR 61 Subpart M
7. Bus & Prof Code §§ 7058.5–7058.6, 7180-7189.7, and 7028.1

14-11.17B Definitions

asbestos: Any of several minerals that readily separate into long flexible fibers. Includes chrysotile, amosite, crocidolite, tremolite, anthrophyllite, actinolite, and any of these minerals that has been chemically treated, altered, or both.

asbestos-containing material (ACM): Building material, including asbestos cement pipe, containing more than 1 percent asbestos by weight, area, or count under 40 CFR §61.145.

certified asbestos consultant (CAC): Asbestos consultant certified by Cal/OSHA under 8 CA Code of Regs § 341.15 and § 1529. A certified asbestos consultant must be registered under Labor Code § 6501.5 and certified under Bus & Prof Code § 7058.6.

friable ACM: Material containing more than 1 percent asbestos, as determined by polarized light microscopy, that can be crumbled, pulverized, or reduced to powder by hand pressure when dry under 22 CCR § 66261.24.

nonfriable ACM: Material containing more than 1 percent asbestos by area with asbestos fibers that:

1. Are tightly bound into the matrix of the material
2. Should not become an airborne hazard as long as the material remains intact and undamaged and is not sawed, sanded, drilled, or otherwise abraded during removal

nonhazardous asbestos waste: Material with an asbestos concentration less than 1 percent or nonfriable ACM. These wastes are not hazardous wastes under 22 CA Code of Regs.

14-11.17C Site Conditions

Asbestos cement pipes ranging from 6 to 36 inches in diameter and from 8 to 266 feet long exist as shown on drainage plan sheets. The asbestos cement pipes are nonfriable ACM. Assume the asbestos cement pipe contains greater than 1 percent asbestos.

Unanticipated friable ACM discovered and generated as part of this project is a Department-generated hazardous waste under section 14-11.07.

14-11.17D Submittals

14-11.17D(1) General

Not Used

14-11.17D(2) Asbestos Compliance Plan

Submit an asbestos compliance plan for preventing or minimizing workers' exposure to asbestos during removal and management of ACM. Submit the plan at least 15 days before starting ACM removal. The plan must be prepared and signed and sealed by a CIH with experience and knowledge of asbestos removal work and include:

1. Identification of key personnel for the project
2. Scope of work and equipment to be used
3. Job hazard analysis for work assignments
4. Summary of risk assessment
5. Description of personal protective equipment
6. Delineation of work zones at the job site
7. Decontamination procedures
8. General safe work practices
9. Security measures
10. Emergency response plans
11. Safety training program

14-11.17D(3) Asbestos Removal Work Plan

Submit a work plan for the removal and management of asbestos 15 days before ACM removal. The work plan must be prepared and signed and sealed by a CAC and include:

1. Name of the CAC who will direct the removal, storage, transportation, and disposal of ACM.
2. Locations at the perimeters of abatement work areas where asbestos warning signs will be installed.
3. Summary of the methods and techniques for removal, handling, packaging, labeling, storing, transporting, and disposing of waste materials.
4. Instructions for wetting asbestos materials with sprayers.
5. Description and locations of disposal bins for temporary storage of asbestos until removal from the job site.

6. Name and address of the hazardous waste transporter that will transport friable ACM. The transporter must be registered with the DTSC to transport hazardous waste under the Health and Safety Code Div 20 Ch 6.5 and 22 CA Code of Regs Div 4.5.
7. Name and address of the California disposal facility permitted by the Regional Water Quality Control Board for the disposal of ACM that will accept the ACM.
8. Documentation of compliance with federal, State, and local requirements for asbestos removal, storage, transport, and disposal.

14-11.17D(4) Certification of Completed Safety Training

Submit certification of completed safety training for all personnel before starting work in areas containing or suspected to contain asbestos.

14-11.17D(5) Asbestos Removal Report

Submit an asbestos removal report documenting your compliance with the asbestos removal work plan.

14-11.17D(6) Disposal Documentation

Submit a copy of the hazardous waste manifest for each shipment of friable ACM. Submit a copy of the waste shipment record for each shipment of nonhazardous asbestos waste.

Within 5 business days of transporting friable ACM or nonhazardous asbestos waste, submit documentation of proper disposal from the receiving disposal facility.

14-11.17E Health and Safety

Before starting work in areas containing or suspected to contain asbestos, provide safety training complying with 8 CA Code of Regs § 1529 to State employees who may enter the work area.

Provide training, personal protective equipment, and medical surveillance as required by the asbestos compliance plan for 2 State employees.

14-11.17F Discovery of Unanticipated Asbestos

If you discover unanticipated asbestos, immediately stop work in the area and notify the Engineer.

14-11.17G Removal of Asbestos

Remove asbestos under 8 CA Code of Regs § 1529 and 341 et seq. Prevent airborne emissions from asbestos removal activities. Remove friable asbestos using the wetting method. Remove and handle nonfriable asbestos such that you prevent breakage.

Mark the regulated work areas with warning signs that read, *Danger, Asbestos, Cancer and Lung Disease Hazard, Authorized Personnel Only.* The message must be legible from a distance of 20 feet by persons with 20/20 vision or vision corrected to 20/20.

14-11.17H Packaging and Temporary Storage of Asbestos-Containing Material

Package and label removed ACM under 22 CA Code of Regs § 66262.30 et seq. Place the removed ACM in minimum, 0.006-inch-thick, double-ply, plastic bags with clearly visible and legible labels affixed to the bags. The labels must read, *Danger/ Contains Asbestos Fibers/ Avoid Creating Dust/ Cancer and Lung Disease Hazard.* Wet the waste before placing it in the plastic bag to prevent asbestos fibers from becoming airborne if the bag is broken.

Do not break apart bulk waste that will not fit inside a plastic bag. Instead, wet the waste, wrap it in plastic, and seal it with packaging or duct tape until it is leak-proof. Place the wrapped and sealed ACM directly into a covered, lockable, roll-off or drop box lined with plastic sheeting and labeled on all sides. The labels must be legible and read, *Danger/ Contains Asbestos Fibers/ Avoid Creating Dust/ Cancer and Lung Disease Hazard.*

14-11.17I Transport and Disposal of ACM

14-11.17I(1) General

Dispose of ACM at a California disposal facility operating under a RWQCB permit to accept asbestos waste. Notify the facility at least 5 business days before the delivery of ACM.

14-11.17I(2) Friable Asbestos-Containing Material

Transport and dispose of friable ACM as a hazardous waste. The Engineer provides the Department's EPA Identification Number for hazardous waste disposal. The Engineer signs the hazardous waste manifests. Notify the Engineer 5 business days before the manifests are to be signed.

Use a transporter for friable ACM with:

1. Current DTSC registration for transporting hazardous waste
2. US EPA Identification number
3. Proof of completion of the California Highway Patrol's Basic Inspection of Terminals Program with a satisfactory rating

The transporter's vehicles must carry a valid DTSC registration when transporting friable ACM.

14-11.17I(3) Nonhazardous Asbestos Waste

Transport nonhazardous asbestos waste to the disposal facility with a waste shipment record.

Replace section 14-11.18 with:

14-11.18 MANAGEMENT OF EQUIPMENT PAINTED WITH LEAD BASED PAINT

14-11.18A General

Section 14-11.18 includes specifications for managing equipment painted with lead based paint during equipment replacement.

Remove, package, store, transport, and dispose of lead-containing equipment and debris when equipment with lead based paint is disturbed under all applicable federal, State, and local laws and regulations. Laws and regulations that govern this work include:

1. Health and Safety Code, Division 20, Chapter 6.5 (California Hazardous Waste Control Act).
2. 22 CA Code of Regs, Div 4.5, (Environmental Health Standards for the Management of Hazardous Waste)
3. 8 CA Code of Regs section 1532.1
4. 17 CA Code of Regs, Division 1, Chapter 8

Management of lead based paint exposes workers to health hazards that must be addressed in your lead compliance plan. Lead based paint produces toxic fumes when heated.

14-11.18B Site Conditions

Lead based paint is present on storm-water pumping plant components (controls, pipes and "wet pit" areas) located as shown on the "Index of sheets and pumping plant data" – sheet GI-1. Pumping plant locations are:

1. 56th Avenue
2. Richards Blvd.
3. South Connector UC
4. South Land Park Drive
5. Woodshire Way

Lead concentrations in the equipment paint exceeds the California hazardous waste threshold for lead of 1,000 mg/kg and is estimated to be 2,300 mg/kg.

14-11.18C Submittals

14-11.18C(1) General

Reserved

14-11.18C(2) Removal Work Plan

Submit a work plan for the removal, storage, transportation and disposal of lead based paint debris and equipment painted with lead based paint. The work plan must include:

1. Installing warning signs at perimeters of abatement work areas
2. Containerizing, labeling and temporary storage methods for hazardous waste
3. Providing hazardous waste manifests for disposal upon completion for the Engineer to sign
4. Providing transporters registered with the DTSC to transport hazardous waste to a Ca Class I permitted disposal facility
5. Performing a lead waste analysis for equipment with intact well adhered lead paint to determine appropriate and legal disposal
5. Disposing of equipment with intact well adhered lead paint at a disposal facility permitted to receive it by the California Environmental Protection Agency
6. Compliance with federal, state, and local requirements for lead-related construction work, and transport and disposal of lead paint and materials painted with lead paint

Allow 5 business days for the Engineer to review and authorize the work plan. Make any changes requested for acceptance within business 5 days. Submit 4 copies of the final work plan.

14-11.18C(3) Safety Training Certification

Submit a written certification of completion of safety training to the Engineer for all personnel before performing any work in areas containing lead paint.

14-11.18D Health and Safety

Supply medical surveillance required under your lead compliance plan to 5 State employees.

14-11.18E Deteriorated Lead Paint Removal

14-11.18E(1) General

Remove deteriorated, flaking, or peeling paint containing hazardous waste concentrations of lead from all surfaces on and around the equipment before removing equipment. Manage the generated paint waste under 14-11.07.

14-11.18E(2) Paint Waste Characterization

Perform waste characterization testing on the paint debris removed from deteriorated, flaking or peeling surfaces and the surrounding area as required by the receiving disposal facility, including:

1. Total lead by US EPA Method 6010B
2. Soluble lead by CA Waste Extraction Test (CA WET)
3. Soluble lead by Toxicity Characteristic Leaching Procedure (TCLP)

From the first 220 gal of hazardous waste or portion thereof, if less than 220 gal of hazardous waste are produced, a minimum of 4 randomly selected samples must be taken and analyzed individually. Samples must not be composited. From each additional 880 gal of hazardous waste or portion thereof, if less than 880 gal are produced, a minimum of 1 additional random sample must be taken and analyzed.

Use chain-of-custody procedures consistent with chapter 9 of US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) while transporting samples from the job site to the analytical laboratory. The laboratory must be certified by the California Department of Public Health's Environmental Laboratory Accreditation Program for all analyses to be performed.

Before performing the analyses, the laboratory must homogenize each sample. The homogenization process must not include grinding of the samples. A sample aliquot must be:

1. Obtained in an amount large enough for all analyses to be performed
2. Homogenized a 2nd time
3. Used for the total and soluble analyses after the 2nd homogenization

14-11.18F Equipment With Intact Well Adhered Lead Paint

14-11.18F(1) General

Manage equipment with intact well adhered lead paint under all applicable regulations. Apply the most stringent requirements if there is a conflict or overlap of requirements.

Perform a waste analysis for lead on equipment with intact well adhered lead paint to determine whether the equipment is a hazardous waste under 22 CA Code of Regs, Div 4.5 before disposal.

14-11.18F(2) Nonhazardous Lead Containing Equipment

If the results of the waste analysis demonstrate that the equipment contains lead below hazardous waste concentrations and the Engineer authorizes the results, dispose of the equipment at an appropriately permitted CA Class II or CA Class III disposal facility or a recycling facility.

14-11.18F(3) Hazardous Waste Lead Containing Equipment

If the results of the waste analysis demonstrate that the lead containing equipment is a hazardous waste, manage the equipment under 14-11.07.

14-11.18G Transportation and Disposal

Make arrangements with the operator of the disposal facilities or recycling facility and perform any additional testing required by the operator.

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15 EXISTING FACILITIES

Add to the end of section 15-1.03C:

At least 2 business days before hauling the pumping plant material to the salvaged material stockpile location, notify the Engineer and inform the district recycle coordinator at telephone no. (916) 798-4698.

The pumping plant salvage material to be stockpiled is as follows:

Location	Material
56th Avenue Pumping Plant	2 pump motors and 2 pump columns/shafts
Richards Blvd Pumping Plant	2 pump motors and 2 pumps
East Connector Pumping Plant	2 submersible pumps with power cables
South Land Park Pumping Plant	2 pump motors and 2 pump columns/shafts
Woodshire Way Pumping Plant	2 pump motors and 2 pumps

The pumping plant salvage stockpile location is:

Richard Hernandez
11325 Sanders Drive
Rancho Cordova, CA 95742

Add to the end of section 15-1.03C:

At least 2 business days before hauling the electrical material to the salvaged material stockpile location, notify the Engineer and inform the district recycle coordinator at telephone no. (916) 859-7807.

The electrical stockpile location is:

Sunrise Electrical Maintenance Shop
11325 Sanders Drive
Rancho Cordova, CA 95742

^^^

The payment quantity for structure backfill (bridge) includes permeable material (bridge) at Bridge Route 5/160 separation and overhead (br. no 24-0296).

The payment quantity for structure backfill (retaining wall) includes subgrade enhancement geotextile below structure backfill at Bridge Southbound Wall at Land Park UP (br. no. 24E0018).

Add to section 19-7.02A:

Obtaining imported borrow includes the following:

1. Constructing an access road as shown.
2. Clearing and grubbing the material site.
3. Selecting material within the source.
4. Screening and wasting from 30 to 60 percent of the finer material.
5. Washing materials so that the imported borrow complies with the sand equivalent requirements.

Replace the 1st paragraph of section 19-9.03 with:

Do not place shoulder backing material containing RAP, reclaimed asphalt concrete, concrete, LCB, or CTB within 150 feet from a culvert, watercourse, waterway or bridge.

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21 EROSION CONTROL

Add to section 21-2.02H:

Straw must be certified weed free under the Department of Food and Agriculture.

Replace *biodegradable jute, sisal, or coir fiber* in the 1st paragraph of section 21-2.02P with:

photodegradable plastic

Add to section 21-2.02P:

Straw for fiber roll must be certified weed free under the Department of Food and Agriculture.

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28 CONCRETE BASES

Replace *Reserved* in section 28-15.02 with:

28-15.02A GENERAL

Section 28-15.02 includes specifications for replacing bases.

Section 15 does not apply to removing base.

RSC base must comply with section 28-3.

Lean concrete base rapid setting must comply with section 28-4.

28-15.02B MATERIALS

Base must be one of the following:

1. RSC base
2. Lean concrete base rapid setting

28-15.02C CONSTRUCTION

Do not remove the existing base with the overlying pavement. Remove only the portion that can be replaced during the same lane closure. If you fail to complete the replacement during the same lane closure, construct a temporary pavement structure under section 41-1.

The dimensions shown for replacing base are approximate. After you remove the overlying pavement, the Engineer determines the exact dimensions for replacing base. Obtain verbal authorization before saw cutting existing base.

Before removing existing base, saw-cut the outline of the base removal area using a power-driven saw. Cut on a neat line that is perpendicular to the pavement surface. Cut at least 2 inches deep except if the existing base is either CTB or any type of concrete base, cut full-depth.

Removal methods must not damage the existing base remaining in place. Do not impact existing base within 18 inches horizontally of the existing base to remain in place.

After removing existing base, grade the remaining underlying material under section 19-1.03C and compact it under section 19-5.03A.

If you remove material below the authorized depth, fill these areas by placing additional base material in the same operation as placing the new base at your expense.

28-15.02D PAYMENT

Not Used

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36-4.02 MATERIALS

Not Used

36-4.03 CONSTRUCTION

The residue from grinding or cold planing contains lead from paint and thermoplastic. The average lead concentrations are less than 1,000 mg/kg total lead and 5 mg/L soluble lead. This residue:

1. Is a nonhazardous waste
2. Does not contain heavy metals in concentrations that exceed thresholds established by the Health and Safety Code and 22 CA Code of Regs
3. Is not regulated by the Federal Resource Conservation and Recovery Act, 42 USC § 6901 et seq.

Management of this material exposes workers to health hazards that must be addressed in your lead compliance plan.

36-4.04 PAYMENT

Not Used

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37 BITUMINOUS SEALS

Add to section 37:

37-7 HIGH FRICTION SURFACE TREATMENT

37-7.01 GENERAL

37-7.01A Summary

Section 37-7 includes specifications for applying high friction surface treatment (HFST).

Applying HFST consists of spreading resin binder and calcined bauxite aggregate on asphalt concrete, polyester concrete, or concrete surfaces.

HFST shall be applied by a truck mounted machine, or may be applied by either hand on areas less than 200 square yards. The Department is aware of at least one automated continuous application method and equipment that is allegedly covered by United States Patents 9,109,332 and 9,115,473.

37-7.01B Definitions

batch: a specific quantity of material of homogenous composition that can be unambiguously identified, manufactured in a single operation or a series of operations according to a well-defined process.

resin binder: a modified epoxy or polyester resin binder used to bond a surface applied aggregate to an asphalt or concrete surface.

prime coat: a resin that is used to fill cracks and voids in existing surface that is compatible with resin binder.

37-7.01C Submittals

37-7.01C(1) General

Submit the names of your proposed independent laboratories that will perform QC testing.

Submit a certificate of compliance and certified test results for the resin binder and calcined bauxite aggregate. Test results must be from tests performed within 90 days from the date of submittal and must have been performed by an independent laboratory.

Submit a SDS for the resin binder and its components.

37-7.01C(2) Quality Control Plan

Submit a QC plan that must be project specific and includes:

1. Surface preparation methods for areas where HFST is to be placed
2. Method of protecting areas and exposed facilities not to receive HFST
3. Method of protecting and reestablishing existing longitudinal and transverse joints and working cracks in concrete pavements and structures
4. Type of resin binder to be used
5. Resin binder manufacturer's recommended mixing and placement instructions, including mixing ratios and temperatures
6. Resin binder manufacturer's estimated cure times for resin binder to be used
7. Method for safe storage and handling of HFST components
8. Disposal methods for excess HFST and containers for HFST components
9. Contingency plan that describes corrective actions you will take in the event of equipment failure or material issues during HFST placement

Submit QC test results for the quality characteristics within the reporting time allowance, after sampling, shown in the following table:

Quality Control Test Result Reporting

Quality characteristic	Test Method	Maximum reporting time allowance
Los Angeles rattler loss at 100 revolutions	California Test 211	2 business Days
Aggregate moisture content	California Test 226	2 business Days
Aggregate magnesium soundness	ASTM C88	7 Days
Aluminum oxide content	ASTM C25	5 Days
Gradation	California Test 202	1 business Day
Polish stone value	ASTM D3319	7 Days
Aggregate acid insolubility	ASTM D3042	7 Days
Resin binder spread rate	Calculated based on amount of materials used	1 business Day
Viscosity	ASTM D2196	2 business Days
Elongation at break point	ASTM D638	2 business Days
Ultimate tensile strength	ASTM D638	2 business Days
Cure rate	ASTM D1640	1 business Day
Gel time	ASTM C881	1 business Day
Adhesive strength at 24 hours	ASTM C1583	2 business Days
Coefficient of friction before opening to traffic	ASTM E1911	Same day of testing and before opening to traffic
Coefficient of friction 7-15 days after opening to traffic	ASTM E1911	1 business Day after testing

37-7.01D Quality Assurance

37-7.01D(1) General

Not Used

37-7.01D(2) Preconstruction Meeting

Schedule a preconstruction meeting with the engineer at a mutually agreed time and place. Make the arrangements for the meeting facility. Before the start of the trial HFST, hold the meeting with the Engineer and your (or applicable personnel):

1. Project Manager
2. QC Manager
3. Project Superintendent
4. Project Foreman
5. Traffic Control Foreman

6. Subcontractors' foreman
7. Resin supplier technical representative

Meeting attendees must sign an attendance sheet provided by the Engineer. The Engineer retains the attendance sheet.

Discuss the project specifications and the processes for producing materials and constructing each item of work, including:

1. Quality assurance
   - 1.1 QC plan
   - 1.2 Quality control
   - 1.3 Acceptance criteria
2. Placement of materials:
   - 2.1 Trial HFST requirements
   - 2.2 Application rates
   - 2.3 Binder resin mixing methods and equipment
   - 2.4 HFST application methods and equipment
3. Contingency plan
4. Issues specific to the project, including:
   - 4.1 Weather
   - 4.2 Alignment and geometrics
   - 4.3 Traffic control issues

Do not place trial HFST, or start production work until the listed personnel have attended the meeting,

37-7.01D(3) Quality Control

37-7.01D(3)(a) General

Perform QC testing for trial HFST and production work. QC testing except coefficient of friction testing must be performed by independent laboratories.

37-7.01D(3)(b) HFST

Perform sampling and testing at the specified frequency and sampling location for the following quality characteristics:

Calcined Bauxite Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of Sampling
Los Angeles rattler loss at 100 revolutions	California Test 211	1st day of production	Point of application or stockpile
Aggregate moisture content	California Test 226	1 per shift	Point of application or stockpile
Aluminum oxide content	ASTM C25	1st day of production	Point of application or stockpile
Gradation	California Test 202	1st day of production	Point of application or stockpile

Resin Binder Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of Sampling
Viscosity	ASTM D2196	1 per batch	Point of application
Elongation at break point	ASTM D638	1 per batch	Point of application
Ultimate tensile strength	ASTM D638	1 per batch	Point of application
Cure rate	ASTM D1640	1 per batch	Point of application
Gel time	ASTM C881	1 per batch	Point of application
Adhesive strength at 24 hours	ASTM C1583	1 per batch	Point of application

HFST Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of Sampling
Resin binder spread rate	Calculated based on amount of materials used	1 per Day	Point of application
Coefficient of friction before opening to traffic	ASTM E1911	Minimum of 1 every 500 ft[a]	Alternate between wheel paths
Coefficient of friction 7-15 days after opening to traffic	ASTM E1911	Minimum of 1 every 500 ft[a]	Alternate between wheel paths

[a]For application lengths <500 ft, test at every 200 ft interval

37-7.01D(4) Department Acceptance

The Department accepts HFST based on:

1. Visual inspection for the following:
   1.1. Uniform surface texture
   1.2. Raveling, which consists of the separation of the aggregate from the resin binder
   1.3. Streaking, which consists of alternating longitudinal bands of resin binder without uniform calcined bauxite aggregate retention, approximately parallel with the lane line
   1.4. Flushing, which consists of resin binder without or fully embedded calcined bauxite aggregate

Areas of raveling, streaking and flushing that are greater than 0.25 sq ft shall be considered defective and must be repaired at your own cost. These must be removed and replaced, and must confirm to the maximum lateral dimensions of the defective area.

2. The Department's sampling and testing of calcined bauxite aggregate for compliance with the requirements shown in the following table:

Calcined Bauxite Aggregate Acceptance Criteria

Quality characteristic	Test method	Requirement
Los Angeles rattler loss at 100 revolutions[a] (max, %)	California Test 211	10
Aggregate moisture content (max, %)	California Test 226	0.2
Sand equivalent (min)	California Test 217	95
Gradation (% passing by weight) Sieve size: No. 4(min) No. 6(min) No. 16(max)	California Test 202	 100 95 5

[a]Use grading D from Table 1.

3. The Department's sampling and testing of resin binder for compliance with the requirements shown in the following table:

Resin Binder Acceptance Criteria

Quality characteristic	Test method	Requirement
Viscosity (centipoise) no. 2 spindle, 10 RPM	ASTM D2196	1,000 - 3,000
Cure rate (max, hrs) Specimen, 0.05 inch thick, Method A, Dry-Through Time	ASTM D1640	3
Gel time (minutes)	ASTM C881	10-30
Elongation at break point (min, %) Type I specimen,	ASTM D638	30
Ultimate tensile strength (min, psi) Type I specimen,	ASTM D638	2,650
Adhesive strength (psi)	ASTM C1583	250 or 100% substrate failure

4. The Department's sampling and testing for HFST for compliance with the requirements shown in the following table:

HFST Acceptance Criteria

Quality Characteristic	Test Method	Requirement
Coefficient of friction at 60 km/h before opening to traffic	ASTM E1911	0.75[a]
Coefficient of friction at 60 km/h 7-15 days after opening to traffic	ASTM E1911	0.75[a]

[a] Report coefficient of friction values at 20 km/h, 40 km/h, 80 km/h.

Perform coefficient of friction calibration and testing in the presence of the Engineer. Notify the Engineer at least 48 hours before coefficient of friction testing.

37-7.01D(5) Trial HFST Application

Do not begin trial HFST until authorized.

Complete a trial of HFST application at an authorized location before starting production work. Resin binder manufacturer's representative must be present during the trial application.

Remove pavement markers and delineation within the area to receive HFST, for the lane and length involved, prior to placing the resin binder.

The trial HFST application must:

1. Be at least 12 feet wide and 20 feet long.
2. Be constructed using the same method and equipment as the production work. Construct an additional trial for each method proposed for the production work.
3. Replicate field conditions, including ambient and surface temperatures, anticipated for production work.
4. Demonstrate surface preparation requirements as outlined in the QC plan.
5. Document the area of application, quantities of resin binder and aggregate with a data management system capable of reporting coverage rates and thickness of the resin binder system after applying the HFST. Calculate and report HFST application rate.
6. Determine the initial set time for the resin binder.
7. Test the coefficient of friction using ASTM E1911 at 20 km/h, 40km/h, 60 km/h and 80 km/h on the HFST. If the coefficient of friction at 60 km/h speed is below 0.75, correct or replace the HFST until the coefficient of friction is greater than or equal to 0.75.

37-7.02 MATERIALS

37-7.02A General

Apply a prime coat to concrete or polyester concrete surfaces when polyester resin binder is used.

37-7.02B Prime Coat

Prime coat must be high-molecular-weight methacrylate resin conforming to section 60-3.03B(2) except:

1. Methacrylate resin must be free of wax
2. Tack-free time requirements do not apply
3. Friction testing is not required for the resin prime coat

37-7.02C Resin Binder

Resin binder must meet the requirements shown in the following table:

Resin Binder Requirements

Quality characteristic	Test method	Requirement
Viscosity (centipoises) no. 2 spindle, 10 RPM[b]	ASTM D2196	1,000 - 3,000
Cure rate (max, hrs) Specimen, 0.05 inch thick, Method A, Dry-Through Time	ASTM D1640	3
Gel time (minutes)	ASTM C881	10-30
Elongation at break point (min, %) Type I specimen,	ASTM D638	30
Ultimate tensile strength (min, psi) Type I specimen,	ASTM D638	2,650
Compressive strength (min, psi at 3 hours)	ASTM C579	1,000
Water absorption (max, %)	ASTM D570	1.0
Durometer hardness (Shore D)	ASTM D2240	65-75
Styrene content[a] (% by weight)	ASTM D2369	30-40

[a]For polyester resin binder only. Perform test before adding initiator.

37-7.02D Calcined Bauxite Aggregate

Calcined bauxite aggregate must be clean, dry, and free from clay and any other deleterious matter and meet the requirements shown in the following table:

Calcined Bauxite Aggregate Requirements

Quality characteristic	Test method	Requirement
Los Angeles rattler loss at 100 revolutions[a] (max, %)	California Test 211	10
Aggregate moisture content (max, %)	California Test 226	0.2
Sand equivalent (min)	California Test 217	95
Polish stone value (min)	ASTM D3319	38
Aluminum oxide content (min, %)	ASTM C25	87
Gradation (% passing by weight) Sieve size: No. 4 No. 6 No. 16	California Test 202	 100 95 5

[a]Use grading D from Table 1.

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37-7.03 CONSTRUCTION

37-7.03A General

Do not begin HFST production work until authorized after successful completion of the trial HFST.

37-7.03B Surface Preparation

37-7.03B(1) General

Protect utilities, utility covers, drainage structures, curbs and other structures within or adjacent to treatment location from HFST materials using methods outlined in the QC plan.

Protect existing transverse and longitudinal joints, and working cracks in concrete pavement and structures by taping or other approved method to prevent intrusion of HFST resin and aggregate into the joints and working cracks.

Surfaces must be clean, dry, and free of any dust, oil, debris, organic matter, or any material that may interfere with the bond between resin binder and existing surfaces.

37-7.03B(2) Asphalt Pavement Surfaces

Perform the following before applying resin binder:

1. Remove pavement markers and delineation to a maximum depth of 0.01 foot from the area receiving HFST
2. Sweep the pavement surface
3. Blow the surface clean with pressurized air using a minimum 150 cfm compressor fitted with an air lance
4. Clean cracks greater than 0.25 inch wide with pressurized air and pretreat with mixed resin binder.

37-7.03B(3) Concrete Structures Surfaces

Perform the following activities in the order listed before applying resin binder:

1. Abrasive blast the surface with steel shot
2. Sweep the surface clean
3. Blow the surface clean with pressurized air
4. Pretreat and seal cracks under section 41-3

Steel shot used for abrasive blast must comply with SSPC-AB3 and recycled steel shot must comply with SSPC-AB2. The surface must be dry when abrasive blasting is performed. All laitance, contaminants, paint, markers, foreign material, etc., must be removed from the surface.

If the concrete structures surface becomes contaminated before placing the HFST treatment, abrasive blast clean the contaminated area, sweep and blow the surface clean.

37-7.03C HFST Application

37-7.03C(1) General

Utilize one of the following methods to apply the resin binder and aggregate wearing course, under manufacturer's recommendations:

1. Automated continuous application
2. Hand mixing and application

Application 2 must not be used on areas greater than 200 square yards.

Apply mixed resin binder under resin binder manufacturer's recommendations.

Do not apply resin binder on wet or damp surfaces. Asphalt concrete pavement surface must be greater than 30 days old before applying HFST.

For concrete structures surfaces, if polyester resin binder is the resin binder being used, comply with section for the application of a prime coat of methacrylate resin before placing polyester resin binder. Aggregate requirements in section for polyester concrete overlay do not apply.

Do not apply HFST when the ambient temperature is below 50 degrees F for epoxy type resin binders and 45 degrees F for other resin binders. Do not apply HFST when the ambient temperature is above 100 degrees F.

Spread resin binder at a minimum rate of 0.32 gal/sq yd to one lane width at a time. Narrower application widths are allowed as determined by the engineer.

Do not allow the mixed resin binder to do any of the following that may impair retention and bonding of aggregate:

1. Separate
2. Cure
3. Dry
4. Be exposed
5. Harden

Do not contaminate the exposed uncured mixed resin binder.

Replace contaminated areas of resin binder.

Spread aggregate until refusal within 3 minutes of resin binder application.

Cure HFST for a minimum period recommended by the resin binder supplier. During curing period do not allow vehicles, construction equipment, or foot traffic on the HFST.

HFST that has not completely cured is considered non performing and must be removed and replaced before opening to traffic.

Re-establish existing transverse and longitudinal joints, and working cracks in concrete pavement and structures by sawing or isolating the full depth of HFST, without damaging the joint or crack seal below, before opening to traffic. Match the width and location of the existing joints and working cracks in the concrete pavement within a tolerance of ±1/4 of an inch.

37-7.03C(2) Automated Continuous Application

Automated continuous application must be performed by an approved self-propelled truck-mounted application machine capable of continuously and thoroughly mixing resin binder components to the ratio recommended by the manufacturer (+/- 2 percent by volume). The machine shall include an aggregate drop spreader capable of mechanically and continuously spreading calcined bauxite aggregate.

The applicator vehicle must be equipped with a built-in data management unit which is capable of producing real time data flow showing:

1. The volume of resin
2. The resin mil thickness on average throughout the application width
3. The volume of aggregate applied throughout the application width

The binder must be continuously applied once blended. The application vehicle must be capable of applying the minimum binder spread rate. Clean the mix head and delivery lines if application of the mixed resin is stopped for more than 30 minutes.

The high friction aggregate must be applied by the same automated continuous application vehicle that applies the resin binder to the pavement section. The automatic aggregate spreader must be capable of applying up to a continuous 12-foot width application.

Exposed uncured mixed resin binder must not be visible after the aggregate topping is applied. If exposed uncured mixed resin binder is visible after applying the aggregate topping, apply aggregate topping to the exposed areas using an approved application method.

37-7.03C(4) Hand Mixing and Application

For approved low volume areas and areas less than 200 square yards, hand-mix the resin binder under manufacturer's recommendations. Uniformly spread the resin binder onto the surface using a serrated edge squeegee. Immediately broadcast the high friction surfacing aggregates until refusal.

37-7.03D Excess Aggregate Removal and Reuse

Excess calcined bauxite aggregate must be recovered by a mechanical sweeper and may be reused for HFST. Before reuse of recovered calcined bauxite aggregate, blend with new calcined bauxite aggregate at a rate of 2 to 1 by volume. The recovered calcined bauxite must be clean, dry, and free from clay and any other deleterious material. Provide a record of all recovered calcined bauxite aggregate used and test results. Super sacks or stockpile containing the blended recovered calcined bauxite aggregate must be clearly marked “Recovered Calcined Bauxite Aggregate” and the contract number.

Before opening to public traffic, remove excess and loose aggregate from the traveled way and shoulders by sweeping. HFST must be completely cured before sweeping and there must be no damage or dislodging of aggregate from HFST surface. Perform additional sweeping before placement of pavement markers and delineation.

37-7.04 PAYMENT

Not Used

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39 ASPHALT CONCRETE

Add to list in section 39-2.01A(1) with:

6. HOT MIX ASPHALT (TYPE A) (LONG LIFE)

Replace *Reserved* in section 39-2.02B(3):

The grade of asphalt binder for Type A HMA must be PG 64-16.

Replace the 2nd paragraph in section 39-2.04A(1) with:

Add to section 39-2.04B(3):

For RHMA-O and HMA-O, the grade of asphalt binder must be PG 64-16.

Replace *Reserved* in section 39-2.08 with:

39-2.08 HOT MIX ASPHALT LONG LIFE

39-2.08A GENERAL

39-2.08A(1) Summary

Section 39-2.08 includes specifications for designing, producing and placing Hot Mix Asphalt (Type A) (Long Life) .

Comply with Section 39-2.02, except as follows:

1. In 39-2.02A(4)(b)(iii), in the second paragraph replace the text "±2.00" with "±1.00".
2. In 39-2.02B(2), paragraph 3 does not apply

Section 4-1.07B does not apply.

The minimum production temperature for mix using WMA technology is 300°F.

39-2.08A(2) Abbreviations

Unless context indicates otherwise interpret the meaning of an abbreviation used in the specification and Bid item list as follows:

Hot Mix Asphalt (Type A) (Long Life) as Hot Mix Asphalt - Surface, Long Life and Hot Mix Asphalt - Intermediate, Long Life and Hot Mix Asphalt - Rich Bottom, Long Life

HMA-LL as Hot Mix Asphalt - Surface, Long Life and Hot Mix Asphalt - Intermediate, Long Life and Hot Mix Asphalt - Rich Bottom, Long Life,

HMA-LL, Surface as Hot Mix Asphalt - Surface, Long Life

HMA-LL, Intermediate as Hot Mix Asphalt - Intermediate, Long Life

HMA-LL, Rich as Hot Mix Asphalt - Rich Bottom, Long Life

39-2.08A(3) Submittals

39-2.08A(3)(a) General

Not Used

39-2.08A(3)(b) Job Mix Formula

Comply with Section 39-2.01A(3)(b).

Add to the list in the first paragraph of Section 39-2.01A(3)(b)(i):

5. Test results which demonstrate HMA conforms to the requirements in the table "HMA-LL Requirements Table"
6. At least 1,500 lb of plant-produced loose HMA
7. The virgin (modified or unmodified) asphalt binder content by total weight of the mix
8. The reclaimed asphalt pavement (RAP) binder replacement ratio
9. The bulk specific gravity of each individual aggregate bin

Place items 7, 8, and 9 in the "NOTE" section of the JMF proposal form.

Add to the list in the 4th paragraph of Section 39-2.01A(3)(b)(i):

9. The target RAP binder replacement ratio
10. The average binder content in a new processed RAP stockpile by more than ± 1.00 percent from the average RAP binder content reported on page 4 of your Contractor Hot Mix Asphalt Design Data form.

Do not submit more than one JMF in any 15 day period.

39-2.08A(3)(c) Test Results

Submit test results on AASHTO T 378 (modified) and AASHTO TP 124 for mix design, JMF verification, production start-up and QC to the Engineer and electronically to the following email addresses:

Moisture_Tests@dot.ca.gov
AClongLife@ucdavis.edu

Submit AASHTO T 378 and AASHTO TP 124 test data within 5 business days of sampling.

39-2.08A(3)(d) Pre-bid meeting

The following personnel must be present at the pre-bid meeting:

1. Project manager for the general contractor
2. Project manager for the HMA producer
3. Project manager for the paving contractor
4. Project Estimator
5. Quality control manager
6. Laboratory manager

39-2.08A(3)(e) Prepaving Conference

No more than 30 days following approval, meet with the Engineer for a pre-paving conference to discuss mix design, quality control, acceptance testing, HMA production and HMA placement.

The following personnel must be present at the pre-paving conference:

1. Project manager
2. HMA producer (Plant manager)
3. Paving Foreman
4. Superintendent
5. Quality control managers
6. Laboratory manager
7. Laboratory supervisors from all the testing firms performing mix design, performance testing and quality control testing

39-2.08A(3)(f) Samples

The Engineer takes loose HMA samples for AASHTO T 378 (Modified), AASHTO T 321 (Modified) AASHTO TP 124 from the plant under California Test 125.

Provide two tons of loose HMA per mix produced by the plant to the University of California Pavement Research Center (UCPRC). Additionally provide the following specimens compacted using plant-produced mix to UCPRC:

List of Compacted Specimens Needed for UCPRC

Specimen type	Specimen dimensions Based on Test Method	Hot Mix Asphalt-Surface, Long Life	Hot Mix Asphalt-Intermediate, Long Life	Hot Mix Asphalt-Rich Bottom, Long Life
Beam[1,2]	AASHTO T 321	12	12	12
Core[1,3]	AASHTO T 320	18	18	--
Core[2]	AASHTO T 378	12	12	--

[1]Produce specimens using rolling wheel compactor, following the procedure included in LLP-AC3, "Sample Preparation and Testing for Long - Life Asphalt Concrete Pavement," available at http://www.dot.ca.gov/hq/esc/Translab/ormt/fpmlab.htm
[2]See note 4 of the "HMA-LL Performance Requirements" table for air voids required.
[3]Specimen prepared at air-voids content of 3% ± 0.5% using AASHTO T 331 for air-voids content.

The loose HMA and compacted specimens should be prepared after the plant has produced 5,000 tons of the corresponding mix.

Notify UCPRC, Irwin Guada at 1 (510) 665-3674, at least 10 business days before sampling materials. Samples must be taken in the presence of UCPRC personnel. Both the loose mix and the compacted specimens should be shipped to the following address:

University of California Pavement Research Center
1353 S. 46th St., Bldg. 480
Richmond, CA 94804

39-2.08A(4) Quality Assurance

39-2.08A(4)(a) General

Not Used

39-2.08A(4)(b) Job Mix Formula Verification

After acceptance of the JMF submittal, the Department verifies each proposed JMF within 30 days of receiving all verification samples.

For each HMA, LL mix types, the Department verifies up to 2 proposed JMF submittals including a JMF adjusted after verification failure. If you submit more than 2 JMFs for an HMA, LL mix type, the Department deducts $40,000 from payments for each verification exceeding this limit.

In addition to JMF verification, you may request the Department may also verify up to 2 times for each of the tests included in the "HMA-LL Performance Requirements" table for each HMA-LL mix type.

39-2.08A(4)(c) Certifications

Testing for permanent deformation, fatigue/stiffness, and fracture potential must be performed by a laboratory qualified under the Caltrans Independent Assurance Program (observed by the UCPRC) for these tests).

39-2.08A(4)(d) Quality Control

39-2.08A(4)(d)(i) Mix Design

HMA-LL mixes must be design to meet the permanent deformation, stiffness, fatigue, fracture potential and Hamburg wheel tracking test requirements enumerated in the following table:

HMA-LL Performance Requirements

Design parameters	Test method	Sample Air Voids	Requirement		
			HMA-LL, Surface	HMA- LL, Intermediate	HMA-LL, Rich Bottom
Permanent deformation: [1,2] Minimum number of cycles to 3% permanent axial strain	AASHTO T 378[3]	Mix specific[4]	2,093	4,131	Not Required
Beam stiffness (psi): [2,5] Minimum stiffness at the 50th cycle at the given testing strain level	AASHTO T 321 Modified[3]	Mix specific[4]	214,000 at 952×10^{-6} in./in.	789,000 at 446×10^{-6} in./in.	756,000 at 441×10^{-6} in./in.
Beam fatigue: [2,5] Minimum of 1,000,000 cycles to failure at this strain Minimum of 250,000 cycles to failure at this strain	AASHTO T 321 Modified[3]	Mix specific[4]	617×10^{-6} in./in. 952×10^{-6} in./in.	299×10^{-6} in./in. 446×10^{-6} in./in.	306×10^{-6} in./in. 441×10^{-6} in./in.
Semicircular beam fracture potential: [2] Minimum flexibility index	AASHTO TP 124[3]	Mix specific[4]	3.0	0.5	0.5
Moisture Sensitivity: [6] Minimum repetitions	AASHTO T 324 Modified[3]	Per test method	20,000	20,000	Not Required

NOTES:

[1] Tested at a temperature of 122°F (50°C), unconfined, 4.4 psi contact stress, and 70 psi repeated axial stress

[2] Average value determined from tests on 3 specimens and calculated as the geometric (not arithmetic) mean.

[3] Included in the testing procedure, LLP-AC3, "Sample Preparation and Testing for Long-Life Asphalt Concrete Pavements" available at: *http://www.dot.ca.gov/hq/esc/Translab/ormt/fpmlab.htm]*

[4] 6 ± 0.5% for HMA-LL, Surface and HMA-LL, Intermediate mixes, and 3 ± 0.5% for HMA-LL, Rich Bottom mix all following AASHTO T 331

[5] Perform tests at 10 Hz load frequency and 68°F (20°C) test temperature
[6] Minimum number of repetitions for rut depth of 0.5 in. at 122°F (50°C)

39-2.08A(4)(d)(ii) Hot Mix Asphalt Production

Comply with section 39-2.02A(4)(b)(ix), except as shown below.

Replace the 7th row of the table in 39-2.02A(4)(b)(ix) with:

Nuclear gauge density	California Test 375	12 readings at stratified random test locations per lift, per day

Add to the table in section 39-2.02A(4)(b)(ix) with:

Permanent Deformation	AASHTO T 378 (modified)	3 per day (not required for HMA-LL, Rich Bottom)
Fracture potential	AASHTO TP 124	3 per day

39-2.08A(4)(e) Department Acceptance

39-2.08A(4)(e)(i) General

Not Used

39-2.08A(4)(e)(ii) HMA-LL In -Place Acceptance

Comply with section 39-2.02A(4)(e), except as follows:

1. Replace the third, fourth and fifth rows in item no. 3 table with:

Air voids content at N_{design} (5)[a,b]	AASHTO T 269	Value reported on JMF ± 1.5
Voids in mineral aggregate on laboratory produced HMA (min,%)[d]	SP-2 Asphalt Mixture Volumetric	Not required
Voids in mineral aggregate on plant produced HMA (min,%)[d]	SP-2 Asphalt Mixture Volumetric	Value reported on JMF ± 1.0

[a,b, d]: See notes a, b, and d respectively for "Type A HMA Acceptance In-Place" table

2. Add to item no. 3 table with:

Permanent Deformation	AASHTO T 378 (modified)	See "HMA-LL Performance Requirements table"
Fracture potential	AASHTO TP 124	See "HMA-LL Performance Requirements table"

3. Replace the first row in item no. 2 table with:

Binder content (% within the average reported)	AASHTO T 164	± 1.0

If HMA is rejected due to failed permanent deformation test results, the Department deducts $35,000.

If HMA is rejected due to failed fracture potential test results, the Department deducts $40 from payments for every ton of rejected HMA.

39-2.08A(4)(e)(iii) Dispute Resolution

Comply with 39-2.01A(4)(i)(v).
The third party participates in a dispute resolution for permanent deformation and fracture potential must be qualified under the Caltrans Independent Assurance Program (observed by the UCPRC). The third party can be one of the following:

Materials and Pavements Division
Texas A&M Transportation Institute
402 Harvey Mitchell Parkway South, Room 158
College Station, TX 77845
Contact: Dr. Fujie Zhou
Phone: (979) 458-3965
Email: f-zhou@tti.tamu.edu

Asphalt Institute
2696 Research Park Drive
Lexington, KY 40511-8480
Phone: 859-288-4960
E-Mail: info@asphaltinstitute.org

39-2.08A(4)(e)(iv) In-Place Density

Take density cores following section 39-2.01A(4)(h)(viii), except take 2 density cores within 12 inches on center of each core for every 250 tons of HMA. The Department will select random locations. The Department determines the percent of theoretical maximum density for each of the density cores and takes the average for in-place acceptance and reduced payment factor.

The target density range relative to the corresponding theoretical maximum density is 94% to 97% for HMA-LL Surface, HMA-LL Intermediate and 97.6 to 100% for HMA-LL Rich Bottom.

Reduced Payment Factors for Percent of Maximum Theoretical Density for:
HMA-LL Surface, HMA-LL Intermediate

HMA Percent of Maximum Theoretical Density	Reduced Payment Factor	HMA Percent of Maximum Theoretical Density	Reduced Payment Factor
93.5	0.0000	97.5	0.0000
93.4	0.0125	97.6	0.0125
93.3	0.0250	97.7	0.0250
93.2	0.0375	97.8	0.0375
93.1	0.0500	97.9	0.0500
93.0	0.0625	98.0	0.0625
92.9	0.0750	98.1	0.0750
92.8	0.0875	98.2	0.0875
92.7	0.1000	98.3	0.1000
92.6	0.1125	98.4	0.1125
92.5	0.2500	98.5	0.2500
92.4	0.2750	98.6	0.2750
92.3	0.3000	98.7	0.3000
92.2	0.3250	98.8	0.3250
92.1	0.3500	98.9	0.3500
<92.1	Remove and replace	<98.9	Remove and replace

Reduced Payment Factors for Percent of Maximum Theoretical Density for:
HMA-LL Rich Bottom

HMA Percent of Maximum Theoretical Density	Reduced Payment Factor	HMA Percent of Maximum Theoretical Density	Reduced Payment Factor
97.6	0.000	96.5	0.275
97.5	0.025	96.4	0.300
97.4	0.050	96.3	0.325
97.3	0.075	96.2	0.350
97.2	0.100	96.1	0.375
97.1	0.125	96.0	0.400
97.0	0.150	95.9	0.425
96.9	0.175	95.8	0.450
96.8	0.200	95.7	0.475
96.7	0.225	95.6	0.500
96.6	0.250	<95.6	Remove and replace

39-2.08B MATERIALS

39-2.08B(1) General

Not Used

39-2.08B(2) Hot Mix Asphalt Long Life Mix Design

Comply with section 39-2.02B(2) except as shown in the following table:

Type A HMA Design Requirements

Quality characteristic	Test method	Requirement
Air void content (%)	AASHTO T 269[a]	$N_{initial}$ > 8.0 Report value at N_{design} on job mix formula (JMF) submittal form N_{max} > 2.0
Voids in mineral aggregate (min,%)	SP-2 Asphalt Mixture Volumetric	Report value on JMF submittal

[a,b]: see footnote a and b respectively for the "Type A HMA Mix Design Requirements" table in Standard Specifications section 39-2.02B(2)

39-2.08B(3) Asphalt Binders

The low temperature grade of asphalt binder for HMA-LL Surface must be -28M or lower.

The low temperature grade of asphalt binder for HMA-LL Intermediate and HMA-LL Rich Bottom must be -10 or lower.

The high temperature grade of asphalt binder for HMA-LL must be 64 or higher.

You must specify the bases for calculating asphalt binder content and RAP asphalt binder content.

39-2.08B(4) Aggregates

Comply with section 39-2.02B(4).

The aggregate for HMA-LL must comply with the 3/4 inch aggregate gradation.

39-2.08B(5) Reclaimed Asphalt Pavement

Comply with section 39-2.02B(5).

The maximum Reclaimed Asphalt Pavement binder replacement ratio for HMA-LL, Intermediate is 25 percent. A blending chart is not required for this mix.

The maximum Reclaimed Asphalt Pavement binder replacement ratio for HMA-LL, Surface and HMA-LL, Rich Bottom is 15 percent.

RAP stockpile should allow for random sampling and testing.

39-2.08B(6) Recycled Asphalt Shingles

The use of recycled asphalt shingles is not allowed.

39-2.08C CONSTRUCTION

You will facilitate the setup and operation of the FHWA mobile asphalt testing trailer. The FHWA mobile asphalt testing trailer's setup and operational needs are described in the informational handout "MOBLIE ASPHALT TESTING TRAILER PROGRAM" leaflet. The setup and operation of the FHWA mobile asphalt testing trailer is change order work.

39-2.08D PAYMENT

Not Used

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40 CONCRETE PAVEMENT

Replace section 40-8 of the RSS for section 40 with:

40-8 PRECAST JOINTED CONCRETE PAVEMENT

40-8.01 GENERAL

40-8.01A Summary

Section 40-8 includes specifications for furnishing and installing precast jointed concrete pavement (PJCP).

Before submitting shop drawings, field verify the existing geometrics described, including profile grade, cross slope, slab width, and pavement thickness.

Match PJCP to the existing roadway geometrics, including horizontal curves and superelevation transition areas. You may grind to match existing profile grades and cross slopes if the PJCP thickness shown on the plans is maintained. Complete all grinding within horizontal curves and superelevation transition areas before opening to traffic.

Install dowel bars at all transverse joints between new JPCP and between new PJCP and the existing concrete.

40-8.01B Definitions

PJCP system: the complete package of all features that are part of precast pavement design, construction, QC/QA, and performance. These features include: panel geometry, thickness, cast-in elements, joints, load transfer method, grade control techniques, and field verification of existing geometrics.

Concrete Pavement Office: Office of Concrete Pavements and Pavement Foundations, Caltrans Pavement Program, Translab, 5900 Folsom Blvd., Sacramento, CA 95819

40-8.01C Submittals

40-8.01C(1) General

40-8.01C(2) Shop Drawings

In addition to the requirements in section 90-4, submit shop drawings under section 50-1.01C(3) except (1) the 6th and 8th paragraphs do not apply and (2) do not send them to the OSD. Submit 4 copies to the Engineer and 1 copy to the Concrete Pavement Office. Allow 15 business days for review.

Shop drawings must include:

1. Details for furnishing PJCP panels including:
   - 1.1. Panel layout and coordinating panel identification system
   - 1.2. Your survey notes for field verification of the existing profile and grade information described
   - 1.3. If required, adjusted panel dimensions including information for:
     - 1.3.1. Pavement profile with any superelevation transition
     - 1.3.2. Horizontal curve locations
     - 1.3.3. Allowable fabrication tolerances
     - 1.3.4. Allowable installation tolerances
   - 1.4. Method for casting connection elements within the specified alignment for final placement
   - 1.5. Type and position of lifting devices
   - 1.6. Underslab grout vent locations on panel details
   - 1.7. Finishing methods and procedures
2. Methods and procedures for handling and transport
3. Details, methods, and procedures for installing PJCP panels including:
   - 3.1. Methods and procedures for supporting and adjusting grade of the PJCP during installation
   - 3.2. Methods and procedures for installing joint filler, joints, and joint seals
   - 3.3. Details and methods for connecting to the existing pavement

Shop drawings and calculations must be sealed and signed by an engineer who is registered as a civil engineer in the State.

Any changes in dimensions or materials from the contract plans proposed in the shop drawings must include calculations and supporting documents and need approval from Concrete Pavement Office.

40-8.01C(3) Alternative System

You may submit a request to use an alternative system. Alternative systems must comply with the following requirements:

1. Proposed panel thickness must be authorized by the Concrete Pavement Office. Corresponding changes in the quantity of roadway excavation or thicknesses of other pavement structure layers are at your expense.
2. Dowel bars must be used to provide load transfer between panels. Do not install dowel bars between precast panels by retrofitting. Install bars using one of the following methods:
   - 2.1. Underslab slots
   - 2.2. Narrow top-of-panel slots
   - 2.3. Side holes for sliding dowels
   - 2.4. Other proposed methods authorized by the Concrete Pavement Office.

3. Precast panels with no pretensioning must have:
   3.1. Reinforcement
   3.2. Maximum transverse and longitudinal dimensions of 15 feet
   3.3. Engineered thickness designed to withstand transportation and installation loads. Submit for authorization by the Concrete Pavement Office.
4. Panel dimensions exceeding 15 feet transversely or longitudinally must be pretensioned in that direction. Panels may be pretensioned in both directions.
5. At horizontal curves with radii smaller than 2,000 feet and transitions, either:
   5.1. Use proprietary warped or folded panels
   5.2. Use cast-in-place concrete pavement under section 40
6. If used, drop-in panels must be at least 8 feet long and reinforced or pre-tensioned.
7. Panels must be adjusted to the finished grade using one of the following methods. For leveling devices, the space between under the panel and top of base must be 1/2 inch or less.
   7.1. Shimming. No metal shims are allowed.
   7.2. Treated bedding layer 0.15 foot or less thick. The Engineer will consider erosion potential before authorizing.
   7.3. Leveling bolts
   7.4. Leveling brackets
   7.5. Leveling beams
   7.6. Other method authorized by the Concrete Pavement Office
8. When lanes are not cast together monolithically, the panel edge must be supported to prevent vertical displacement of adjacent panels at the longitudinal joint. This could be achieved by one of the following methods. Obtain approval from Concrete Pavement Office for use of additional reinforcement or other proposed methods.
   8.1. Additional reinforcement at the longitudinal edges
   8.2. Key and keyway
   8.3 Dual keyway with shear key
   8.4. Tie bar retrofit
   8.5. Other proposed methods authorized by the Concrete Pavement Office
9. If synthetic fiber reinforced concrete (FRC) is used, fibers must not affect the final surface finish and grindings. Obtain approval from Concrete Pavement Office for use of fibers.

For alternate system:

1. Submit specifications, fabrication drawings, and installation procedures to the Concrete Pavement Office for review and approval.
2. Construct a trial panel installation for evaluation by the Concrete Pavement Office and obtain authorization that trial installation is successful.

The Department is not responsible for delays related to authorizing your proposed alternative system, and does not pay for your use of proprietary items.

Any new idea or process submitted to the Department as an alternative system for evaluation and authorization is the property of the Department.

40-8.01C(4) Quality Control Plan

In addition to the requirements of section 90-4 for fabrication QC plan, submit a handling and installation QC plan. Allow 15 business days for review.

40-8.01C(5) Just-In-Time Training

At least 5 business days before Just-In-Time Training (JITT), submit:

1. Instructor's name and qualifications
2. Training location
3. 1 copy of:
   3.1. Course syllabus
   3.2. Handouts
   3.3. Presentation materials

Each attendee must complete training evaluation. Submit completed forms within 5 business days after JITT to the Engineer and the electronic mailbox address:

HQ_Construction_Engineering@dot.ca.gov

40-8.01C(6) Coefficient of Thermal Expansion

Submit coefficient of thermal expansion test results under AASHTO T 336 for each mix design as an informational submittal. The mix design may be authorized before submitting test results.

Submit coefficient of thermal expansion test data at:

cte@dot.ca.gov

40-8.01C(7) Underslab Grout

Submit test data from an authorized laboratory for underslab grout materials 15 business days before the start of grouting activity.

40-8.01D Quality Assurance

40-8.01D(1) General

Section 40-1.01D does not apply, except for coefficient of friction and pavement smoothness requirements under Section 40-1.01D(8)(c).

Provide a QC manager and comply with section 90-4.

Arrange for a prepaving conference facility and hold the conference after submitting the shop drawings, and at least 10 business days before starting installation activities including test strip construction. Discuss methods of performing the installation work.

At the minimum, the meeting must be attended by your:

1. Project superintendent
2. QC manager
3. Installation construction foreman
4. Fabricator's project manager
5. Personnel responsible for saw cutting, underslab grouting, and joint sealing

40-8.01D(2) Just-In-Time Training

Your personnel required to attend the prepaving conference must also complete JITT. Provide the facility for the training.

JITT must be:

1. At least 4 hours long
2. Conducted at a mutually agreed place
3. Completed at least 20 days before you start paving activities
4. Conducted during normal working hours

The instructor's name must be on the Department's Authorized Precast Pavement Instructor List available on the Concrete Pavement Office webpage at:

http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/index.html

Upon JITT completion, the instructor must issue a certificate of completion to each participant.

The Department pays you for 1/2 of the cost for providing the JITT. The Engineer determines the costs under section 9-1.04 except no markups are added. The costs include training materials, facility use, and the JITT instructor's wages, including expenses for travel, lodging, meals, and presentation materials. The Department does not pay your costs for attending JITT.

40-8.01D(3) Handling and Installation Quality Control Plan

Establish, implement, and maintain a handling and installation QC plan for PJCP. The QC plan must describe the organization and procedures used to:

1. Control the construction process
2. Determine if a change to the construction process is needed
3. Implement a change

The QC plan must address all the activities related to panel storage, transportation, and installation, including:

1. Field measurements and survey
2. Saw cutting and removal of any existing concrete
3. Placing base layer
4. Panel handling
5. Base and panel grading
6. Transverse and longitudinal joints
7. Panel connection
8. Underslab grouting
9. Filling dowel slots
10. Surface smoothness
11. Preparation to open to traffic

The QC plan must include:

1. Names, qualifications, and certifications of QC personnel, including:
1.1. QC manager
1.2. Assistant QC managers
1.3. Samplers and testers
2. Outline of procedure for the handling, storage, transportation, and installation of PJCP, including test strips
3. Outline of procedure and forms for sampling and testing to be performed during and after PJCP construction, including testing equipment, location, and frequencies
4. Contingency plan for identifying and correcting problems in storage, transportation, or installation of PJCP.
5. Temporary pavement structure provisions, including the determination of need and quantity and location of standby material
6. Outline procedure for placing and testing test strips, including:
   6.1. Locations and times
   6.2. Installation procedures
   6.3. Grading methods
   6.4. Testing and test result reporting
7. Procedures or methods for controlling PJCP quality, including panel:
   7.1. Finished grade
   7.2. Joints
   7.3. Conforms with existing pavement
   7.4. Protecting PJCP before opening to traffic

40-8.01D(4) Test Strips

Construct a test strip and obtain authorization of the test strip before additional paving. Test strip must comply with the authorized shop drawings and be:

1. At least 300 feet long
2. Same width as shown on the authorized shop drawings
3. Same cross-section dimensions as for the highest rate of superelevation transition as shown on the authorized shop drawings

Notify the Engineer at least 25 working days before you start initial test strip construction.

Allow 3 business days for test strip authorization.

Test strips must comply with the following criteria:
1. Panels follow the road alignment
2. Finished surface varies less than 0.02 foot from a 12-foot straightedge's lower edge
3. Wheel path's individual high points are less than 0.025 foot over a 25 foot length
4. Final finishing specifications except for the coefficient of friction
5. No excess underslab grout flows into joints, dowel slots, or onto the pavement
6. Before grouting, no void more than 1/2 inch between top of base and bottom of panel
7. No joint wider than 3/4 inch

If the test strip complies with the acceptance criteria except for the coefficient of friction, you may grind the test strip under section 42. If the test strip complies with the acceptance criteria after grinding, you may request to leave the test strip in place.

If the test strip does not comply with the panel alignment criteria, submit revised shop drawings that include your proposed changes to correct the alignment. After the revised submittals are authorized, install a new test strip. Repeat this process until the test strip complies with the acceptance criteria.

Dispose of rejected test strips.

Construct additional test strips if you change:

1. Methods and equipment including:
   1.1. Fabrication plants
   1.2. Panel lifting, shipment, and delivery methods
   1.3. Grouting equipment
   1.4. Connections to the existing pavement
2. Base layer preparation method
3. Underslab grout material or mix design proportioning
4. Panel leveling methods

If you have successfully installed PJCP on a previous Department project and used the same fabrication plant, installation equipment and procedures, and personnel, you may request to waive the test strip construction. Include supporting information from the previous Department project with your request for authorization.

40-8.01D(5) Department Acceptance

Construct PJCP panels to the dimensions shown on the authorized shop drawings. PJCP panels are rejected if the fabricated dimensions are not within the tolerances shown in the following table:

PJCP Panel Fabrication

Dimension	Tolerances (inches)
Length (longer dimension)	±1/4
Width (shorter dimension)	±1/8
Nominal thickness	±1/8
Edge alignment straightness measured from a horizontal plane	±1/8
Skew at the ends	±1/8
Batter	±1/16
Pre-tensioning strand position	
Vertical[a]	±1/8
Horizontal	±1/8
Difference of the diagonal corner to corner measurements	±1/8
Lifting anchor position	±3

[a]Measured from the bottom of the panel

The profile and grade of finished PJCP must match adjacent existing pavement, including any superelevation transitions. Do not open to traffic if the installed alignment is not within the tolerances shown in the following table:

PJCP Panel Installation

Alignment	Tolerance (inches)	
Transverse joints	Vertical	1/4
	Horizontal	1/8
Longitudinal joints	Vertical	1/4
	Horizontal	1/4

The Engineer rejects PJCP if either:

1. Panels have full-depth cracks
2. Joints are wider than 1-1/2 inch
3. Pavement surface does not comply with smoothness under section 40-1.

40-8.02 MATERIALS

40-8.02A General

Proportion underslab grout under ASTM C938 or use prepacked grout complying with ASTM C1107. If used, fine aggregate must be Grading 2 under ASTM C637. Proportion the grout ingredients to have the following quality characteristics:

Underslab Grout

Quality Characteristic	Test method	Requirement
Compressive strength at 1 hr (psi, min): at 73 °F at 45 °F	ASTM C942	 2,500 2,000
Compressive strength at 7 days (psi, min) at 73 °F at 45 °F	ASTM C942	 7,600 6,000
Expansion (%, at 30 min)	ASTM C940	0–3
Bleeding (%, max, at 30 min)	ASTM C940	0.1
Efflux Time (seconds)	ASTM C939	15–30

Note: for tests at 45 °F, condition materials to 45 °F for 24 hrs before fabrication and store specimens at 45 °F until testing.

Polyester concrete must comply with section 41-1.02C.

Tack coat must comply with section 39.

For panels with traffic loop detectors, use glass fiber reinforced polymer (GFRP) bar reinforcement complying with section 40-1.02C.

40-8.02B Prestressing Steel

Prestressing steel must comply with section 50-1.02B.

Transverse pretensioning strand must be either 0.5 or 0.6 inch diameter unless otherwise authorized. Comply with the requirements for ASTM A416, Grade 270 (low relaxation).

41-18.02C Joint Seal

Joint seal for transverse and longitudinal joints must be preformed compression and comply with section 41-5.

40-8.02D Joint Filler

Joint filler must comply with either ASTM D1742 or ASTM D7174, and must be compatible with polyester concrete.

40-8.02E Expansion Cap

Expansion cap must comply with section 41-17.

40-8.03 CONSTRUCTION

40-8.03A General

Section 40-1.03C does not apply.

Prestressing must comply with section 50-1.03. The specifications for a member apply to a PJCP panel.

Where existing pavement is replaced with PJCP, replace only the portion of pavement where the work will be completed during the same lane closure. If installation of the PJCP is not completed during the same lane closure, comply with section 41-1.02E.

40-8.03B Furnishing Precast Concrete Panels

If the roadway alignment is on a curve with a radius less than 2,500 feet, place the reinforcement along a single straight line aligned with the radius point. If the curve does not allow the spacing shown between transverse bar reinforcement and prestressing steel, space them a distance that is between 1/2 the spacing and the full spacing shown.

Before casting, apply dowel bar lubricant under section 41-8.

Recess lifting devices at least 1/2 inch below the panel surface.

After casting and before curing, panel surface texture must comply with section 40-1.03H(3).

PJCP must have a minimum compressive strength of 4,000 psi before releasing the pretensioning strands or moving PJCP panels. PJCP must cure for 14 days and attain a minimum compressive strength of 6,000 psi before shipping.

Section 40-1.03I does not apply. Cure PJCP under section 90-4, except do not use water method.

Sections 40-1.03J and 40-1.03K do not apply.

40-8.03C Installing Precast Concrete Panels

40-8.03C(1) General

Match panel dimensions and saw cut area to prevent wide joints. At transverse or longitudinal joints, the existing concrete pavement may be saw cut up to 2 inches from the joint to provide a straight, uniform edge.

Grade the base and remove loose or unstable material. If a bedding layer is used, its thickness must be 0.15 foot or less.

Do not place any bond breaker on the base.

When lanes are not cast together monolithically, follow the requirements shown on the authorized shop drawings to support the panel edges at longitudinal joints.

40-8.03C(2) Underslab Grouting

Complete underslab grouting before opening to traffic. You may request authorization to delay underslab grouting up to 48 hours after opening to traffic, provided that panels are uniformly supported by properly graded base layer. Leveling devices that result in point-loads are not uniform support.

Do not place grout if the ambient temperature at the time of placement and within 3 hours after that is less than 40 degrees F.

After the panels are set and leveled, clean out grout ports and fill them with grout. Do not allow excess grout to flow into dowel slots or onto the pavement surface.

40-8.03C(3) Filling Dowel Bar Slots

Fill dowel bar slots in the PJCP and existing concrete pavement immediately after final panel grading. Fill dowel bar slots with polyester concrete under section 41-8.

If you do not fill dowel bar slots on the pavement surface that are more than 2 inches wide before opening to traffic, install temporary covers that can withstand traffic loading. Fasten the temporary covers to the panels so that they are not disturbed or dislodged by traffic. Temporary covers must be flush with the finished pavement surface. Do not leave temporary covers at any given location for more than 48 hours. Do not use other filler materials before final filling.

Clean dowel bar slots under section 41-8.03D before filling.

Consolidate the polyester concrete in place and finish the surface flush with the panel surface. Replace the fill if it is recessed or cracked.

Fill recessions at lifting anchor or grout port locations with polyester concrete.

40-8.03C(4) Joints

Joint width must be uniform and less than 3/4 inch. If joint width is between 1/4 and 3/4 inch, seal the joints with preformed compression seals under section 41-5.

Clean the faces of joints from loose material and contaminants.

Install joint filler before grinding. Seal joints after grinding is completed.

40-8.03D Correcting Noncompliant Work

40-8.03D(1) Precast Jointed Concrete Pavement Panel Repair

Repair panels damaged during removal from forms, handling, or installation under section 41-4 , except use polyester concrete or material from the Authorized Material List for precast portland cement based repair material. Repair any damage that will affect ride quality, assembly of the panels, or long-term performance of the pavement. Repairs to panel edges and panel surface must not protrude above the pavement surface.

Treat the cracks that do not extend to the full depth of a panel with HMWM resin under section 41-3 except a grey sand cover must be used.

40-8.03D(2) Joint Repair

If joint width is more than 3/4 inch, stop placing PJCP and take corrective action. Repair joints between 3/4 and 1-1/2 inches wide with polyester concrete as shown.

Replace panels with joints wider than 1-1/2 inches.

40-8.04 PAYMENT

Not Used.

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41 EXISTING CONCRETE PAVEMENT

INDIVIDUAL PRECAST SLAB REPLACEMENT

41-18.01 GENERAL

41-18.01A Summary

Section 41-18 includes specifications for furnishing and installing precast concrete panels (PCP) for individual slab replacement (ISR) as individual precast slab replacement (IPSR). Before submitting shop drawings, field verify the existing geometrics described, including but not limited to profile grade, cross slope, slab width, and pavement thickness.

Install dowel bars at transverse joints between IPSR and the existing concrete under section 41-8 “Dowel Bar Retrofit”.

41-18.01B Definitions

system: consists of features that are part of precast pavement design, construction, QC/QA and performance. These features include but are not limited to: panel size, thickness, cast-in elements, and slabs, joints, load transfer method, grade control techniques, and field verification of existing geometrics.

Concrete Pavement Office: Office of Concrete Pavements and Pavement Foundations, Caltrans Pavement Program, Translab, 5900 Folsom Blvd., Sacramento, CA 95819

41-18.01C Submittals

41-18.01C(1) General

41-18.01C(2) Shop Drawings

In addition to the requirements in section 90-4, submit shop drawings under section 50-1.01C(3) except (1) the 6th and 8th paragraphs do not apply and (2) do not send them to the OSD. Submit 4 copies to the Engineer and 1 copy to the Concrete Pavement Office. Allow 15 business days for review.

Shop drawings must include:

1. Details for furnishing IPSR panels including:
   - 1.1. Panel layout and coordinating panel identification system
   - 1.2. If required, adjusted panel dimensions
   - 1.3. Method for casting connection elements within the specified alignment for final placement
   - 1.4. Type and position of lifting devices
   - 1.5. Underslab grout vent locations on panel details.
   - 1.6. Finishing methods and procedures
3. Methods and procedures for handling and transport
2. Details, methods and procedures for installing IPSR panels including:
   - 2.1. Methods and procedures for supporting and adjusting grade of the during installation
   - 2.2. Methods and procedures for installing joint filler, joints, and joint seals
   - 2.3. Details and methods for connecting to the existing pavement
   - 2.4. Any manufacturer’s installation instructions

Shop drawings and calculations must be sealed and signed by an engineer who is registered as a civil engineer in the State.

Any changes in dimensions or materials from the contract plans proposed in the shop drawings must include calculations and supporting documents and need approval from Concrete Pavement Office.

41-18.01C(3) Alternative System

In lieu of the design shown on the project plans, you may propose an alternative system. For the alternate system, the thickness of panels must be 0.65 feet or more. The maximum dimension must be less than 36 feet. Panels could be conventionally reinforced or pretensioned in one or two directions. Panel with a dimension exceeding 15 feet transversely or longitudinally must be pretensioned in that direction.

For alternate system authorization, submit specifications, fabrication drawings, installation procedures, and all calculations and supporting documents. Do not perform precasting until the alternate system is authorized by the Engineer.

The Department is not responsible for delays related to authorizing your proposed alternative system, and does not pay for your use of proprietary items.

Any new idea or process submitted to the Department as an alternative system for evaluation and authorization is the property of the Department.

41-18.01C(4) Quality Control Plan

In addition to the requirements of section 90-4 for fabrication QC plan, submit a handling and installation QC plan. Allow 15 business days for review.

41-18.01C(5) Just-In-Time Training (JITT)

At least 5 business days before JITT, submit:

1. Instructor's name and qualifications
2. Training location
3. 1 copy of:
   3.1. Course syllabus
   3.2. Handouts
   3.3. Presentation materials

Each attendee must complete training evaluation. Submit completed forms within 5 business days after JITT to the Engineer and the electronic mailbox address:

HQ_Construction_Engineering@dot.ca.gov

41-18.01C(6) Coefficient of Thermal Expansion

Submit coefficient of thermal expansion test results under AASHTO T 336 for each mix design as an informational submittal. The mix design may be approved before submitting test results.

Submit coefficient of thermal expansion test data at:

http://169.237.179.13/cte/

41-18.01C(7) Underslab Grout

Submit test data from an authorized laboratory for underslab grout materials 15 business days before the start of grouting activity.

41-18.01D Quality Assurance

41-18.01D(1) General

Section 40-1.01D does not apply.

Provide a QC manager and comply with section 90-4.

Arrange for a prepaving conference facility and hold the conference after submitting the shop drawings, and at least10 business days before beginning installation activities including test strip. Discuss methods of performing the installation work.

At the minimum, the meeting must be attended by your:

1. Project superintendent
2. QC manager
3. Installation construction foreman
4. Fabricator’s project manager
5. Personnel responsible for saw cutting, underslab grouting, and joint sealing

41-18.01D(2) Just-In-Time Training

Your personnel required to attend the prepaving conference must also complete JITT. Provide the facility for the training.

JITT must be:

1. At least 4 hours long
2. Conducted at a mutually agreed place
3. Completed at least 20 days before you start paving activities
4. Conducted during normal working hours

The instructor’s name must be on the Department’s Authorized Precast Pavement Instructor List available on the Concrete Pavement Office webpage at:

http://www.dot.ca.gov/hq/maint/Pavement/Offices/Pavement_Engineering/index.html

Upon JITT completion, the instructor must issue a certificate of completion to each participant.

The Department pays you for 1/2 of the cost for providing the JITT. The Engineer determines the costs under section 9-1.04 except no markups are added. The costs includes training materials, facility use, and the JITT instructor's wages, including expenses for travel, lodging, meals and presentation materials. The Department does not pay your costs for attending JITT.

41-18.01D(3) Handling and Installation Quality Control Plan

Establish, implement, and maintain a handling and installation QC plan for PJCP. The QC plan must describe the organization and procedures used to:

1. Control the construction process
2. Determine if a change to the construction process is needed
3. Implement a change

The QC plan must address all the activities related to panel storage, transportation, and installation, including:

1. Filed measurements and survey
2. Saw cutting and removal of the existing concrete (if any)
3. Placing base layer
4. Panel handling
5. Base and panel grading
6. Transverse and longitudinal joints
7. Panel connection
8. Underslab grouting
9. Filling dowel slots
10. Surface smoothness
11. Preparation to open to traffic

The QC plan must include:

1. Names, qualifications, and certifications of QC personnel, including:
   1.1. QC manager
   1.2. Assistant QC managers
   1.3. Samplers and testers
2. Outline of procedure for the handling, storage, transportation, and installation of PCP, including trial panels
3. Outline of procedure and forms for sampling and testing to be performed during and after PCP construction, including testing equipment, location, and frequencies
4. Contingency plan for identifying and correcting problems in storage, transportation, or installation of PCP.
5. Contingency plan for correcting problems with existing base
6. Temporary pavement structure provisions, including the determination of need and quantity and location of standby material
7. Outline procedure for placing and testing trial panels, including:
   7.1. Locations and times
   7.2. Installation procedures
   7.3. Grading methods
   7.4 Testing and test result reporting
8. Procedures or methods for controlling IPSR quality, including panel:
   8.1. Finished grade
   8.2. Joints
   8.3. Conforms with existing pavement
   8.4. Protecting before opening to traffic

41-18.01D(4) Trial Panels

Construct trial panels and obtain authorization of the trial panels before starting paving work. Trial panels must comply with the authorized shop drawings and be:

1. Be at a mutually-agreed location that is on the roadway within the project limits
2. Be installed under similar traffic conditions and with the same equipment to be used for the planned installation, and under similar atmospheric and temperature conditions expected during replacement operations.
3. Be at least 12' wide and 8' long
4. Be the maximum panel thickness shown on shop drawings
5. Include two adjacent panels for each proposed panel design (e.g. pretensioned or reinforced)
5. For locations with three or more panels in a row, include location with highest superelevation transition

Notify the Engineer at least 25 working days before you start initial trial panel construction.

Allow 3 business days for trial panel authorization.

The Engineer rejects trial panels if either:

1. Before grouting, there are voids more than 1/2 inch between top of base and bottom of panel
2. Any joint width exceeds 3/4 inch
3. Finished surface varies more than 0.02 foot from a 12-foot straightedge's lower edge
4. Excess underslab grout flows into joints, dowel slots, or onto the pavement
5. Final finishing does not comply with the specifications

If the test strip does not comply with the panel alignment criteria, submit revised shop drawings that include your proposed changes to correct the alignment. After the revised submittals are authorized, install a new test strip. Repeat this process until the test strip complies with the acceptance criteria.

Remove and dispose of rejected trial panels.

Construct additional trial panels if you change:

1. Methods and equipment including:
    1.1. Fabrication plants
    1.2. Panel lifting, shipment, and delivery methods
    1.3. Grouting equipment
    1.4. Connections to the existing pavement
2. Base layer preparation method
3. Underslab grout material or mix design proportioning
4. Panel leveling methods

If you have successfully installed IPSR on a previous Department project and used the same fabrication plant, installation equipment and procedures, and personnel, you may request to waive the trial panel construction. Include supporting information from the previous Department project with your request for authorization.

41-18.01D(5) Department Acceptance

Construct PCP panels to the dimensions shown on the authorized shop drawings. PCP panels are rejected if the fabricated dimensions are not within the tolerances shown in the following table:

PCP Panel Fabrication

Dimension	Tolerances (inches)
Length (longer dimension)	±1/4
Width (shorter dimension)	±1/4
Nominal thickness	±1/8
Edge alignment straightness measured from a horizontal plane	±1/8
Skew at the ends	±1/8
Batter	±1/18
Pre-tensioning strand position Vertical[a] Horizontal	 ±1/4 ±1/4
Difference of the diagonal corner to corner measurements	±1/4
Lifting anchor position	±3

[a]Measured from the bottom of the panel

The profile and grade of finished PCP must match adjacent existing pavement, including any superelevation and transitions.

The Engineer rejects IPSR if either:

1. Panels have full-depth cracks
2. The vertical differences at transverse or longitudinal joints are more than 3/8”
3. Joints are wider than 1 ½ inch

41-18.02 MATERIALS

41-18.02A General

Proportion underslab grout under ASTM C938 or use prepacked grout complying with ASTM C1107. If used, fine aggregate must be Grading 2 under ASTM C637. Proportion the grout ingredients to have the following quality characteristics:

Underslab Grout

Quality Characteristic	Test method	Requirement
Compressive strength at 1 hr (psi, min): at 73 °F at 45 °F	ASTM C942	 2,500 2,000
Compressive strength at 7 days (psi, min) at 73 °F at 45 °F	ASTM C942	 7,600 6,000
Expansion (%, at 30 min)	ASTM C940	0–3
Bleeding (%, max, at 30 min)	ASTM C940	0.1
Eflux Time (seconds)	ASTM C939	15–30

Note: for tests at 45 °F, condition materials to 45 °F for 24 hrs before fabrication and store specimens at 45°F until testing.

Polyester concrete must comply with section 41-1.02C “Polyester Concrete”.

For panels with traffic loop detectors, use glass fiber reinforced polymer (GFRP) complying with section 40-1.02C of these special provisions

41-18.02B Prestressing Steel

Prestressing steel must comply with section 50-1.02B “Prestressing Steel”.

Transverse pretensioning strand must be either 0.5 or 0.6 inch diameter unless otherwise authorized by the Engineer. Comply with the requirements for ASTM A416, Grade 270 (low relaxation).

41-18.02C Joint Seal

Joint seal for transverse and longitudinal joints must be silicone and comply with section 41-5 “Joint Seals”.

41-18.02D Joint Filler

Joint filler must comply with either ASTM D1742 or ASTM D7174, and must be compatible with polyester concrete.

41-18.02E Expansion Cap

Expansion cap must comply with section 41-17 “Dowel Bar Slots”.

41-18.03 CONSTRUCTION

41-18.03A General

Prestressing must comply with section 50-1.03. The specifications for a “member” apply to a PCP panel.

If installation of the IPSR is not completed during the same lane closure, comply with section 41-1.02E “Temporary Pavement Structure”.

41-18.03B Furnishing PCP

If the roadway alignment is on a curve with a radius less than 2,500 feet, place the reinforcement along a single plane. If the curve does not allow the spacing shown between transverse bar reinforcement and prestressign steel, space them a distance that is between 1/2 the spacing and the full spacing shown.

Before casting, apply dowel bar lubricant under section 41-8.

Recess lifting devises at least 1/2 inch below the panel surface.

After casting and before curing, panel surface texture must comply with section 40-1.03H(3) “Final Finishing”.

PCP must have a minimum compressive strength of 4,000 psi prior to releasing the pretensioning strands or moving PCP panels. PCP must cure for 14 days and attain a minimum compressive strength of 6,000 psi prior to shipping.

Section 40-1.03I “Curing” does not apply. Cure PCP under section 90-4, except do not use water method.

Sections 40-1.03J “Protecting Concrete Pavement” and 40-1.03K “Early Use of Concrete Pavement” does not apply.

41-18.03C Installing PCP

41-18.03C(1) General

At longitudinal joints, the existing concrete pavement may be saw cut up to 2 inches from the joint to provide a straight, uniform edge. Match panel dimensions and saw cut area to prevent wide joints.

Grade the base and remove loose or unstable material. If a bedding layer is used, its thickness must be 0.15 foot or less.

Do not place any bond breaker on the base.

Before installing PCP, attach joint filler across the full length and depth of the transverse and longitudinal panel faces. Place the top of the joint filler recessed below the top of the panel and extend it to the bottom edge of the panel. Secure joint filler to the panel face and prevent it from moving, curling, tearing and other damage. At dowel slots, joint filler installation must comply with caulking and foam inserts requirement of this specification. Repair or replace damaged joint filler.

41-18.03C(2) Underslab Grouting

Complete underslab grouting before opening to traffic. You may request authorization to delay underslab grouting up to 48 hours after opening to traffic, provided that panels are uniformly supported by properly graded base layer. Leveling devices that result in point-loads are not uniform support.

Do not place grout if the ambient temperature is less than 40 ˚F.

After the panels are set and leveled, clean out grout ports and fill them with grout. Do not allow excess grout to flow into dowel slots or onto the pavement surface.

Backfill any gaps that remain between IPSR and existing AC to remain in place with underslab grout.

41-18.03C(3) Filling Dowel Bar Slots

Fill dowel bar slots in the IPSR and existing concrete pavement immediately after final panel grading. Fill dowel bar slots with polyester concrete under section 41-8, or 41-17 ”Dowel Bar Slots” in these special provisions.

If you do not fill dowel bar slots that are more than 2 inches wide, install temporary covers that can withstand traffic loading prior to opening to traffic. Fasten the temporary covers to the panels so that they are not disturbed or dislodged by traffic. Temporary covers must be flush with the finished pavement surface. Do not leave temporary covers at any given location for more than 48 hours. Do not use other filler materials before final filling.

Clean dowel bar slots under section 41-8.03D before filling.

Consolidate the polyester concrete in-place and finish the surface flush with the panel surface. Replace the fill if it is recessed or cracked.

Fill recessions at lifting anchor or grout port locations with polyester concrete.

41-18.03C(4) Final Finishing

If the Engineer determines by visual inspection the final texturing may not comply with the specifications for coefficient of friction, the Engineer tests to determine coefficient of friction. Open the pavement to traffic and the Department tests for coefficient of friction. If pavement does not comply with the specifications for coefficient of friction, groove or grind the pavement under Section 42.

The Engineer tests for smoothness using a 12-foot straightedge placed parallel with and perpendicular to the centerline. Straightedge smoothness specifications do not apply to the pavement surface placed within 12 inches of existing concrete pavement except you must place a straightedge longitudinally with the midpoint coincident with the transverse joint.

The concrete pavement surface must not vary from the lower edge of a 12-foot straightedge by more than:

1. 0.01 feet when parallel to the centerline
2. 0.02 feet when perpendicular to the centerline extending from edge to edge of a traffic lane

41-18.03C(5) Joints

Joint width must be uniform and less than 3/4 inch. If joint width is between 1/4 and 3/4 inch, seal the joints under section 41-5 “Joint Seals”.

Clean the faces of joints and underlying base from loose material and contaminants.

Install joint filler before grinding. Seal joints after grinding is completed

41-18.03D Correcting Noncompliant Work

41-18.03D(1) PCJP Panel Repair

Repair panels damaged during removal from forms, handling, or installation under section 41-4 “Spall Repair”, except use polyester concrete or material from the Authorized Material List for precast portland cement based repair material. Repair any damage that will affect ride quality, assembly of the panels, or long-term performance of the pavement. Repairs to panel edges and panel surface must not protrude above the pavement surface.

Treat the cracks that do not extend to the full depth of a panel with HMWM resin under section 41-3 ”Crack Treatment", except a grey sand cover must be used.

41-18.03D(2) Joint Repair

If joint width is more than 3/4 inch, stop placing PJP and take corrective action. Repair joints between 3/4 and 1-1/2 inches wide with polyester concrete as shown.

Replace panels with joints wider than 1-1/2 inches.

41-18.04 PAYMENT

Reserved.

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46-1.01C(3) Installation Plan

46-1.01C(3)(a) General

Submit an installation plan for ground anchors. The installation plan must include:

1. Name, address, and telephone number of the subcontractor performing the work.
2. Construction schedule and sequence of installing and grouting.
3. Encapsulation details.
4. Repair procedure for damaged sheathing.
5. Drilling methods and equipment, including:
   5.1. Drilled hole diameter.
   5.2. Equipment space requirements.
6. Grout mix design and testing procedures.
7. Grout placement equipment and procedures, including minimum required cure time.
8. Details for providing the bonded and unbonded length. If packers or other similar devices are to be used, include the type.
9. Testing equipment, including:
   9.1. Jacking frame and appurtenant bracing.
   9.2. Method and equipment for measuring movement during testing.

The installation plan must be sealed and signed by an engineer who is registered as a civil engineer in the State.

Allow 20 days for review.

46-1.01C(3)(b) Ground Anchor Installation Plan

Ground anchor installation plan must include the following additional information:

1. Details and specifications for the anchorage system and ground anchors.
2. Details for the transition between the corrugated plastic sheathing and the anchorage assembly.
3. If shims are used during lock-off, shim thickness and supporting calculations.

46-1.01C(4) Test Data

Submit the following data for each ground anchor test:

1. Key personnel
2. Test loading equipment
3. Anchor or nail location
4. Time and date of:
   4.1. Drilling
   4.2. Installation
   4.3. Grouting
   4.4. Testing
5. Hole diameter and depth
6. Drilling method
7. Soil or rock classification and description
8. Bonded and unbonded length
9. Quantity of groundwater encountered within the bonded length
10. Grout quantity and pressure used within the bonded length
11. Anchor end or nail head movement at each load increment or at each time increment during the load hold period

Submit the test data when ground anchor testing is complete or when requested.

Add to section 46-2.01D(2)(b)(i):

Performance test a minimum of 3 ground anchors per wall. The Engineer determines which anchors are to be performance tested.

Add to section 46-2.03A:

Expect difficult ground anchor installation at Bridge no.s 24E0019, 24E0020, 24E0021, and 24E0022 due to the presence of the following conditions:

1. Low overhead clearance
2. Drilling through existing abutment concrete

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48 TEMPORARY STRUCTURES

Add between the 1st and 2nd paragraphs of section 48-4.01C:

The following items do not need to be included in the shop drawing submittal if design details for the temporary decking are shown:

1. Description, location, and value of all loads
2. Details of the connection between the temporary decking and the existing or new structure

Replace *Not Used* of section 48-4.02 with:

Material for temporary decking must comply with section 48-2.

Replace the 2nd sentence in the 3rd paragraph of section 48-4.03 with:

For Bridge no. 24-0296, use a 20:1 horizontal-to-vertical ratio for tapers.

For Bridge no. 24-0265, use a 70:1 horizontal-to-vertical ratio for tapers.

Replace the 1st sentence of the 7th paragraph of section 48-4.03 with:

Do not allow traffic on deck concrete until it has attained a compressive strength of 3600 psi.

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49 PILING

Replace item 1 of the RSS for 7th paragraph of section 49-1.01D(4) with:

1. Have an additional length of 7 feet.

Replace item 4 in the 8th paragraph of section 49-1.01D(4) with:

4. Resume driving operations as ordered by the Department. Suspend driving operations approximately 3 foot above the specified tip elevation.

Replace item 6 in the 8th paragraph of section 49-1.01D(4) with:

6. After 7 days, install the instrument package on the pile and attach the cables and resume driving the pile to the specified tip elevation. If using a diesel hammer for resuming pile driving, warm-up the hammer by driving one pile at an adjacent footing to within 10 feet of the specified tip elevation.

Add to the end of section 49-1.01D(4):

The Department performs dynamic monitoring of the first production pile driven for each control zone at the support location shown in the following table:

Bridge no.	Control zone	Dynamic monitoring support location
24-0388	Bent 3	Center of pile group
24-0388	Bent 6	Center of pile group
24-0388	Bent 9	Center of pile group

Add to section 49-2.01A(1):

Galvanized bar reinforcing steel used for pile anchors must comply with section 52-3.

Add to section 49-2.01A(3)(a):

Before installing driven piles, submit a Pile and Driving Data Form for each pile type for each of the support locations or control zones shown in the following table:

Bridge no.	Pile type	Support location or control zone
24-0262 R/L	Class 140, Alt X	Abutments 1 and 14
24-0262 R/L	18" PC/PS concrete piles	Bents 1 through 13
24-0296R/L	Class 140, Alt X	Abutments 1 and 6
24-0296R/L	Class 140, Alt X	Bents 2 through 5
Sound wall 1	18" Cast-In-Steel-Shell Pile	Sta 10+00 to 12+88
Sound Wall 2	1.18" Cast-In-Steel-Shell Pile 2..24" Cast-In-Steel-Shell Pile	Sta 19+59.66 to Sta 35+26.04 Sta 21+10.00 Sta 24+83.01 Sta 34+50.21
Sound Wall 3	18" Cast-In-Steel-Shell Pile	Sta 10+00 to Sta 10+35

Add to section 49-2.01A(3)(b):

Before installing driven piles, submit a driving system submittal for each pile type for each of the support locations or control zones shown in the following table:

Bridge no.	Pile type	Support location or control zone
24-0388	PP 30 X 1.0	Bents 1 through 5
24-0388	PP 30 X 1.0	Bent 6
24-0388	PP 30 X 1.0	Bents 7 through 11

Replace *Reserved* in section 49-2.01A(4)(b) with:

Drive piles for sound walls to the specified tip elevation or penetration shown. Section 49-2.01A(4)(c) and the 8th paragraph of section 49-2.01C(5) do not apply to driven piles for sound walls.

Add to section 49-2.01C(3):

For sound walls, drilling through the center of steel pipe piles to attain the specified tip elevation may be necessary. The diameter of the drilled hole must be less than the inside diameter of the pile. Equipment or methods used for drilling holes must not cause quick soil conditions or cause scouring or caving of the hole. Drilling must not extend below the specified tip elevation. Do not drill before driving piles.

Add to section 49-2.01C(4):

At existing embankments and fills, drive piles in predrilled holes at the locations and to the bottom of hole elevations shown in the following table:

Bridge name or no.	Abutment no.	Bent no.	Bottom of hole elevation
24-0296R/L	1		10
24-0296R/L	6		5
24-0296R/L		3	-2
24-0296R/L		4	3
24-0262R/L	1,14		2

Add to section 49-2.01C(5):

At Bridge no. 24-0262R/L, piles should be driven sequentially at each support from left to right, or right to left. If piles do not attain the nominal driving resistance at a penetration of 2 feet above the specified tip elevation shown, you may allow them to stand for a set period without driving. The set period must be at least 24 hours. If the piles do not attain the nominal driving resistance at a penetration of 0.5 feet above specified tip elevation shown, you must allow them to stand for a set period without driving. The set period must be at least 72 hours.

After the set period has elapsed, redrive 2 piles or 10 percent of the piles in the bent, whichever is greater. The Engineer designates which piles are to be redriven. Redriving consists of operating the driving hammer at full rated energy on the pile and calculating the nominal driving resistance of the pile.

For Bridge no. 24-0296, install the piles at the center of the each footing first and progress toward the perimeter after driving the piles at the center.If the first 2 piles at the support do not obtain required nominal resistance at the specified tip, 2 piles located at opposite sides of the footing must be driven to a tip elevation of 2 feet above their specified tip elevation. Allow these piles to stand for a set period of at least 48 hours without driving. After the set period has elapsed, redrive these 2 piles to the specified tip elevation. Redriving consists of operating the driving hammer at full rated energy on the pile and calculating the nominal driving resistance of the pile.

If the nominal driving resistance is attained for each pile designated to be redriven, the remaining piles in that footing are considered satisfactory and further driving is not required. If redriving the designated piles demonstrates that the nominal driving resistance has not been attained, redrive all piles in the footing until the nominal driving resistance is attained.

Add to section 49-2.01C(6):

Any pile at Bridge no.s 24-0388, 24-0262R/L, and 24-0296R/L that attains 1.5 times the required nominal resistance in compression as shown on the contract plans, within 5 feet of the specified tip elevation, may be considered satisfactory and cut-off with written approval from the Engineer.

Replace *Reserved* in section 49-2.04C(3) with:

You may splice piles at Abutment 6 at Bridge no. 24-0296 .

Locate splices at least 1/2 the distance from the bottom of footing elevation to the specified tip elevation.

Splice piles by the dowel and sleeve splice method.

Epoxy mortar for use with dowel splices must consist of a mixture of epoxy binder and aggregate. The epoxy mortar must comply with section 95-1.02C. The mix proportions of epoxy mortar must be 1 part binder to 1 part aggregate by volume. Aggregate must consist of a combination of 1 part material passing the No. 30 sieve and 3 parts material passing the No. 20 sieve.

You may substitute epoxy for the epoxy mortar specified for the dowel splice. Epoxy must comply with section 95-1.02C.

Forms for retention of epoxy mortar or epoxy for the dowel splice must be mortar tight.

Epoxy for use with sleeve splices must comply with section 95-1.02H.

Sleeve splice material must comply with section 75-3 except galvanizing is not required.

After insertion into the bottom portion of the pile, hold the top portion rigid until the epoxy has cured.

Add to section 49-3.02A(1) :

The CIDH concrete piles shown in the following table are specified as end bearing:

Bridge name or no.
Sound Wall 1
Sound Wall 2

Add to section 49-3.02B(6)(c):

The synthetic slurry must be one of the materials shown in the following table:

Material	Manufacturer
SlurryPro CDP	KB INTERNATIONAL LLC 735 BOARD ST STE 209 CHATTANOOGA TN 37402 (423) 266-6964
Super Mud	PDS CO INC 105 W SHARP ST EL DORADO AR 71731 (870) 863-5707
Shore Pac GCV	CETCO CONSTRUCTION DRILLING PRODUCTS 2870 FORBS AVE HOFFMAN ESTATES IL 60192 (800) 527-9948
Terragel or Novagel Polymer	GEO-TECH SERVICES LLC 220 N. ZAPATA HWY STE 11A-449A LAREDO TX 78043 (210) 259-6386
BIG FOOT	MATRIX CONSTRUCTION PRODUCTS 50 S MAIN ST STE 200 NAPERVILLE IL 60540 (877) 591-3137
POLY-BORE	BAROID INDUSTRIAL DRILLING PRODUCTS 3000 N SAM HOUSTON PKWY EAST HOUSTON TX 77032 (877) 379-7412

Use synthetic slurries in compliance with the manufacturer's instructions. Synthetic slurries shown in the above table may not be appropriate for a given job site.

Synthetic slurries must comply with the Department's requirements for synthetic slurries to be included in the above table. The requirements are available from the Offices of Structure Design, P.O. Box 168041, MS# 9-4/11G, Sacramento, CA 95816-8041.

SlurryPro CDP synthetic slurry must comply with the requirements shown in the following table:

SlurryPro CDP

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 67.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 50–120 ≤ 70
pH	Glass electrode pH meter or pH paper	6.0–11.5
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Super Mud synthetic slurry must comply with the requirements shown in the following table:

Super Mud

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 64.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 32–60 ≤ 60
pH	Glass electrode pH meter or pH paper	8.0–10.0
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Shore Pac GCV synthetic slurry must comply with the requirements shown in the following table:

Shore Pac GCV

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 64.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 33–74 ≤ 57
pH	Glass electrode pH meter or pH paper	8.0–11.0
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Terragel or Novagel Polymer synthetic slurry must comply with the requirements shown in the following table:

Terragel or Novagel Polymer

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 67.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 45–104 ≤ 104
pH	Glass electrode pH meter or pH paper	6.0–11.5
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

BIG-FOOT synthetic slurry must comply with the requirements shown in the following table:

BIG-FOOT

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 64.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 30–125 55-114
pH	Glass electrode pH meter or pH paper	8.5–10.5
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

POLY-BORE synthetic slurry must comply with the requirements shown in the following table:

POLY-BORE

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 62.8-65.8[a] 62.8-64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 50–80 50-80
pH	Glass electrode pH meter or pH paper	7.0–10.0
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Add to section 49-3.02C(1):

If the piling center-to-center spacing is less than 3 pile diameters, do not drill holes or drive casing for an adjacent pile until 24 hours have elapsed after concrete placement in the preceding pile and your prequalification test results for the concrete mix design show that the concrete will attain at least 1800 psi compressive strength at the time of drilling or driving.

Add to section 49-3.02C(4):

If the hole is drilled below the specified tip elevation shown, the reinforcement must extend to within 3 inches of the bottom of the drilled hole for the piles that are specified as end bearing.

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51 CONCRETE STRUCTURES

Add to section 51-1.01A:

Closure plate at barrier slab must comply with section 75-3 for concrete anchorage devices.

Concrete for joint reconstruction at the existing hinge at bridge no.24-0296 and existing joint at bridge no. 24-0265 may be constructed using RSC.

If you are unable to complete bridge reconstruction activities before the bridge is to be opened to traffic, furnish and maintain temporary decking under section 48-4 until that portion of the work is complete.

Add to section 51-1.01C(1):

If the methacrylate crack treatment is performed within 100 feet of a residence, business, or public space, submit a public safety plan that includes:

1. Public notification letter with a list of delivery and posting addresses. The letter must describe the work to be performed and state the treatment work locations, dates, and times. Deliver the letter to residences and businesses within 100 feet of overlay work and to local fire and police officials not less than 7 days before starting overlay activities. Post the letter at the job site.
2. Airborne emissions monitoring plan. A CIH certified in comprehensive practice by the American Board of Industrial Hygiene must prepare and execute the plan. The plan must have at least 4 monitoring points including the mixing point, application point, and point of nearest public contact. Monitor airborne emissions during overlay activities.
3. Action plan for protecting the public if levels of airborne emissions exceed permissible levels.
4. Copy of the CIH's certification.

After completing methacrylate crack treatment activities, submit results from monitoring production airborne emissions as an informational submittal.

Replace the 2nd paragraph of section 51-1.01C(1) with:

Submit a deck placement plan for concrete bridge decks. Include in the placement plan your method and equipment for ensuring that the concrete bridge deck is kept damp by misting immediately after finishing the concrete surface.

Add to section 51-1.02B:

Concrete for concrete bridge decks must contain polymer fibers. Each cubic yard of concrete must contain at least 1 pound of microfibers and at least 3 pounds of macrofibers.

Concrete for concrete bridge decks must contain a shrinkage reducing chemical admixture. Each cubic yard of concrete must contain at least 3/4 gallon of a shrinkage reducing admixture. If you use the maximum dosage rate shown on the Authorized Material List for the shrinkage reducing admixture, your submitted shrinkage test data does not need to meet the shrinkage limitation specified.

Replace the paragraphs of 51-1.02D with:

RSC used to reconstruct existing joints must have a minimum specified compressive strength of 3600 psi at the age of break.

If you use chemical admixtures or SCMs in RSC, the same proportions must be used when testing.

Aggregate must be on the Authorized Material List for innocuous aggregate or your proposed mix design must comply with one of the following:

1. Any hydraulic cement, with or without any proposed SCM, must be have an expansion ratio of less than 0.10 percent when tested with glass aggregate under ASTM C1260. Test specimens must be prepared using proportions of ingredients under ASTM C441.
2. For portland cement, the quantity of SCM in your proposed mix design must satisfy equation 1 of section 90-1.02B(3).

The specifications for a reduction in the operating range and contract compliance for cleanness value and sand equivalent specified in section 90-1.02C(2) and section 90-1.02C(3) for aggregate do not apply to RSC used for a bridge element.

Add between the 3rd and 4th paragraphs of section 51-1.03G(1):

Fractured rib texture at Bridge no. 24E0018 includes the concrete cap and the groove.

Fractured rib texture with ribbon pattern at Bridge no.s 24E0019 and 24E0022 includes the concrete cap, the recess, the 1/2" relief ribbon pattern, the grooves, the 1 1/2" relief fractured rib texture and 3/4" relief fractured rib texture.

Fractured rib texture with curve pattern at Bridge no.s 24E0020 and 24E0021 includes the concrete cap, fractured rib texture, and the recess above the fractured rib texture.

Add to section 51-1.03G(1):

The 3/4" and 1-1/2" relief fractured rib concrete surface textures at Bridge no.s 24E0018, 24E0019, 24E0020, 24E0021, 24E0022, and 24-0388 must match the texture, and pattern of the corresponding referee sample available for inspection by bidders at 1801 30th street, Sacramento, CA 95816, 916-227-8006.

Replace the 2nd paragraph of section 51-1.03H with:

Cure the top surface of bridge decks by (1) misting and (2) the water method using a curing medium under section 90-1.03B(2). After strike off, immediately and continuously mist the deck with an atomizing nozzle that forms a mist and not a spray. Continue misting until the curing medium has been placed and the application of water for the water method has started. At the end of the curing period, remove the curing medium and apply curing compound on the top surface of the bridge deck during the same work shift under section 90-1.03B(3). The curing compound must be curing compound no. 1.

Delete the 4th paragraph of section 51-1.03H.

Replace the paragraphs of the RSS for section 51-1.03H with:

Section 90-3.03 does not apply to curing RSC for joint reconstruction. Cure joint reconstructed using RSC as follows:

1. Immediately after strike-off, continually mist the joint with water using atomizing nozzles. Continue misting until the concrete reaches a compressive strength of at least 2000 psi.
2. After misting, apply curing compound no. 1 to the joint under section 90-1.03B(3).

Repair any damage to the film of the curing compound with additional curing compound. Repairing damaged curing compound after the joint is opened to traffic is not required.

Add to section 51-2.02:

51-2.02G Bonded Joint Seals

51-2.02G(1) General

51-2.02G(1)(a) Summary

Section 51-2.02G includes specifications for installing bonded joint seals.

For the locations where bonded joint seals are shown, the table in the 4th paragraph of section 51-2.02A(1)(a) does not apply.

Bonded joint seals consist of a preformed joint seal adhesively bonded to the joint openings.

51-2.02G(1)(b) Definitions

Not Used

51-2.02G(1)(c) Submittals

Submit:

1. Certificate of compliance for each batch of seals
2. Manufacturer's recommendations for cleaning, preparing, and installing
3. Splice details
4. Adhesive information including name of adhesive, supplier, and technical data

51-2.02G(1)(d) Quality Assurance

For the 1st joint seal installed, a technical representative of the joint seal manufacturer must be present during cleaning, preparing, and installing.

51-2.02G(2) Materials

Adhesive must be 2 component type.

Bonded joint seals must be one of the systems shown in the following table, or equal:

Bonded joint seal system	Contact information
V-Seal Expansion Joint System	D.S. Brown Company 300 East Cherry Street North Baltimore, OH 45872 (419) 257-3561 Fax (419) 257-2200 www.dsbrown.com
Wabo SPS Joint Seal System	Watson Bowman Acme Corporation 95 Pineview Drive Amherst, NY 14228 (800) 677-4922 www.wbacorp.com
W-Seal Expansion Joint	D.S. TechStar, Inc 1219 West Main Cross Street Findlay, OH 45840 (419) 424-0888 www.techstar-inc.com

Joint seals delivered to the job site must be labeled with:

1. Manufacturer's name
2. Lot or batch number
3. Dates of manufacturing, packaging, and expiration

51-2.02G(3) Construction

Prepare joints under section 51-2.02B(3)(b).

Thoroughly clean contact surfaces and install bonded joint seals under the manufacturer's instructions.

You may make splices if authorized. Submit proposed splice locations and methods with your request for authorization. Seals must be manufactured full-length and then cut at the splice locations and rematched before splicing.

Shop and field splices must have no visible offset of exterior surfaces and no evidence of bond failure.

At the maximum joint closure, the top surface of the bonded joint seal must be at least 3/4 inch and not more than 1 inch below the deck surface.

Adhesive must not run down the joint face during installation.

51-2.02G(4) Payment

Not Used

Replace *Reserved* in section 51-5.03B with:

RSC is not allowed in the construction of Type N approach slabs at Bridge No.s 24-0262 and 24-0296.

Replace the 6th paragraph in section 51-5.03E with:

Except when using RSC, magnesium phosphate concrete, or modified high-alumina-based concrete, allow 12 hours between placing the paving notch extension and the approach slab.

^^

52 REINFORCEMENT

Replace section 52-4 with:

52-4 ELECTRIC-RESISTANCE WELDED STIRRUPS FOR CONCRETE BARRIER REINFORCEMENT CAGES

52-4.01 GENERAL

52-4.01A Summary

Section 52-4 includes specifications for welding longitudinal support wire to stirrups using electric-resistance welding (ERW) to partially fabricate reinforcing cages for concrete barriers.

Electric-resistance welded supports may be used only for concrete barrier stirrups on structures.

You may use ERW to weld support wire to no.5 reinforcing bars or smaller. The support wire must be W 6.5 or smaller.

52-4.01B Definitions

partially fabricated reinforcing cage: Stirrups for concrete barrier reinforcing cages held in position by welded longitudinal support wires.

lot: 150 count, or fraction thereof, of welds for each size of reinforcing bar and support wire and for each change to the welding equipment settings.

52-4.01C Submittals

52-4.01C(1) General

Not Used

52-4.01C(2) Certificate of Compliance

Submit a certificate of compliance for each shipment of partially fabricated cages. Include with the submittal:

1. Identification of each cage including lot numbers, welds traceable by welding clamp, and location tracking information.
2. Grade and size of welded reinforcement used for the stirrups and support wire.
3. For the reinforcing bar and support wire:
   3.1. Heat number
   3.2. Mill certificate

52-4.01C(3) Test Samples

Submit QA test samples to METS.

Include copies of certificates of compliance with the test samples.

52-4.01C(4) Welding Quality Control Plan

Submit 2 copies of a welding QC plan for each subcontractor or supplier performing ERW. The QC plan must include:

1. WPSs
2. Names and certifications of welding personnel
3. Welding procedures including current setting, welding clamp force, weld time, and hold time for each size of reinforcement to be welded
4. Welding equipment manufacturer's operating instructions including the recommended calibration frequency of the welding equipment
5. Documentation of ERW equipment calibration
6. Fabricator's *QC Process Control Manual*
7. Method for identifying welds and tracking lots

For the contents, format, and organization required for a welding QC plan, go to the METS website.

52-4.01C(5) Shop Drawings

Submit shop drawings showing the stirrup positioning, welded connections of the support wire to the stirrups, and welding equipment layout. Allow 15 days for the Engineer's review.

52-4.01C(6) Prefabrication Test Results

Submit the prefabrication test results within 3 days of prefabrication testing. The prefabrication test results must include:

1. Contract number
2. Bridge number
3. Welds identified by welding clamp
4. Reinforcement and support wire sizes
5. Test specimen length
6. Physical condition of test samples
7. Notable defects
8. Ultimate tensile strength of each sample
9. Location of necking area of each sample

Allow 3 business days for the Engineer's review.

52-4.01C(7) Quality Control Test Reports

Submit a QC test report within 7 days of testing for each lot. The report must be prepared by the authorized laboratory performing the testing. The report must be signed by the QC manager. For each lot, the report must include:

1. Contract number
2. Bridge number
3. Lot numbers with welds identified by welding clamp
4. Installed location of completed cages
5. Reinforcement and support wire sizes
6. Cage types
7. Cage lengths
8. Test specimen length
9. Physical condition of test samples
10. Notable defects
11. Ultimate tensile strength of each sample
12. Location of necking area of each test sample

Allow 3 business days for the Engineer's review.

52-4.01D Quality Assurance

52-4.01D(1) General

Provide a welding QC manager. The QC manager must be registered as a civil engineer in the State or currently certified as a CWI.

52-4.01D(2) Prewelding Meeting

Before submitting a welding QC plan, hold a prewelding meeting to discuss the work and the requirements for the welding QC plan. The meeting attendees must include the Engineer, your welding QC manager, and a representative from each entity performing welding or welding inspection.

52-4.01D(3) Test Samples

Samples must be a minimum length of 4 feet of bar reinforcing steel with a support wire welded at midpoint. You may furnish shorter length samples if authorized.

Prepare the samples using the same materials, procedures, equipment, and equipment settings used in the work.

The welding clamps that produce the samples are determined by the Engineer.

Prepare QC test samples and the Department acceptance test samples concurrently:

1. During fabrication of samples representing the 1st lot
2. From 1 of every 5 subsequent lots, or fraction thereof, randomly selected by the Engineer

After receiving notification that lots are ready for QC testing, the Engineer (1) randomly selects test samples to represent each lot and (2) places tamper-proof markings or seals on the test samples.

Before transporting test samples to an authorized laboratory and METS:

1. Securely bundle and package the test samples for each test in a way that preserves their condition during transportation
2. Identify each test sample by lot number and Contract number using weatherproof markings
3. Attach a completed Sample Identification Card to each bundle

If a sample show signs of tampering before testing, the sample is rejected.

52-4.01D(4) Quality Control

52-4.01D(4)(a) General

Test the samples for tensile strength under California Test 670, Section E, Part III, Tensile Test.

Tensile testing must be performed by an authorized laboratory. The laboratory must be on the Authorized Laboratories List for testing reinforcing steel splices.

52-4.01D(4)(b) Prefabrication Testing

Before the start of fabrication of production cages, prepare 4 samples from each welding clamp.

Notify the Engineer at least 5 business days before fabricating the samples.

If 3 or more of the 4 samples from each welding clamp attain the specified minimum tensile strength, the Department accepts the prefabrication test results.

If 2 of the 4 samples attain the specified minimum tensile strength, determine the cause of the failure and take corrective action as specified in section 52-4.01D(4)(c). Fabricate 4 additional samples from the clamp that produced the noncompliant samples, and perform tensile tests until at least 3 of the 4 samples attain the specified minimum tensile strength.

Do not start fabrication of production cages until the Department accepts the test results.

52-4.01D(4)(c) Fabrication Testing

During fabrication of production cages, for each lot prepare 8 test samples.

At least 5 business days before performing fabrication testing, notify the Engineer of:

1. Date of the testing
2. Location of the authorized laboratory where the tests will be conducted
3. Number of lots to be tested

Do not perform tests on test samples from bundles containing fewer than 8 samples. Test 4 of the samples. The Engineer determines the samples to be tested.

If 3 or more of the 4 samples from a lot attain the specified minimum tensile strength, the Department accepts the lot.

If 2 of the 4 samples from a lot attain the specified minimum tensile strength, perform additional tests on the remaining samples. If any of the additional samples do not attain the specified minimum tensile strength, the Department rejects the lot.

If a lot is rejected, stop production until the following corrective actions have been performed:

1. QC manager reviews your QC process
2. You have prepared a welding rejection mitigation report describing:
   2.1. Cause of the failure
   2.2. Method used to identify the cause of failure
   2.3. Identification of affected lots
   2.4. Provisions for preventing similar failures in future lots
   2.5. Procedure for repairing or replacing the welded connections in the rejected lot
3. Engineer has notified you that the welding rejection mitigation report is authorized

52-4.01D(5) Department Acceptance

The Department accepts lots based on your QC tension test results specified in section 52-4.01D(4)(c).

The Department performs tensile test on samples from the 1st lot and from 1 of every 5 subsequent lots, or fraction thereof, randomly selected by the Engineer.

If 3 or more of the 4 samples attain the specified minimum tensile strength, the Department accepts the lot.

If 2 of the 4 samples attain the specified minimum tensile strength, fabricate 4 additional samples using the same materials and welding machine settings as the noncompliant lot. If any of the 4 additional samples do not attain the minimum specified tensile strength, the Department rejects the lot.

If QC and Department acceptance testing results have different compliance determinations, the Department will perform QA testing for all subsequent lots until QC testing and the Department testing are consistent for 2 consecutive lots before resuming testing for 1 of every 5 lots, or fraction thereof, as determined by the Engineer.

52-4.02 MATERIALS

52-4.02A General

Reinforcing bars must comply with ASTM A706, Grade 60.

Support wire must comply with the specifications for plain wire in ASTM A1064.

The tensile strength of reinforcing bars with the support wire welded to the bar must be at least 80,000 psi.

52-4.02B Fabrication

Perform ERW at a fabrication shop using computer-controlled equipment.

Weld the support wire to the stirrups. The stirrups must be positioned as shown. The support wire must be capable of maintaining the dimensions, position, and shape of the stirrups until the cage is complete.

52-4.03 CONSTRUCTION

Provide bracing to avoid collapse of the cage during assembly, transportation, and placement as needed.

Field tack welding of support wire to reinforcement is not allowed.

Wiring longitudinal reinforcement at each stirrup intersection is not required.

52-4.04 PAYMENT

Not Used

^^

56 OVERHEAD SIGN STRUCTURES, STANDARDS, AND POLES

Replace *Reserved* in section 56-2.03B(2) with:

Section 56-2.03B(2) includes specifications for removing a sign structure.

Removing an overhead sign structure includes removing:

1. Frames, braces, supports, and brackets
2. Portions of foundations
3. Sign panels
4. Mounting hardware for light fixtures
5. Walkways, safety railing, gutter
6. Electrical equipment for sign lighting
7. Hardware
8. Posts

Removing a bridge mounted sign structure includes removing:

1. Frames, braces, supports, and brackets
2. Portions of foundations
3. Sign panels
4. Mounting hardware for light fixtures
5. Walkways, safety railing, and gutter
6. Electrical equipment for sign lighting
7. Hardware
8. Exposed ends of sign anchor bolts one-inch below the concrete surface.

You may abandon concrete foundations in place, except remove the top portion of the foundation, including anchor bolts, reinforcing steel, and conduits, to a depth of at least 3 feet below the adjacent finished grade. Backfill and compact the resulting holes with material at least equal in quality to the surrounding material.

Remove the sign's conduit and wiring to the nearest pull box. Remove fuses within spliced connections in the pull box.

Remove exposed ends of sign anchor bolts one-inch below the concrete surface by mechanical means. Do not remove bolts using flame-type or air-arc cutting equipment.

Voids remaining after removing sign anchor bolts must be filled with mortar under section 51-1.02F.

Replace *Reserved* in section 56-2.03B(5) with:

Section 56-2.03B(5) includes specifications for removing and installing a sign structure at a new location.

Remove foundations to a depth of at least 3 feet below the adjacent finished grade. Foundations include anchor bolts, reinforcing steel, conduit, and electrical wiring.

Remove wiring to the nearest pull box.

Add to section 56-3.01C(1):

The sign mounting hardware must be installed at the locations shown.

Set the Type 1 standards with the handhole on the downstream side of the pole in relation to traffic or as shown.

^^

58 SOUND WALLS

Add to section 58-2.02B:

The color of the CMUs of Sound wall 1, 2, and 3 must match shown color no.s .

The color of the CMUs replacing existing CMUs at sound wall near Bridge no. 24-0388 must match color of the pattern and color of the corresponding CMUs of the existing sound wall that has been removed.

Add to section 58-2.03A:

The angle of internal friction (ϕ) to be used with the plans for the soil at sound wall 1 is 35 degrees.

The angle of internal friction (ϕ) to be used with the plans for the soil at sound wall 2 and 3 is 30 degrees.

Replace *Not Used* in section 58-2.04 with:

The payment quantity for sound wall (masonry block)(modified) includes access gate (sound wall).

^^

60 EXISTING STRUCTURES

Add to section 60-2.01A:

Remove the following structures or portions of structures:

Bridge no./Structure name	Description of work
24-0265	Concrete barrier, portion of bridge deck, including the asphaltic plug joint seal, for joint reconstruction, portion of bridge deck for deck drainage system
24-0251	Concrete barrier
24-0252	Concrete barrier
24-0253	Concrete barrier, portion of bridge deck for deck drainage system
24-0255	Concrete barrier, bridge overhang, top of wingwall ,and portion of bridge deck for deck drainage system
24-0262	Bridge overhang, concrete barrier on the bridge and approach slabs, portion of wingwalls, portion of abutment diaphragms
24-0296	Bridge overhang, portions of bridge deck, concrete barrier on the bridge and approach slabs, portion of wingwalls, portion of abutment diaphragms, existing joint seal assembly and portion of bridge deck at the hinge for joint reconstruction
24-0388	Whole bridge and the portion of sound wall (masonry block)
24-4113	Top of wingwall
24-0266	Top of wingwall
Retaining Wall #489	Top of Retaining Wall

Add to section 60-2.02A(3):

For the following bridges or portions of bridges, allow the days shown in the following table for the review of the bridge removal work plan:

Bridge or portion of bridge	Review time (days)
24-0296	40

Replace the 5th paragraph of section 60-2.02C(1) with:

For bridge no.24-0388, temporary support shoring, temporary bracing, and protective covers must not encroach within 70 feet horizontally of the northbound lane and 61 feet horizontally of the southbound lane, and 16 feet vertically of any traffic lane or shoulder open to traffic.

For bridge no.24-0296, temporary support shoring, temporary bracing, and protective covers must not encroach within 24 feet horizontally, and 16.5 feet vertically of any traffic lane or shoulder open to traffic.

Replace item 4 in the list in the 1st paragraph in section 60-2.02C(2) with:

4. For bridge no.24-0388, provide the openings specified in section 12-4. If no openings are specified for removal work, provide a vertical opening of 16 feet and a horizontal opening of 70 feet for the northbound lane and 60 feet for the southbound lane for traffic.

Add to the list in the 1st paragraph in section 60-2.02C(2):

6. Falsework or supports for protective covers must not extend below the vertical clearance level or to the ground line at any location within the roadbed.

Add to section 60-3.02A:

Bridge deck repair and preparation work includes (1) repairing approach slabs and (2) preparing approach slabs to receive an overlay or a deck treatment.

Add to section 60-3.02C(7):

When abrasive blasting within 10 feet of traffic, remove the residue using a vacuum attachment operating concurrently with the blasting equipment.

Add to section 60-3.04A(1):

Bridge deck overlay work includes overlaying approach slabs.

Add to section 60-3.04B(1)(c):

Submit a public safety plan. The public safety plan must include:

1. Public notification letter with a list of delivery and posting addresses. The letter must describe the work to be performed and state treatment work locations, dates, and times. Deliver the letter to residences and businesses within 100 feet of the overlay work and to local fire and police officials at least 7 days before starting overlay activities. Post the letter at the job site.
2. Airborne emissions monitoring plan. A CIH certified in comprehensive practice by the American Board of Industrial Hygiene must prepare and execute the plan. The plan must have at least 4 monitoring points, including the mixing point, application point, and point of nearest public contact. Monitor airborne emissions during overlay activities.
3. Action plan for protecting the public if airborne emissions levels exceed permissible levels.
4. Copy of the CIH's certification.

Submit results from trial overlay airborne emissions monitoring before starting production work.

Submit results from production airborne emissions monitoring as an informational submittal after completing overlay activities.

Replace the 5th paragraph of section 60-3.04B(1)(d) with:

The completed trial overlay must demonstrate (1) compliance with these specifications, (2) that the work will be completed within the time allowed, and (3) suitability of the airborne emissions monitoring plan.

Replace the 5th paragraph of section 60-3.04B(3)(b) with:

Apply methacrylate resin at an approximate rate of 90 sq ft/gal.

Replace Reserved in section 60-3.06 with:

60-3.06 HIGH FRICTION SURFACE TREATMENT FOR BRIDGES

60-3.06A General

60-3.06A(1) Summary

Section 60-3.06 includes specifications for placing a high friction surface treatment (HFST) on concrete bridge decks, consisting of a multi-component resin binder topped with calcined bauxite aggregate.

HFST may be applied to the concrete deck by hand or automated application process. The Department is aware of at least one automated continuous application method and equipment that is covered by United States Patents 9,109,332 and 9,115,473.

60-3.06A(2) Definitions

batch: a specific quantity of material of homogenous composition that can be unambiguously identified, manufactured in a single operation or a series of operations according to a well-defined process.

60-3.06A(3) Submittals

60-3.06A(3)(a) General

Submit a certificate of compliance and certified test results for the resin binder and calcined bauxite aggregate. Test results must be from tests performed within 90 days from the date of submittal.

Submit a SDS for the resin binder and its components.

60-3.06A(3)(b) Quality Control Plan

Submit a QC plan. The plan review time is 15 business days.

The QC plan must include:

1. A schedule for both trial and production HFST work
2. Type of resin binder to be used, including manufacturer's recommended mixing and placement instructions
3. Description of equipment for placing, measuring, mixing, placing, and finishing HFST
4. Method of protecting areas not to receive HFST
5. Estimate of cure time at 50, 60, 70, 80, 90, and 100 degrees F
6. Safe storage and handling methods of HFST components
7. Disposal methods for excess HFST and containers
8. Contingency plans for possible equipment failure and material issues during placement
9. Name of the certified independent testing laboratory

60-3.06A(3)(c) Quality Control Testing Results

Submit QC test results for the quality characteristics within the reporting time allowance shown in the following table:

Quality Control Testing Results Reporting

Quality characteristic	Test method	Reporting time allowance
Los Angeles rattler loss at 100 revolutions	California Test 211	2 business days
Aggregate moisture content	California Test 226	2 business days
Aggregate soundness	ASTM C88	7 days
Aluminum oxide content	ASTM C25	7 days
Gradation	California Test 202	1 business day
Polish stone value	ASTM D3319	10 days
Aggregate acid insolubility	ASTM D3042	7 days
Resin binder spread rate	Calculate using amount placed	1 business day
Adhesive strength at 24 hours	ASTM C1583	2 business days
Coefficient of friction before opening to traffic	ASTM E1911	Same day of testing and before opening to traffic
Coefficient of friction 7-15 days after opening to traffic	ASTM E1911	1 business day after testing
Viscosity	ASTM D2196	2 business days
Elongation at break point	ASTM D638	2 business days
Ultimate tensile strength	ASTM D638	2 business days
Cure rate	AST D1640	1 business day
Gel time	ASTM C881	1 business day

60-3.06A(4) Quality Assurance

60-3.06A(4)(a) General

Not Used

60-3.06A(4)(b) Pre-construction Meeting

Schedule a pre-construction meeting with the Engineer at a mutually agreed time and place. Make the arrangements for the meeting facility. Be prepared to discuss:

1. Quality assurance
   - 1.1. QC plan
   - 1.2. Quality control
   - 1.3. Acceptance criteria
2. Placement of materials
   - 2.1. Trial HFDST requirements
   - 2.2. Application rates
   - 2.3. Binder resin mixing methods and equipment
   - 2.4. HFDST application methods and equipment
3. Contingency plan
4. Issues specific to the project
   - 4.1. Weather
   - 4.2. Alignment and geometrics
   - 4.3. Traffic control issues

Attendance at the pre-construction meeting is mandatory for:

1. HFST Supplier
2. HFST Foreman
3. Project Superintendent
4. QC Manager
5. Traffic Control Foreman

60-3.06(4)(c) Trial Application

Unless otherwise authorized, complete a trial application of HFST at an authorized location before starting HFST production work.

The trial HFST application must:

1. Be at least 12 feet wide by 20 feet long.
2. Be constructed using the same equipment as the production work.
3. Replicate field conditions anticipated for the production work, including ambient and deck surface temperatures.
4. Demonstrate surface preparation requirements as outlined in the QC plan.
5. Determine the initial set time for the resin binder.

Remove pavement markers and delineation within the area to receive HFST.

After applying the trial HFST, document:

1. Settings on the applicator equipment
2. Initial quantities of resin and aggregate topping
3. Unused quantities of resin binder and aggregate remaining in the applicator equipment
4. Total deck surface treated with HFST

Test the coefficient of friction of the trial HFST under ASTM E1911 at 20, 40, 60, and 80 km/h. If the coefficient of friction of the HFST at 60 km/h is less than 0.75, correct or replace the trial HFSDS until the coefficient of friction is equal to or greater than 0.75.

60-3.06A(4)(d) Quality Control

60-3.06A(4)(d)(i) General

Perform QC testing for HFST trial and production work. Except for coefficient of friction testing, QC testing must be performed by independent laboratories.

60-3.06A(4)(d)(ii) Sampling and Testing Frequency

Perform sampling and testing for calcined bauxite at the specified frequencies and sampling locations for the following quality characteristics:

Calcined Bauxite Sampling Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Los Angeles rattler loss at 100 revolutions	California Test 211	1st day of production	Point of application or stockpile
Aggregate moisture content	California Test 226	1 per shift	Point of application or stockpile
Aggregate soundness	ASTM C88	1st day of production	Point of application or stockpile
Aluminum oxide content	ASTM C25	1st day of production	Point of application or stockpile
Gradation	California Test 202	1st day of production	Point of application or stockpile

Perform sampling and testing for resin binder at the specified frequencies and sampling locations for the following quality characteristics:

Resin Binder Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Viscosity	ASTM D2196	1 per batch	Point of application
Elongation at break point	ASTM D638	1 per batch	Point of application
Ultimate tensile strength	ASTM D638	1 per batch	Point of application
Cure rate	ASTM D1640	1 per batch	Point of application
Gel time	ASTM C881	1 per batch	Point of application

Perform testing for HFST at the specified frequencies and sampling locations for the following quality characteristics:

High Friction Surface Treatment Testing Requirements

Quality characteristic	Test method	Minimum testing frequency	Location of testing
Resin binder spread rate	Calculate based on materials used	1 per day of production	Point of application
Adhesive strength at 24 hours	ASTM C1583	1 per day of production	Point of application
Coefficient of friction before opening to traffic	ASTM E1911	Minimum of 1 test every 500 linear feet[a]	Alternate between wheel paths
Coefficient of friction 7-15 days after opening to traffic	ASTM E1911	Minimum of 1 test every 500 linear feet[a]	Alternate between wheel paths

[a]For bridges less than 500 feet long, test a minimum of 2 locations

60-3.06A(4)(e) Department Acceptance

60-3.06A(4)(e)(i) General

The Department accepts HFST based on:

1. Visual inspection
2. Department's sampling and testing of calcined bauxite
3. Department's sampling and testing of resin binder
4. Your coefficient of friction and adhesion testing

Visual inspection criteria include:

1. Uniform surface texture
2. Raveling, which consists of the separation of the aggregate from the resin binder
3 Streaking, which consists of alternating longitudinal bands of resin binder without uniform calcined bauxite aggregate retention, approximately parallel with the lane line
4 Flushing, which consists of resin binder without or fully embedded calcined bauxite aggregate

Replace areas of non-uniform texture, undulations, raveling, streaking, or flushing greater than 0.25 sq ft.

The Department tests calcined bauxite aggregate for compliance with the requirements shown in the following table:

Calcined Bauxite Acceptance Criteria

Quality characteristic	Test method	Requirement
Los Angeles rattler loss at 100 revolutions (max, %)	California Test 211 Table 1, Grading D	10
Aggregate moisture content (max, %)	California Test 226	0.2
Sand equivalent (min)	California Test 217	95
Gradation (% passing by weight)	California Test 202	
No. 4 sieve		100
No. 6 sieve		95
No. 16 sieve		5

The Department tests resin binder for compliance with the requirements shown in the following table:

Resin Binder Acceptance Criteria

Quality characteristic	Test method	Requirement
Viscosity (centipoise)	ASTM D2196	1,000-3,000
Cure rate (max, hours)	ASTM D1640	3
Gel time (minutes)	ASTM C881	10-30
Elongation at break point (min, %)	ASTM D638	30
Ultimate tensile strength (min, psi)	ASTM D638	2,650

The Department accepts your test results of HFST for compliance with the requirements shown in the following table:

High Friction Deck Surface Treatment Acceptance Criteria

Quality characteristic	Test method	Requirement
Adhesion (min, psi)	ASTM C1583	250
Coefficient of friction (min at 60 km/h)	ASTM E1911	
Before opening to traffic		0.75
7-15 days after opening to traffic		0.75

Perform coefficient of friction calibration and testing in the presence of the Engineer. Notify the Engineer at least 48 hours before coefficient of friction testing.

60-3.06B Materials

60-3.06B(1) General

The resin binder must be either an epoxy-based resin complying with section 60-3.06B(1) or a polyester resin complying with section 60-3.04B(2).

The epoxy-based resin binder must (1) be multi-component and (2) comply with the requirements shown in the following table:

Epoxy-Based Resin Binder Requirements

Quality characteristic	Test method	Requirement
Tensile strength (min, psi) Type 1 specimen at 25 ±1°C	ASTM D638	2,650
Elongation at break point (min, %) Type 1 specimen at 25 ±1°C	ASTM D638	30
Compressive strength at 3 hours (min, psi)	ASTM C579	1,000
Water Absorption (max, %)	ASTM D570	1.0
Shore D Hardness (min, at 25°C)	ASTM D2240	60-80
Viscosity[a] (centipoise, at 25 ±1°C) RV, no. 2 spindle, 20 RPM	ASTM D1084	1,000-3,000
Gel time (minutes)	ASTM C881	10-30
Cure rate (max, hours, dry-through time) 0.05-inch thick specimen	ASTM D1640, Method A	3

[a]Mix components for resin binder and measure viscosity after 3 minutes

The calcined bauxite aggregate must (1) be clean, dry, and free from clay and any other deleterious material and (2) comply with the requirements shown in the following table:

Calcined Bauxite Aggregate Requirements

Quality characteristic	Test method	Requirement
Los Angeles rattler loss at 100 revolutions (max, %)	California Test 211, Table 1, Grading D	10
Polish stone value (min)	ASTM D3319	38
Aggregate acid insolubility (min, %)	ASTM D3042	90
Aggregate soundness (max, %) Tested with magnesium sulfate solution Tested with sodium sulfate solution	ASTM C88	 30 10
Aluminum oxide content (min, %)	ASTM C25	87
Sand equivalent (min)	California Test 217	95
Aggregate moisture content (max, %)	California Test 226	0.2
Aggregate grading (% passing) No. 4 sieve No. 6 sieve No. 16 sieve	California Test 202	 100 95 5

60-3.06C Construction

60-3.06C(1) General

Do not begin production HFST work until the trial HFST has been authorized.

Concrete deck surfaces must be at least 30 days old before applying HFST.

60-3.06C(2) Surface Preparation

Protect utilities, drainage structures, curbs, and other structures within or adjacent to treatment location from HFST materials.

Remove pavement markers and delineators to a maximum depth of 0.01 foot from the area receiving HFST before resin binder application.

Prepare concrete deck surfaces to be treated under section 60-3.02C(7).

Surfaces to receive HFST must be clean, dry, and free of any dust, oil, debris, organic matter or any material that may interfere with the bond between the resin binder and existing surface.

If you use polyester resin as the resin binder, apply a methacrylate resin treatment under section 60-3.04B(3)(b) before applying HFST.

60-3.06C(3) Mixing and Application

60-3.06C(3)(a) General

Apply HFST under the manufacturer's recommendations using one of the following methods:

1. Automated continuous application
2. Hand mixing and aggregate broadcast application

Apply polyester resin binder when the ambient temperature is at least 45 degrees F. Apply epoxy-based resin binder when the ambient temperature is at least 50 degrees F. Do not apply resin binder when the ambient temperature is above 100 degrees F.

Apply resin binder to a clean, dry deck surface. Spread resin binder at a minimum rate of 0.45 gal/sq yd.

Spread calcined bauxite at a minimum rate of 13 lb/sq yd within 5 minutes of applying resin binder.

Cure HFST for a minimum period recommended by the supplier. Do not allow vehicles and construction equipment on the HFST during curing.

Remove and replace resin binder material that has not completely cured within 3 hours of application before opening the treated bridge to traffic.

The surface texture of HFST must be uniform in appearance. Any areas free of HFST must be covered by HFST and cured before opening the area to traffic.

60-3.06C(3)(b) Automated Continuous Application

Perform automated continuous application using an applicator vehicle with the following capabilities:

1. Equipped to heat resin binder material
2. Continuously mixes, meters, and monitors HFST components during application activities
3. Equipped with a built-in data management unit producing real time data showing
   - 3.1. Volume of resin binder applied
   - 3.2. Average resin binder thickness in mils across the width of application
   - 3.3. Weight of aggregate applied across the application width
4. Uses continuous pumping and portioning devices that blend the binder within a controlled system using positive displacement geared pumps
5. Mixes the binder with a tolerance of ±2 percent by volume
6. Has a non-atomizing laminar extruded application bar tied to the forward motion of the application vehicle through an automated self-contained vehicle drive
7. Can apply resin binder and aggregate at the minimum spread rate
8. Applies resin binder and aggregate in a continuous pass as 1 layer to a width of up to 12 feet

Clean the mix head and delivery lines if application of the mixed resin binder is stopped for more than 30 minutes.

Apply the aggregate within 6 seconds of the binder application onto the pavement surface from a maximum height of 12 inches.

Replace any exposed sections of uncured resin binder that are contaminated.

Apply additional layers within 4 hours of the previous cured layer.

60-3.06C(3)(c) Hand Mixing and Application

For authorized low volume areas and areas less than 200 square yards, hand mix the resin binder under the manufacturer's recommendations. Uniformly spread the resin binder onto the surface using a serrated edge squeegee. Apply aggregate immediately after placing resin. Use only authorized footware if walking on resin during aggregate application.

60-3.06C(3)(d) Excess Aggregate Removal and Reuse

You may reuse excess aggregate. Reclaim excess aggregate using a mechanical sweeper. Recovered calcined bauxite aggregate for reuse must be clean, dry, and uncontaminated. Recycled aggregate for reuse must comply with gradation requirements for new aggregate. You may combine new and recycled aggregate as necessary to meet gradation requirements.

Remove excess and loose aggregate from the deck by street sweeping after the resin has hardened. Perform a second street sweeping 24-48 hours after the initial sweeping and before placing pavement markers and delineation.

60-3.06D Payment

Not Used

Replace section 60-4.11 with:

60-4.11 Pipe Shear Key

Pipe shear key must comply with the requirements for pipe-type restrainers in section 60-4.09.

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1. Controlled low-strength material under section 19-3.02G
2. Slurry cement backfill under section 19-3.02E

Ends of culverts and pipelines must be securely closed by a 6-inch-thick, tight-fitting plug or wall of commercial-quality concrete.

71-6.03D Payment

If backfilling inside the culvert or pipeline is required, payment for backfilling inside the culverts or pipelines is included in the payment for abandon culvert or abandon pipeline. Payment for backfilling outside the culvert or pipeline is included in the payment for abandon culvert or abandon pipeline.

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74 PUMPING EQUIPMENT AND CONTROLS

Add to section 74-1.01C(1):

Submit separate submittal packages for each pumping plant location.

Replace 3rd paragraph in section 74-1.01C(2) with:

Submit shop drawings for the electrical equipment including:

1. Electrical equipment schematics
2. Control diagrams
3. Wiring diagrams
4. Conductor numbers for control and power conductors
5. Equipment plan layout, elevation and sections
6. Sequence of operation
7. Pump controller ladder logic program
8. Pump controller register database tags
9. Detailed test procedure for the factory equipment test
10. Display screens

Add to item list of 1st paragraph of section 74-1.01C(6):

7. Copy of the pump controller ladder logic program saved on external USB storage media as an executable file
8. Copy of pump controller register database tags in Microsoft Excel spreadsheet format
9. Licensed copy of the pump controller manufacturer software to open the executable file
10. Troubleshooting procedures for hardware supplies

Add to section 74-1.01C(6):

Submit a separate maintenance and operational manual for each pumping plant location.

Replace the 2nd paragraph of section 74-1.01D(2)(c) with:

Performance tests must show that each installed drainage pump complies with at least (1) 95 percent of the factory certified performance curve and (2) the design pump rates shown. Each pump must not load its motor more than the actual full load nameplate amperage, regardless of head. The motor service factor will not be applied.

Add to 1st paragraph of section 74-2.01C(2):

7. Vacuum breaker valves, gate valves and check valves.
8. Access hatch.

Replace the paragraphs in 74-2.02B(2) with:

74-2.02B(2)(a) Wet-Pit Submersible Drainage Pump

Drainage pumps must be wet-pit submersible type as shown, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal wastewater pumps complying with ANSI/HI 1.1-1.2 and ANSA/HI 1.3. Pumps must be assembled and tested at the factory. Do not use a base elbow mounted pump. Drainage pumps must be coated with the manufacturer's standard finish for the intended use.

Drainage pumps must be the rpm and voltage shown and comply with the design pump rates and dynamic head shown.

Drainage pumps must have cast iron:

1. Casings
2. Brackets
3. Volutes with open inlet
4. Horizontal pump discharges

Drainage pumps must have a base support engineered to allow design flow into the volute and support the assembled weight of the drainage pump. Base support legs must be bolted to the floor.

Drainage pumps must have (1) replaceable bronze or 300-series stainless steel wear rings on the impeller and casing, and (2) non-metallic stainless steel external nuts and bolts.

Drainage pump impellers must be:

1. Dynamically balanced.
2. Made from ductile iron, bronze or equal as approved by the Engineer.
3. Nonclog type, open or semi-open design for sludge, and able to handle solids up to 3 inches.
4. Trimmed to develop from 95 to 98 percent of the motor nameplate power at the point of maximum load and still deliver at least the design pump rates and dynamic heads shown.
5. Keyed and secured to the shaft. The impeller balancing must not weaken or deform the impeller.

Drainage pumps must have a stainless steel shaft with factory-sealed lubricated roller bearings, tandem double-mechanical seals of tungsten carbide or silicon carbide with an oil reservoir, and have internal moisture sensors in the oil reservoir.

Motors must be standard efficiency, NEMA code letter “A” through “G”, 3-phase NEMA Design B motor with cable assembly. The cable assembly must include a 4-conductor power cable and a 5-conductor control cable. The motor with cable assembly must be rated for Class 1, Division 1 locations.

Motors must have NEMA Class F insulation, built in thermal insulation, with lifting eyes or lugs.

The cables must be listed for Extra Hard Service for Class 1, Division 2 locations. Each cable must include an equipment grounding conductor with green or green with yellow stripe insulation. The cables must be long enough to be installed from the motor to the enclosure shown without splicing. Install cable connectors for termination in the junction box.

Each drainage pump must have a motor nameplate and pump identification nameplate. Attach identical nameplates to the inside of the corresponding starter compartment door on the motor control cabinet.

74-2.02B(2)(b) Dry-Pit Submersible Drainage Pump

Drainage pumps must be dry-pit submersible type as shown, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal wastewater pumps complying with ANSI/HI 1.1-1.2 and ANSA/HI 1.3. Pumps must be assembled and tested at the factory. Do not use a base elbow mounted pump. Drainage pumps must be coated with the manufacturer’s standard finish for the intended use.

Drainage pumps must be the rpm and voltage shown and comply with the design pump rates and dynamic head shown.

Drainage pumps must have cast iron:

1. Casings
2. Brackets
3. Volutes with open inlet
4. Horizontal pump discharges
5. Long radius elbow for attachment to suction side flange

Drainage pumps must have a base support engineered to support the assembled weight of the drainage pump. Base support legs must be designed to bolt to the concrete base for support and alignment to the suction piping. The motor and impeller assembly must be able to be removed for periodic maintenance and repair without the need to remove the volute or disconnect any suction or discharge piping. Prior to installing the concrete base and setting the pump, verify adequate clearances.

Drainage pumps must have (1) replaceable bronze or 300-series stainless steel wear rings on the impeller and casing, and (2) non-metallic stainless steel external nuts and bolts.

Drainage pump impellers must be:

1. Dynamically balanced.
2. Made from ductile iron, bronze or equal as approved by the Engineer.
3. Nonclog type, open or semi-open design for sludge, and able to handle solids up to 3 inches.
4. Trimmed to develop from 95 to 98 percent of the motor nameplate power at the point of maximum load and still deliver at least the design pump rates and dynamic heads shown.
5. Keyed and secured to the shaft. The impeller balancing must not weaken or deform the impeller.

Drainage pumps must have a stainless steel shaft with factory-sealed lubricated roller bearings, tandem double-mechanical seals of tungsten carbide or silicon carbide with an oil reservoir, and have internal moisture sensors in the oil reservoir.

Motors must be standard efficiency, NEMA code letter “A” through “G”, 3-phase NEMA Design B motor with cable assembly. The cable assembly must include a 4-conductor power cable and a 5-conductor control cable. The motor with cable assembly must be rated for Class 1, Division 1 locations.

Motors must have NEMA Class F insulation, built in thermal insulation, with lifting eyes or lugs.

The cables must be listed for *Extra Hard Service* for Class 1, Division 2 locations. Each cable must include an equipment grounding conductor with green or green with yellow stripe insulation. The cables must be long enough to be installed from the motor to the enclosure shown without splicing. Install cable connectors for termination in the junction box.

Each drainage pump must have a motor nameplate and pump identification nameplate. Attach identical nameplates to the inside of the corresponding starter compartment door on the motor control cabinet.

Add before the 1st paragraph of section 74-2.02B(3):

Vacuum breaker valves must be flanged, have an iron body, have a cast bronze or aluminum bronze seat and plug with a Buna-N seal, and stainless steel trim. The spring must be ASTM A313 type 316 stainless steel designed for 100,000 cycles without failure and must provide a cracking pressure of 0.25 psi and be fully open at 2 psi.

Gate valves must be flanged, have an iron body with bronze trim, removable bonnet and non-rising stem, tapered solid wedge disc and be class 125. Gate valves must comply with ASME B16.10 and ASME B16.1.

Check valves must be flanged, be swing type, have an iron body and removable cap, be class 150, and comply with ASME B16.34 and ASME B16.10.

Replace the 2nd paragraph of section 74-2.02C(1) with:

Hinges must comply with ANSI/BHMA A156.26. Locksets must comply with ANSI/BHMA A156.2. Door gasketing must comply with ANSI/BHMA A 156.22. Thresholds must comply with ANSI/BHMA A156.21.

Replace the 5th paragraph of section 74-2.02C(2) with:

Hinges must be continuous geared aluminum hinge, Pemko or equal.

Replace section 74-2.02C(4) with:

74-2.02C(4) Access Hatch

Access hatch must be mill finish aluminum diamond plate, reinforced for 300 pounds per square foot live load and must have:

1. Heavy duty forged stainless steel type 316 hinges and pins.
2. Standard stainless steel type 316 slam lock with removable cover plug and square key wrench.
3. Stainless steel spring lifting mechanism.
4. Automatic hold open arm.
5. Stainless steel lock strike.
6. 1/4” aluminum channel frame with bituminous coating applied to the frame exterior.

Replace the 1st paragraph of section 74-3.01A with:

Section 74-3 includes specifications for installing pumping plant electrical equipment, fiber termination enclosure and hiring a system integrator to perform modification to the Departments existing Supervisory Control And Data Acquisition system (SCADA).

Replace Reserved in section 74-3.01B with:

CPU: Central Processing Unit

I/O: Input/output

IT: Information Technology

LTE: Long Term Evolution

PLC: Programming Logic Controller

SCADA: Supervisory Control And Data Acquisition

SIM: Subscriber Identity Module

UPS: Uninterruptable Power Supply

VPN: Virtual Private Network

Add to the list in 1st paragraph of section 74-3.01C(2) with:

7. Fiber Termination Enclosure

Replace Reserved in section 74-3.01D(1) with:

A factory test of the completed system must be witnessed by the Engineer.

The factory test must include:

1. Motor control center
2. Fiber termination enclosure
3. Communication link with the Departments existing SCADA system.

The testing must include dummy inputs and outputs signals to mimic the signals from field instrumentation devices. Include failure modes in the testing. Do not ship the equipment until you receive written authorization.

The factory testing of the communication link with the Departments existing SCADA system must be coordinated with the system integrator. Install the 4G cellular carrier private network SIM card into the VPN router to perform the communication testing between the pump controller and the Departments existing SCADA System.

Add to section 74-3.01D(3):

At contract acceptance, provide 12 months of manufacturer's field service support for the pump controller and fiber termination enclosure to resolve any hardware failures and communication issues with the Departments existing SCADA system at each pumping plant location.

Add to section 74-3.01D(4):

A manufacturer authorized service representative must inspect, test, and program the pump controller for each pumping plant location and coordinate with the system integrator for integrating the operation of the pump controller with the Departments existing SCADA system.

A manufacture authorized service representative must inspect, test, and program all the equipment's installed inside the fiber termination enclosure by coordinating with system integrator and with the Departments IT representative. A secure VPN tunnels between the pumping plant electrical equipment and the Departments SCADA server must be configured utilizing both the cellular carrier private network and Departments fiber backbone network.

The pump controller operation for each pumping plant location must be simulated utilizing the panel mounted operator interface at each location, from Departments existing SCADA system, and from a hand held tablet.

The operation of the power transfer switch and standby power receptacle must be tested at completion of the installation. Each pumping plant must be operated from a standby generator to test the operation of pumps and to test the standby power phase sequences.

Add to section 74-3.01D(5):

The system integrator must train 6 Departments personnel in remotely logging, controlling, troubleshooting and operating the Department existing SCADA system. The training must be for at least 4 hours at Departments District 3 Maintenance yard, located at 11325 Sanders Drive, Rancho Cordova, CA 95742.

At six months after contract acceptance, a manufacturer authorized service representative of pump controller must train 6 Departments personnel in operation and troubleshooting of the pump controller at the job site. The training must be for at least 4 hours.

Add to the end of the section 74-3.01:

74-3.01E Modifying Departments Existing SCADA System

74-3.01E(1) General

The Departments existing SCADA system must be modified to remotely operate and monitor the storm water pumping plants electrical equipment. The Department's existing SCADA system is located on Front Street in Sacramento, adjacent to southbound Route 5 and approximately 275 feet north of O Street.

You must hire Tesco Controls Inc. as system integrator to modify the Department's existing SCADA system. The Department utilizes central SCADA monitoring system in Sacramento for remotely monitoring and controlling various water treatment plants and tunnel lighting systems for facilities throughout the State.

Arrangements have been made to ensure that you can obtain the services to modify the Departments existing SCADA system directly from the warrantee provider and vendor, Tesco. The price quoted by Tesco for providing services to modify existing system is $43,000 and does not include taxes, discounts, or other conditions.

The quoted price is good until May 01, 2018.

Contact information for Tesco is:

Tesco Controls, Inc
P. O. Box 239012
Sacramento, CA 95823
Shain Thomas/Jerry Horst
(916) 395-8800

Tesco's quoted price includes providing the following services for the Department's existing SCADA system:

1. Modify existing SCADA system
2. Coordinate with the Pump Controller manufacture
3. Develop Stormwater Pumping Plant display screens and reporting for 5 pumping plant sites
4. Provide 3 years of pre-paid cellular carrier private network SIM cards for 5 locations
5. Start up and final commissioning of the complete SCADA system for 5 sites
6. 4 hours of training on the SCADA system for 6 designated State employees
7. Provide operation and maintenance manuals for operating the SCADA Display screens
8. Provide all required software licenses and hardware required at the SCADA server for integrating the pump controller
9. Provide support for up to 16 hours to modify the pumping plant display screens, for a duration of twelve months after project acceptance
10. 5-year system performance and operational warranty
11. Provide two handheld tablet computers with Intel Core i5 Processor, 128GB Hard Drive, 4GB RAM, MS Office Software, Keyboard Cover, Screen Protector, Rugged Military Grade Case (MIL-STD-810G), 4G cellular network card with pre-paid data plan to access the SCADA remotely
12. Provide two new Wonderware Historian Client 2014 R2 Concurrent User License for remote logins
13. Provide and install two way encrypted VPN tunnel router between the cellular carrier private network & SCADA server, with capability of providing two way encrypted VPN tunnels between SCADA server and remote fiber connected pump plant sites

The Department makes the provisions of the agreement with TESCO Controls Inc. available in the Information handout in the document titled "TESCO Sac 5 Corridor Quote No. 17D130Q01.pdf".

A signed Blanket Approval Of Cost Effectiveness/Public Interest Finding for utilizing TESCO Control Inc as system integrator is provided in the information handout in the document titled "Supervisory Control And Data Acquisition (SCADA) PIF.pdf" and is also available on the Department website at the following link.

http://des.onramp.dot.ca.gov/office-engineer/public-interest-findings-pifs-and-approved-pifs

74-3.01E(2) Existing Conditions

The Departments existing SCADA system uses Tesco Siteglas Enterprise SCADA system configuration software for all menu, overview, trends and report screens.

The existing Department sites currently being monitored and controlled by the existing system are:

1. Dewatering pump stations located near existing system in Sacramento County (District 03)
2. Water and wastewater treatment systems at C V Kane SRRA in San Bernardino County (District 08)
3. Water and wastewater treatment systems at Honey Lake SRRA in Lassen County (District 02)
4. Tunnel Lighting System at I-210 to State Hwy 134 Tunnels in Los Angeles County (District 07)

The existing SCADA server hardware is as follows:

1. PowerEdge R520 Rack Mounted Server
2. Intel 1.8 GHz Xenon E5-2403, Quad-Core CPU
3. 16GB RDIMM System RAM
4. (2) 500 GB SATA 3Gbps, 3.5 inch hot plug hard drive
5. S110, Software RAID Controller
6. Software RAID 1 for S110 Controller
7. DVD+/-RW, SATA, Internal

8. PCI Express x16 Graphics Card with 512 MB RAM
9. 3-Year Basic Hardware Warranty
10. Office Connect Dual 56K LAN Modem
11. 16-Port 10/100 MBits/sec Auto-Sensing Network Hub
12. Cat-5 LAN Cables, Connectors, Assembly
13. Cable Assemblies, External SCSI Cables

The existing server software is as follows:

1. Windows Server 2012, Standard Edition
2. 5-pack of Windows Server 2012 Remote Desktop Services
3. Microsoft Office Professional 2007
4. Symantec AntiVirus Corporate Edition
5. Norton System Works
6. SCADAlarm v6.0 w/SP2
7. Tesco's Siteglas MBTCP DAServer Version C
8. Tesco's Siteglass Development Software for Terminal Services
9. Tesco's Siteglass Terminal Services w I/O
10. ProWorx 32
11. Active Factory 9.2
12. Tesco's Siteglass Runtime for Terminal Services

The existing historical database server hardware is as follows:

1. PowerEdge R520 Rack Mounted Server
2. Intel 1.8 GHz Xenon E5-2403, Quad-Core CPU
3. 16GB RDIMM System RAM
4. (2) 500 GB SATA 3Gbps, 3.5 inch hot plug hard drive
5. S110, Software RAID Controller
6. Software RAID 1 for S110 Controller
7. DVD+/-RW, SATA, Internal
8. PCI Express x16 Graphics Card with 512 MB RAM
9. 3-Year Basic Hardware Warranty
10. Cat-5 LAN Cables, Connectors, Assembly
11. Cable Assemblies, External SCSI Cables

The existing historical database server software is as follows:

1. Windows Server 2012, Standard Edition
2. 5-pack of Windows Server 2012 Remote Desktop Services
3. Microsoft Office Professional 2007
4. Symantec AntiVirus Corporate Edition
5. Norton System Works
6. SCADAlarm v6.0 w/SP2
7. Tesco's Siteglas MBTCP DAServer Version C
8. Tesco's Siteglass Development Software for Terminal Services
9. Tesco's Siteglass Terminal Services w I/O
10. ProWorx 32
11. Active Factory 9.2
12. Tesco's Siteglass Runtime for Terminal Services

Other existing hardware and communication equipment is as follows:

1. APC 1500VA, 120VAC UPS
2. Power Distribution Unit
3. TRIPPLITE KVM switch/console, Netcontroller, 8 port
4. ADVANTECH 17" SXGA TFT LCD LED Backlit Touchscreen
5. CISCO 10 User VPN Firewall, Remote Network Access
6. CISCO Integrated Services Router, 4G, LTE, Verizon, 700 MHZ Band
7. CISCO Ethernet Managed Switch, Model #2955, 12 Port, 10/100 and 2 port 10/100/1000, @4 VDC powered

Existing software is as follows:

1. Wonderware, INTOUCH, Development Studio, 2014, UNLIM/60K/500 RDs, (LICENSE #964422)
2. Wonderware, INTOUCH, 2014, 60K TAG, With I/O RDS (LICENSE #964419)
3. Wonderware, INTOUCH, 2014, 60K TAG, Without I/O RDS (LICENSE #964425)
4. Wonderware, INTOUCH, 2014, 60K TAG, Without I/O RDS (LICENSE #958615)
5. Wonderware, HISTORIAN, CLIENT, 2014, 3 users (LICENSE #964428, #964432)
6. Wonderware Client Access License (CAL), With Microsoft CAL Runtime, Single, SQL 2012 Standard (License #964421, 964424, #964427, #964429)
7. SPECTER INSTRU WIN-911 Alarm Notification Software, E-mail, Premium Voice

The existing software has capacity for monitoring and controlling up to 60,000-tag for developing graphics on the server and a 60,000-tag runtime license for all Terminal Server graphic clients. The existing historian software has capacity for 25,000-tag.

74-3.01E(3) Coordination

System integrator must coordinate with the pump controller manufacturer to incorporate all required functionality into the Departments existing SCADA system to ensure complete remote operation and monitoring of the pumping plant electrical equipment. The pump controller manufacturer must implement any programming modifications required to integrate the controls into the Department's existing SCADA system.

Pump controller manufacturer must provide all information requested by system integrator within 10 days of the request.

Add to section 74-3.02B:

74-3.02B(4) Power Transfer Switch

Power transfer switch must be a 3-pole, 480-V(ac), ampere rating as shown on plans, molded case dual circuit breakers with the following features:

1. Mechanical interlock to prevent simultaneous “ON” for both breaker handles
2. Interrupting capacity of 10 times the circuit breaker ampere rating, symmetrical at 480 V(ac)
3. Auxiliary normally open contact rated 10 A at 120 V(ac)

74-3.02B(5) Standby Power Receptacle

A standby power receptacle must be a circuit-breaking, weather-resistant, raintight receptacle with a male interior assembly. The male interior assembly must be a 4-pole, 3-wire male assembly rated for 200 A at 600 V(ac). The standby power receptacle must include an AJ back box and angle adapter with either (1) screw-on dust cover and chain, or (2) self-closing, spring actuated cover.

Standby power receptacles must be compatible with the Department's standby power plug, Crouse-Hinds, Catalog No. AP20468-S22 with female interior assembly.

Provide one standby power plug for each standby power receptacle.

Replace *Reserved* in section 74-3.02B(2) with:

Service pedestal must be tamper resistant, Type 3R enclosures with:

1. Underground pull section
2. Service disconnect compartment
3. Meter compartment
4. Power transfer section

Service pedestal must be constructed with:

1. 10-gauge exterior sheet steel and 12-gauge interior sheet steel
2. Baked enamel or baked thermosetting polyester exterior finish
3. Stainless steel hardware, including screws, latches, hasps, hinge pins, and similar items
4. Main meter disconnect switch that operates with the exterior door open and the interior deadfront door closed

Each compartment of the service pedestal must have exterior doors equipped with hidden shackle padlock.

Main meter disconnect must be 3-pole, 480-V(ac), 200-A frame, 60-A trip, molded case circuit breakers with the following features:

1. Adjustable AC magnetic trip set to 600 A
2. Interrupting capacity of 65,000 A symmetrical at 480 V
3. Handle that is lockable with a padlock in the "OFF" position

Add to the beginning of section 74-3.02B(3):

The motor control center must be a factory assembled unit fabricated from individual sections joined together to form a rigid, freestanding assembly. The motor control center must be rated for voltage and ampacity ratings for each pumping plant location 3-phase, 4-wire, 60 Hz service.

The motor control center must comply with NEMA ICS 18 and UL 845.

Motor control center wiring must comply with NEMA ICS 18 Class II, Type B-D.

The motor control center must have power sections and pump control section.

The sections must be NEMA Type 12 enclosures that are (1) totally enclosed, (2) front accessible, and (3) freestanding. The sections must be suitable for:

1. Service disconnect
2. Front-mounted panels
3. Combination motor starters
4. Transformer
5. Disconnects
6. Pump Controller
7. Other unit structures

The sections must:

1. Be no more than 78 inches high and 13 inches deep including steel base channels
2. Include a removable 3-inch lifting angle
3. Have control terminal blocks with side-mounted, positive latch, pull-apart type connectors rated at 600 V(ac)
4. Be no more than 13 inches deep including seismic support mounting steel base channels
5. Have back panels to mount devices automatic shutter mechanisms in all plug-in or unused spaces
6. Have removable, flanged, blank cover plates with captive screws covering unused spaces
7. Use corrosion resistant hardware, including screws, latches, hasps, hinge pins, and similar items
8. Have the interior painted white, including panels and backs of doors
9. Have a baked enamel or baked thermosetting polyester exterior finish

Power sections must have horizontal wireways at the top and bottom. Openings must be continuous the full length of the motor control center and at least 12 sq in. Furnish end caps on the outer sections.

Power sections must have a vertical wireway on the right hand side that connect the top and bottom horizontal wireways. Openings into horizontal wireways must be at least 19 sq in. Furnish a hinged door with captive-type screws over the vertical wireway. Furnish reusable wire ties in each vertical wireway.

Power sections must have power terminal blocks located in top and bottom horizontal wireways to terminate conductors. Each section must have dedicated ground terminal blocks and a dedicated neutral terminal blocks in the top and bottom wireways. Ground terminal blocks must be green in color or painted green and neutral terminal blocks must be white in color or painted white. Number of terminal blocks must be as required. Label all terminal blocks with wire numbers.

Pump control section must:

1. Be factory pre-wired to comply with NEMA Class IIC wiring
2. Have wires entering or leaving the section terminate on terminal blocks
3. Have 7 strand No. 14 MTW control wiring except for hinge wiring, which must be 19 strand No. 14 MTW
4. Be wired using red colored insulation conductors for general wiring
5. Have white colored insulation conductors for neutrals
6. Do not use gray colored insulation conductors
7. Have neatly trained and bundled wires
8. Use wiring troughs to run control wires
9. Be wired so that apparatus may be removed without disconnecting wiring except its leads
10. Have no equipment or device mounted on the side or the bottom of the panel
11. Have full depth metal barrier between the interior panel and the interior hinged door with a 11/2 inch insulated chase nipple with lock-nut and nylon bushing for conductor entry
12. Have a minimum of 6 inches of empty space at the bottom of the section for bundling field conductors and terminating field conduits
13. Have a schematic diagram encased between two heat-fused laminate plastic sheets with brass mounting eyelets attached to the inside of the section

Each section component must have an individual door. Doors must be concealed hinge type, attached to a section structural member, and hinged on the left side. Doors must:

1. Have slotted thumbscrews for closing.
2. Swing open a minimum of 112 degrees.
3. Remain in place when any unit is removed from its structure. Doors must close when the unit is not installed.
4. Where combination starters are shown, have an external low-profile overload relay reset button.

Install an external key interlock kit that prohibits circuit-breaker operation. The key must be removable only when circuit breaker is in the "OFF" position. Furnish breaker handles that can be padlocked in the "OFF" position by from 1 to 3 padlocks.

Service disconnect must be 3-pole, voltage and ampere trip ratings as shown for each pumping plant location, molded case circuit breaker with 120-V(ac) shunt trip coil. Service disconnect must:

1. Have an adjustable AC magnetic trip set to 5 times the ampacity rating of the service disconnect
2. Have an interrupting capacity of 65,000-A symmetrical at 480-V(ac)
3. Be padlocked in the "OFF" position

Phase failure relay disconnect must be 3-pole, 480-V(ac), 100-A frame, 15-A trip, molded case circuit breakers. Disconnect must have an interrupting capacity of 14,000-A symmetrical at 480-V(ac).

Phase failure relays must be adjustable, automatic reset, voltage sensing relays. The relays must:

1. Be panel mounted
2. Have 2 SPDT, 10-A, 120-V(ac) contacts
3. Have a LED that indicates the relay is energized
4. Sense phase loss, phase unbalance, and phase reversal

Motor starters must be a combination line voltage starter and motor circuit protector, NEMA rated, 3-pole, voltage, ampacity ratings and NEMA sizes as shown for each pumping plant location. Motor starters must have:

1. 120-V(ac) coil and double-break silver alloy contacts
2. 3 auto-reset, thermal overloads
3. 2 auxiliary contacts, 1 normally-closed and 1 normally-open
4. Overloads that trip between 115 and 125 percent of full load motor nameplate amperage
5. Current transducers
6. Current switches

Digital Multimeters must:

1. Be microprocessor based line of multifunction, three phase current and voltage meter.
2. Be supplied completely wired with Instrument accuracy Class 1 or better type CTs at all three phases, and fuses at voltage and auxiliary power inputs.
3. Have CTs primary rating selected so that each motor full load current lies between 40% to 80% of its full scale.
4. Be capable of operating on a power supply range of 90 to 265 Volts AC
5. Be capable of operating on a direct voltage input range of up to 416 Volts Line to Neutral, and a range of up to 721 Volts Line to Line.
6. Be programmable for current to any CT ratio. The use of DIP switches for selecting fixed ratios will not be acceptable.
7. Have an accuracy of +/- 0.25% or better for volts and amps, and 0.5% for power and energy functions. The meter must meet the accuracy requirements of IEC 687 (class 0.5%) and ANSI C12.20 (Class 0.5%).
8. Provide true RMS measurements of phase and line voltage and current
9. Have operating temperature range from -20 to +70 degrees C
10. Must communicate with the pump controller for power monitoring

Power terminal block must:

1. Have at minimum ampacity rating equal to the ampacity rating of conductors being terminated
2. Be 600-volt rated power terminal blocks
3. Comply with UL 1059 requirements
4. Have SCCR of 10,000 ampere
5. Have phenolic insulator base with temperature rating of -40O C to 150O C
6. Have copper tin plated, tubular, high-pressure clamp connectors
7. Have brass tin plated studs
8. Be suitable for panel mount
9. Have clear polycarbonate flat covers
10. Have white vinyl strip with mounting screws

Current transducers must:

1. Be self-powered
2. Have instrument accuracy Class 1 or better
3. Provide one transducer for each phase of the motor
4. Have primary rating selected so that each motor full load current lies between 40% to 80% of its full scale
5. Be compatible with the DMM's

Light transformer primary disconnects must be 2-pole, voltage and ampere trip ratings as shown for each pumping plant , molded case circuit breakers with an interrupting capacity of 14,000-A symmetrical at voltage rating as shown for each pumping plant.

Light transformer secondary disconnect must be 2-pole, 240-volt, 100-ampere frame, 30-ampere trip, molded case circuit breakers with an interrupting capacity of 14,000 amperes symmetrical at 240 volts.

Light transformers must be double-wound, 5-kVA, 60-Hz, surface-mounted dry type transformers having a primary voltage rating as shown for each pumping plant and 120/240-V(ac) secondary with integral conduit box.

24-V(dc) Power Supply must be 120-V(ac), output 24-V(dc) at 10-amperes regulated power supply.

12-V(dc) Power Supply must be 120-V(ac), output 12-V(dc) at 5-amperes regulated power supply.

Flasher relay must:

1. Include a solid state flasher complying with section 8 of NEMA Standards Publication no. TS 1 for 10 A, dual circuits
2. Be a solid-state device with no contact points or moving parts
3. Be rated for 10A at 120 V(ac)

Timer switch must:

1. Be spring wound mechanical timer with a rotary dial
2. Have contacts rated 20 amperes at 120 V(ac)
3. Have time adjustments range from zero to two hours
4. Be single-pole, single throw switch
5. Must have hold feature to override 2 hour limit

Float transceiver must:

1. Be completely solid state and din-rail mounted type transceiver suitable for use with specified fiber optic float switches
2. Be at least two channel, fiber optic, input type device with separate output relay for each input channel
3. Output relay contacts must be rated 3-amperes at 120-V(ac)

Uninterruptible Power Supply must:

1. Be 1200 VA, 120-V(ac), 60 Hz input line voltage, output voltage of 120-volts at 60 Hz sine wave
2. Have total harmonic distortion not exceeding 7 percent
3. Transfer power to UPS power upon power failure in 10 milliseconds
4. Be equipped with sealed maintenance free battery that requires no more than 16 hours to recharge
5. Provides 5 minutes of back-up time at full load, or 10 minutes at half load
6. Be capable of operating at 50 degrees C ambient temperature and 95 percent non-condensing humidity

Replace item 1 in the list in the 1st paragraph of section 74-3.02B(3) with:

1. Molded case branch circuit breakers

Add item 4 in the list in the 4th paragraph of section 74-3.02B(3):

4. 2 auxiliary contacts, 1 normally-closed and 1 normally-open

Replace the 5th paragraph of section 74-3.02B(3) with:

Pilot lights must be panel mounted, 120 V(ac), push to test, high-visibility LEDs with a colored plastic lens and screw.

Replace item 3 in the list in the 7th paragraph of section 74-3.02B(3) with:

3. Have time delays set for durations as shown

Replace 1st line of the 10th paragraph of section 74-3.02B(3) with:

Terminal blocks for the pump control section must comply with NEMA ICS 4 and be:

Replace 1st paragraph of section 74-3.02C(3) with:

The pump controller must (1) control the pumps based on the analog 4 to 20-mA input signal from the water level monitoring system, (2) process digital inputs and outputs, (3) process current and voltage monitoring, (4) generate alarms and store events in log file (5) records and display trends, and (6) interface with the Departments existing remote monitoring and control system.

Delete the 3rd, 4th, 5th, 7th, and 8th paragraphs of section 74-3.02C(3).

Add to section 74-3.02C(3):

Pump controller configuration indicated on plans is diagrammatic. The pump controller at minimum must consist of following components:

1. Pump Controller unit
2. Power supply
3. Digital and Analog I/O's
4. Power Monitoring
5. Communication
6. Operator Interface Terminal Touch Screen

The pump controller components must be factory manufactured to form a complete packaged assembled unit with all the components integrated into the same assembly, including the operator interface terminal touch screen. Operator interface terminal touch screen if not part of the packaged assembled unit then it can be mounted remote from the packaged unit on the hinged panel door, and the packaged assembled unit must be mounted on the back panel. The complete packaged assembled unit with integrated operator interface touch screen must be suitable for panel door mount.

The pump controller must be easy to configure using built-in setup wizards without any need for computer programming for a typical pumping plant station for up to 3 pumps. The pre-built configuration parameters must be selected using operator interface terminal touch screen. The pump controller must be capable of interfacing with the Departments existing SCADA system over MODBUS or TCP/IP MODBUS communication protocol for remote monitoring and control of the pump station. The pump controller manufacturer must provide the Department a copy of the pump controller program and list of the pump controller program database tags in a Microsoft spreadsheet format on a CD. The controller tag database information must be utilized by system integrator for integrating the pump controls into the Departments existing SCADA system. The pump controller must be configured, to send email and text messages, for each enabled alarm condition.

The pump controller must also communicate with the pump digital multimeters located in the pumps motor control section.

You have the option to utilize a modular PLC system with I/O modules as a pump controller with a separate operator interface terminal touch screen to perform the similar functionality of the packaged assembled pump controller unit. The modular PLC system must be Allen Bradley Compact Logix; Modicon ePAC M340, Automation Direct Productivity 3000, or Phoenix Contact ILC series only. The PLC and operator interface terminal programming software licensed copy must be supplied to the Department for system maintenance. The PLC programming must be performed in ladder logic and factory acceptance test must be performed to verify the functionality of the entire system before shipping the equipment.

The pump controller must:

1. Be rated for 24 V(dc)
2. Be a microprocessor based, industrial grade digital pump controller
3. Have at minimum CPU of at least 566 Mhz speed
4. Have at minimum 64 MB flash memory and 256 MB RAM

5. Have real time clock for time stamping
6. Be rated for operating temperature from at least 10 degree C to 60 degree C
7. Be factory programmed with pre-configured pumping plant configuration capabilities, selected using a setup wizard
8. Have built-in nonvolatile memory to store the software and program
9. Have Micro SD and USB slot for firmware upgrades and saving configuration software
10. Be programmable using IEC61131-3 PLC programming language
11. Have Ethernet ports, two EIA-232/EIA-485 serial ports
12. Have non-proprietary communication protocols and supports Modbus and DNP3 communication
13. Be pre-programmed to operate a 3 pump plant station with option to expand to 6 pumps
14. Have built-in web server

Power supply must:

1. Be either assembled as one packaged unit with the controller unit or din-rail mounted
2. Be 120 V(ac) input and 24 V(dc) output
2. Be at least 120 Watts, 5 Ampere rated
3. Have LED indicator for DC power ON
4. Be UL listed

Digital and Analog I/O's must:

1. Be assembled as one packaged unit with the controller unit
2. Be 24 V(dc) rated
3. Have at minimum 20 Digital Inputs and 12 Digital Outputs
4. Have at least two isolated 4-20 mA analog inputs
5. Have at least two analog output
6. Have LED indicators to indicate status of the input/output
7. Have 5 ampere relay contact outputs rated for 240 V(ac)

Digital Inputs must be provided for:

1. Moisture in pump motor
2. Motor over-temperature
3. Pump operation when called
4. Pump Hand-Auto selector switch status
5. Power fail status
6. Redundant high and low float status
7. Service disconnect circuit breaker status
8. Power transfer Utility-Generator switch status

Digital Outputs must be provided for:

1. Pump run signal
2. 3-way solenoid valve and air compressor controls
3. Common alarm

Analog Inputs must be provided for:

1. Interfacing with water level monitoring system

Analog Outputs must be provided for:

1. Displaying water level

Pump controller must communicate with digital multimeter located at pump motor starter section for:

1. 3-phase current monitoring
2. 3-phase voltage monitoring
3. Power energy monitoring
4. Power factor monitoring

5. Pump efficiency
6. Reporting the power information

Operator Interface Terminal Touch Screen provides operator access to the pumps for monitoring and control purposes. Operator interface terminal touch screen must:

1. Be at minimum a 10 inch touch screen panel
2. Have minimum 800 x 480 resolution
3. IP65 rated for outdoor environment
4. Ethernet port and USB ports
5. Have graphical display screens to provide:
    - 4.1. Status
    - 4.2. Manual Controls
    - 4.3 Control Setpoint
    - 4.4. Alarms Setpoint/Fault
    - 4.5. History & trends

Status display screen must display:

1. Liquid level in user definable units
2. Pump status for each pump
    - 2.1. Available/not available status
    - 2.2. Selector switch Hand/Auto position
    - 2.3. Lead/Lag status
    - 2.4. Running/stopped status
    - 2.5. Lifetime starts
    - 2.6. Lifetime run hours
    - 2.7. Pump Start/Stop setpoints
    - 2.7 High/low alarms
    - 2.8 3-phase current and voltage
    - 2.9 Power in kW and power factor
3. Pumphouse intrusion contact status
4. Utility power status

Manual Control display screen at minimum must provide controls for:

1. Pump modes, Hand/Auto
2. Pump Start/Stop
3. Pump controller test mode
4. Manual purge controls

Control Setpoint display screen at minimum must provide for:

1. Lead pump Start/Stop setpoints
2. Lag pump Star/Stop setpoints
3. Power resume delay start setpoint
4. Pump alternation sequence
5. Lead/lag pump selection
6. Maximum pump starts per hour

Control setpoints must be password protected with at least two operator access levels.

Alarms Setpoint and fault display screen at minimum must provide for:

1. High/Low water level setpoints
2. Redundant High/Low float status
3. Pump Controller failure selection
4. Water level monitoring failure
5. Utility power failure
6. Pump moisture seal failure
7. Pump motor overtemp

8. Pump overcurrent/undercurrent/volts imbalance

Faults must be logged with date/time stamp and displayed for user to acknowledge and reset. User must be able to reset the faults upon entering a password.

History and trends display screens at minimum must provide for:

1. Date/time stamped all faults and events
2. Pumping plant liquid level and pump Starts/Stops trends
3. Pump run hours by:
   3.1. Today
   3.2. This week
   3.3. Last week/month/year
4. Pump start/stops:
   4.1. Today
   4.2. This week
   4.3. Last week/month/year
5. Pump current/voltage:
   5.1. Today
   5.2. This week
   5.3. Last week/month/year

Pump history and faults must be stored for a minimum of 5 years. History and faults must be exportable into comma separated Excel spreadsheet file for analysis. Trends must be displayed in graphical format on display screens.

Replace the 1st paragraph of section 74-3.02D with:

Conduits and fittings must be Type 1 complying with section 86-1.02B(1).

Replace the 2nd paragraph of section 74-3.02D with:

Flexible conduit and fittings must be Type 4 complying with section 86-1.02B(1).

Add to section 74-3.02D:

Underground conduits and fittings must be Type 3 complying with section 86-1.02B(1).

Add to section 74-3.02E:

74-3.02(E)(4) Cables

Category 6 cables must be the unshielded, outdoor rated, non-gel filled type, and must meet the requirements of ANSI/TIA 568-C, category 6 cable.

Category 6 cables must meet the following:

1. The cable must contain 8 conductors, each of which must be no. 24, minimum, solid bare copper conductors. Each conductor must be insulated with polyolefin, polyethylene, polyvinyl chloride or fluorinated ethylene propylene material.
2. The cable jacket must be rated for a minimum of 300 V(ac) and 140 degrees F and must be polyvinyl chloride, polyethylene, polyolefin or fluorinated ethylene propylene. The jacket must be black, gray, or blue. The jacket must be marked as required by NEMA. The jacket must be marked at intervals of not more than 3 feet with the cable identification: manufacturer's name, product identification and voltage rating.
3. The finished outside diameter of the cable must not exceed 1/2-inch.
4. Terminate the ends of category 6 cable with 8P8C modular connectors.

Category 6 patch cables must be similar to Category 6 cables but at least 6 feet long. Category 6 patch cables must have RJ45 Modular Jack factory installed. It must have a snag less cable boot and the plug retaining clip.

Add to section 74-3.02F(2):

Indicating Light Description Plate letters must be black, upper case Helvetica, and 1/2 inch in height. Leave at least 1/2-inch between lines. Leave at least 3/8-inch white background on all 4 sides. Install indicating light description plate inside the pump house at a location directed by the engineer.

Delete the 3rd paragraph of section 74-3.02G.

Replace the 4th paragraph of section 74-3.02G with:

Room light must:

1. Be NRTL listed for damp locations
2. Be ceiling mounted, heavy duty, industrial type fixture
3. Have a fiber-reinforced polymer housing with steel wireway
4. Have a hinged acrylic lens with closed-cell gasket and ABS or stainless steel hatches
5. Includes nominal 52-watt, 120-volt LED array
11. Deliver 4000 lumens at minimum

Replace the 5th paragraph of section 74-3.02G with:

Sump light must:

1. Be listed and labeled for Class 1, Division 2 locations
2. Be listed for outdoor installation
3. Be totally enclosed gasketed fixture
4. Be wall-mounted with junction box
5. Have stainless steel external hardware
6. Have cast aluminum housing
7. Have epoxy powder coated finish
8. Have impact and heat resistance clear globe
9. Have die cast guard
10. Includes nominal 20-watt, 120-volt LED array
11. Deliver 1000 lumens at minimum

Delete the 11th, and 12th paragraphs of section 74-3.02G.

Add to section 74-3.02G:

Plywood backing board for mounting equipment must be 3/4-inch, APA plywood panel, C-D PLUGGED and touch-sanded, Exposure 1.

Construction channel must be 1-5/8 by 1-5/8 inch, stainless steel channel with 17/32 inch diameter bolt holes at 1-1/2 inch centers in the channel base.

Flashing beacon must:

1. Be a double flash strobe light
2. Include 75 double flashes per minute
3. Be rated for 120 V(ac)
4. Be rated for outdoor installation
5. Have an impact and heat resistant amber colored glass threaded globe with neoprene gasket
6. Have minimum 650 Candelas per second light output
7. Include hardware for pole mounting as shown
8. Have threaded die-cast aluminum guard
9. Be UL listed for wet locations

Air horn must:

1. Be a high decibel double (bi-directional) horn
2. Have corrosion resistant finish
3. Have adjustable output from 78 dB to 101 dB at 10 feet
4. Be made of heavy-duty die-cast housing
5. Be rated for outdoor application
6. Be rated for 120V (ac)
7. Include hardware for pole mounting as shown
8. Be UL listed for wet locations

Door surface contact must:

1. Be 2-section, extra heavy-duty, surface mounting type switch with stainless steel armored cable
2. Have stainless steel housing
3. Have 1 normally closed and 1 normally open contact

Fiber optic float switches must:

1. Be completely fiber optic type
2. Be NSF approved, and NRTL listed
3. Be impact and corrosion resistant float switch with sealed fiber optic cable and external weight
4. Have SJOW type, 2 strands fiber optic cable

Remote power shut-off pushbutton must:

1. Be heavy duty pushbutton
2. Have 1 normally open, momentary contact rated at 120 V(ac) and 35 percent power factor
3. Have an inductive pilot duty rating of:
   3.1. 60 A make
   3.2. 6 A break
   3.3. 10 A continuous
4. Have a round 40 millimeter mushroom head to push
5. Be NEMA 4X rated , complete with back box
6. Have mounting feet for mounting inside the NEMA 4X enclosure

Remote power shut-off enclosure must:

1. Be deadfront NEMA Type 4X enclosure
2. Have mounting panel on the back
3. Have remote power shut-off pushbutton
4. Have grounding lug
5. Have shackle padlock
6. Have mounting feets
7. Have continuous door hinge on one side
8. Have door clamps

Shackle padlock must:

1. Be constructed from hardened steel and chrome plated
2. Have a flat back body
3. Be hardened boron alloy with a diameter of 3/8”

Construction box for shackle padlock must be 10 gage construction box with open bottom and slotted back.

Add to the end of the section 74-3.02:

74-3.02H Fiber Termination Enclosure

74-3.01H(1) General

Fiber termination enclosure must:

1. Be deadfront NEMA Type 4X enclosure
2. Have mounting panel on the back
3. Have grounding lug
4. Have mounting feets
5. Have shackle padlock
6. Have louver plate & filter near bottom on both sides
7. Have continuous door hinge on one side
8. Have door clamps

Shackle padlock must:

1. Be constructed from hardened steel and chrome plated
2. Have a flat back body
3. Be hardened boron alloy with a diameter of 3/8”

Construction box for shackle padlock must be 10 gage construction box with open bottom and slotted back.

Fiber termination enclosure must include:

1. Fiber distribution unit
2. Remote Network Interface Switch
3. Managed Ethernet Switch
4. VPN Router
5. Duplex receptacle
6. Surge protector power strip for communication equipment

74-3.01H(2) Fiber Distribution Unit

Fiber distribution unit must be back panel mounted termination panel to patch and splice single mode fiber cables.

74-3.01H(3) Remote Network Interface Switch

Remote network interface switch is a combination network interface switch and fiber media converter, which will provide stand-alone remote UTP (unshielded twisted-pair copper) to SMFO (single-mode fiber optic) media conversion.

Description	10/100/1000BASE-T copper UTP to 1000BASE-X Stand-Alone Fiber Media Converter and Network Interface Device
Protocols	10/100/1000BASE-T UTP to 1000BASE-X with 10,240 bytes max. frame size
UTP cable	EIA/TIA 568A/B, Category 5 and higher
Fiber Cables	Single Mode: 9/125µm
Connectors: UTP SFP Serial Management Port	 RJ-45 LC (SFP module to be provided per specification) 6-Pin Din
AC power Adapter	100 to 240VAC, 50/60Hz, 0.06A @ 120VAC
Controls	Dip-switches and LEDs
Humidity	5 to 95% (non-condensing)
Operating Temperature	-40°F to +167°F
Weight without power adapter	1 lb
Dimensions (Standalone)	4.8” D x 3.1” W x 1.0” H
IP-Based Management	Telnet, SNMPv1, SNMP v2c, SNMP v3; IEEE 802.3ah (OAM)
Compliance	UL,CE, FCC Class A, NEBS Level 3
Mounting Option	Backpanel Mountable

74-3.01H(3) Managed Ethernet Switch

The managed Ethernet switch must:

1. Have 4-port 10/100Base (RJ45) Fast Ethernet ports, 2-Small Form Factor Gigabit (SFP) pluggable ports
2. Include everything needed to quickly deploy
3. Be hardened, compact, industrial grade and designed for outdoor applications
4. Connect to network equipment on both sides of the link
5. Establish link automatically on power up when both units are connected to the power source

Description	**Specifications**
Ethernet Interface	10/100Base-TX
Ports	(4 Min) RJ-45 auto-cross, (2 Min-GBIC) Gigabit SFP Small From Factor pluggable ports and mini-USB connector
Performance	Forwarding Performance: 6.5 Mpps
Memory	64 MB on-board flash memory, 256 MB RAM
Manage Functions	SNMPv3 , DHCP, Secure Shell, RADIUS
Security	MAC address filtering, port security
Alarm Contact	Two alarm inputs (dry contacts), one alarm output
Rated Nominal Input Voltage	AC 100-240V/2.3A 60Hz
Routing Protocol	IGP, static IPv4
Installation	DIN Rail mount or back panel mount
Dimensions (max)	3.0” (W) x 5.0” (D) x 5” (H)
Weight (max)	3.0 lbs
Remote Management Protocol	SNMP 3, HTTPS, SSH
Authentication Method	Secure Shell (SSH), RADIUS, TACACS+
Compliant Standards	IEEE 802.1x

74-3.01H(4) VPN Router

The VPN router must:

1. Be a combination 4G LTE cellular and copper (Ethernet) WAN interface router
2. Be hardened, compact, industrial grade and designed for outdoor applications
3. Include everything needed to quickly deploy
3. Be hardened, compact, industrial grade and designed for outdoor applications
4. Be capable of supporting multiple 4G LTE band from different carrier
5. Include firewall, intrusion prevention, VPN and web security
6. Have Serial and Gigabit Ethernet WAN interfaces
7. Have 4 port 10/100 Fast Ethernet ports

Description	**Specifications**
Bands	LTE band 2, 4, 5, 17, 13 and band 25
Speed-Download/Upload	100/50Mbps
Network	ATT, Verizon
Antenna	Two Multiband swivel mount dipole antennae
LED Indicators	Signal strength, WWAN, 4G LTE Service. GPS
Power Supply-AC Adapter	100-264 VAC/0.5A
Security	Secure connectivity, Firewall, content filtering
Memory	1GB flash memory
WAN Interface	Wireless WAN with 4G LTE, 10/100/1000 GB Ethernet Port
LAN Interface	Four 10/100 Fast Ethernet Managed Ports
Dimensions (max)	3.0” (W) x 5.0” (D) x 5” (H)
Weight (max)	3.5 lbs
SIM Support	Dual SIM support
Authentication Method	SNMP, TELENT, HTTP+
Quality OF Service Feature	YES
Operating Temperature Range	-25 Degree C to 60 Degree C
Mounting	Din rail mount or back panel mount

Replace Reserved in section 74-3.03B(1) with:

Cored holes for conduits must not be greater than 1-inch in diameter larger than the conduit. Fill the voids with mortar under section 51-1.02F.

Add to the beginning of the section 74-3.03B(2):

Install conduits under section 87-1.03B.

Add to the beginning of the section 74-3.03B(3):

Install 3 feet wide floor coverings in front of each section of the motor control center.

Replace the heading of section 74-3.03B(4) with:

74-3.03B(4) Light Panelboard

Add to the end of the section 74-3.03B with:

74-.03B(5) Fiber Termination Enclosure

Mount the enclosure on a plywood backing board.

Mount all equipment as required inside the enclosure. Provide all brackets, hardware, and accessories required to mount the equipment.

Coordinate with system integrator and Department's IT engineer to program all the communication devices to establish communication link with the Departments existing SCADA system using cellular carrier private network and through Department's fiber communication network.

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75 MISCELLANEOUS METAL

Add to the list in the 2nd paragraph of section 75-3.01A:

6. Splash guard plate
7. Mechanical expansion anchors for splash guard plate

Add to the end of section 75-3.01A:

Bridge deck drainage system consists of:

1. Drain pipe or conduit
2. Expansion coupling
3. Pipe hanger
4. Deck drains
5. Hardware and pipe fittings
6. Anchor studs for deck drainage

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77 LOCAL INFRASTRUCTURE

Replace *Reserved* in section 77-1 with:

77-1.01 GENERAL

77-1.01A Summary

Section 77-1 includes general specifications for constructing local infrastructure.

Maintain drainage flows throughout construction.

Notify the Engineer at least 7 days before starting drainage work, 15 days if a shutdown is required.

Notify the Engineer two working days in advance of anticipated flow control, cleaning and CCTV inspection operation.

77-1.01B Definitions

CCTV: Closed Circuit in-line television

SSPWC: City of Sacramento, Standard Specifications for Public Works Construction

77-1.01C Submittals

77-1.01C(1) As-Builts

Submit a set of as-build drawings within 30 days of installation. Each drawing sheet must:

1. Be 24 by 36 inches
2. Be on a minimum of 20 lb paper
3. Have text a minimum nominal height of 5/32 inch

As-build drawings must show the location of the 60" City RCP and manholes.

77-1.01C(2) Flow Control Plan

Ten days prior to use, submit a flow control plan (FCP) showing:

1. Pumping bypass system to maintain flow
2. Conveyance lines of adequate diameters to prevent backup to private property
3. Pumps (hps) capacity to prevent backup to private property.

Amend the SWPPP to include the flow control plan.

77-1.01C(3) CCTV Recording

CCTV recordings must be made and submitted in high quality electronic media. Recordings must be recorded entirely in digital MPG or AVI format written to DVD and compatible with Granite XP software, version 5.4.17 , unless otherwise directed). CCTV inspection length on the video must match within +\- 2 feet of the measured linear footage along the pipe centerline, from manhole center to manhole center, or access point.

77-1.01D Elbows

Submit shop drawings for three- piece fabricated RCP elbows.

77-1.02 MATERIAL

Except for factory made mitered joints, seal all joints with rubber gaskets that comply with ASTM C443.

77-1.03 CONSTRUCTION

Not Used

77-1.04 PAYMENT

Not Used

77-2 CITY MANHOLE

77-2.01 GENERAL

Section 77-2 includes specifications for city manhole.

77-2.02 MATERIALS

77-2.02A General

The city manhole must be a saddle type watertight structure constructed with precast concrete sections placed atop a poured concrete base.

77-2.02B Manhole

Concrete must comply with section 90-2, except that it must contain not less than 564 pounds of Portland cement per cubic yard.

Fly ash, if used must comply with ASTM C 618 and may not replace more than 20% of the Portland cement.

Precast PCC manhole barrels, cones, and grade rings must comply with ASTM C478.

77-2.02C Joint Sealant Compound

Joint seals must comply with Federal Specifications SS-S-210A, AASHTO M-198, and ASTM 990.

77-2.02D Grade Rings

Use 4" tall Precast PCC grade rings. Use a minimum of two rings or a three rings maximum.

77-2.02E Crushed Rock

Crushed rock must comply with section 77-3.

77-2.02F Manhole Cover

Manhole cover must comply with section 75. Manhole cover must be traffic rated and as shown on plans.

77-2.03 CONSTRUCTION

Place crushed rock on compacted or undisturbed soil.

Place precast concrete sections atop a poured concrete base.

Manholes must be constructed true and plumb. All interior manhole surface irregularities must be grouted smooth with non-shrink non-metallic grout. Install eccentric cones leaning away from traffic. In all cases maintain positive slope for all pipes through manhole. Side inlet pipe connections above the cast-in-place base must be grouted in-place and made watertight.

Join precast concrete sections using nominal one and one-half inch (1-1/2") diameter continuous segments of preformed plastic sealing compound. Clean all joints surfaces thoroughly before installation. Sealing compound ends must be joined end-to-end, but not overlapped. Sufficient compound must be used to cause a visual "squeeze-out" of compound material when adjacent section are seated. Trim squeeze-out on the inside of the manhole to be neatly trimmed flush with the inside manhole surface.

Set the manhole top 6" above adjacent finish ground.

77-2.04 PAYMENT

Not Used

77-3 CITY STORM DRAIN

77-3.01 GENERAL

Section 77-3 includes specifications for city storm drain.

77-3.02 MATERIALS

77-3.02A General

City storm drain must be reinforced concrete pipe and comply with section 65, precast Class III or stronger per ASTM C-76

77-3.02B Trench Backfill

77-3.02B(1) Type A Crushed Rock

Aggregate gradation for Type A Crushed Rock must be within the percentage passing limits for the sieve sizes shown in the following table:

Sieve size	Percentage passing
3/4"	100
1/2"	90-100
3/8"	20-60
No. 4	1-15
No. 200	0-2

The aggregate quality characteristic must comply with the requirements for the classes shown in the following table:

Quality characteristic	Requirements
Cleanliness value	60 minimum
Fractured faces	50% of particles retained on the 3/8" sieve must have 3 or more fractured faces

77-3.02B(2) Aggregate Base (Class 2)

Aggregate Base (Class 2) must comply with 3/4-inch maximum per section 26-1.02B.

77-3.02C Joint seal

Use rubber gasket made for reinforced concrete pipe joint seals. Rubber gaskets must comply with ASTM C443.

77-3.02D Elbows

Elbows must be commercially fabricated 60" three-piece 60-degree RCP elbows with equal 5'-9" bell and spigot laid length. Steel reinforcement through the mitered mortared connections must be welded or lapped at least 20 bars diameters with the standard precast pipe bars, and equal to or greater than the adjacent precast pipe's reinforcement.

On elbow ends that connect to the existing 60" RCP provide plain ends.

77-3.02E City Concrete closure Collar

Concrete closure collars must comply with section 77-4.

77-3.03 CONSTRUCTION

77-3.03A CCTV Recording

Inspect the new section of RCP pipe by CCTV in accordance with NASSCO's Pipeline Assessment Certification Program (PACP) after backfill is placed.

Before performing CCTV inspection, clean pipe to remove excess standing water and to remove solids, debris grease, or grit from the inside of the pipe between access points.

Make a 360-degree inspection, video, and photographic record of each joint and lateral joint.

Documentation must consist of one or more DVDs that show all features encountered. The speed of travel must be slow enough to detect reverse slope or low spots in pipe grades and to inspect and identify each pipe joint and provide accurate distance measurements to all features. Position the CCTV camera in the center of the pipe to provide maximum clarity, and provide accurate distance measurements to all features. Footage measurements must be displayed continuously on the video. Submit the DVDs to the Engineer for review and approval prior to pipe acceptance.

Every section of new pipe (manhole to manhole or access point) must be identified at the beginning of each video, Information to display must include: project name, street name, manhole number, inspectors pipe dimeter and length, and date of inspection.

77-3.03B Trench Backfill

Native backfill soil and Type A crushed rock must comply with section 19.

77-3.04 PAYMENT

Not Used

77-4 CITY CONCRETE CLOSURE COLLAR

77-4.01 GENERAL

Section 77-4 includes specifications for city concrete closure collar.

77-4.02 MATERIALS

77-4.02A General

Sawcut ends of existing RCP to make flush with new city RCP.

77-4.02B Crushed Rock

Type A Crushed rock must comply with section 77-3.

77-4.02C Concrete

Use Portland cement concrete with a compression strength of 4,000 psi at 28 days.

The maximum water to cement ratio must be 0.5.

77-4.02D Rebar

Reinforcement must be grade 60.

77-4.02E Water Stop Grouting Ring

Water stop grouting ring must be compatible with the pipe. Use rubber gasket made for next size up reinforced concrete pipe joint, or use 1" x 3/4" coils of bentonite water stop material such as Tremco, Superstop or approved equal. Wrap grouting around full pipe circumference.

77-4.03 CONSTRUCTION

The crushed rock must be wet and compacted until a firm, unyielding condition is achieved or as directed by the Engineer.

Wash pipe to remove all loose material and soil from surface prior to pouring concrete.

Construct forms to prevent concrete from entering the pipe.

Place concrete collar in one continuous pour.

Embed the water stop ring into the concrete while still fluid.

Do not pour or place concrete collar in water.

Do not backfill concrete collar until the concrete has sufficient strength or as directed by Engineer.

77-4.04 PAYMENT

Not Used.

^^

80 FENCES

Replace *Reserved* in section 80-2.02A with:

Posts must be metal.

Add to the end of section 80-2.02B:

Galvanize posts under section 75-1.02B.

^^^^^^^^^^^^^^^^^^^

Cement concrete barrier delineator (16-inch) bases to the barrier with rapid set epoxy adhesive as specified in section 81-3.03C for cementing pavement markers to the pavement. Apply rapid set epoxy adhesive and place concrete barrier delineators (16-inch) on clean, dry surfaces.

Replace section 81-8.03C with:

81-8.03C Remove Delineators

Remove existing delineators when directed by the Engineer.

Replace the paragraph of section 81-8.04 with:

Full compensation for removing pavement markers and delineators is included in the payment for the bid items shown in the Bid Item List.

^^

82 SIGNS AND MARKERS

Add to section 82-2.02A:

The protective-overlay film must be from the same manufacturer as the retroreflective sheeting used.

Add to section 82-2.04:

The payment quantity for retroreflective sheeting (Type XI) for any type of sign panel is the area of the panel determined from the dimensions shown.

Payment for retroreflective sheeting (Type XI) is not included in the payment for furnishing any type of sign panel.

Add to section 82-3.02B:

Metal posts for roadside signs must comply with the details shown and must comply with section 75 except for payment.

Add to section 82-5.03:

Cement the object marker (Type K-1) bases to the surface with rapid set epoxy adhesive as specified in section 81-3.03C for cementing pavement markers to the pavement. Apply rapid set epoxy adhesive and place object markers (Type K-1) on clean, dry surfaces.

Cement concrete barrier markers (non-impactable) to the barrier with rapid set epoxy adhesive as specified in section 81-3.03C for cementing pavement markers to the pavement. Apply rapid set epoxy adhesive and place concrete barrier markers (non-impactable) on clean, dry surfaces.

Add to section 82-9.03A:

If an existing post is metal, remove the foundation, including the anchor sleeve and concrete footing. Backfill and compact the resulting hole with material equivalent to the surrounding material.

Foundations for metal post installations must comply with the details shown and must comply with sections 75 and 90-2 except for payment.

Replace section 82-9.03D with:

82-9.03D Remove Markers

Remove existing object markers and highway post markers when directed by the Engineer.

Add to section 82-9.04:

Full compensation for removing object markers and highway post markers is included in the payment for the bid items shown in the Bid Item List.

^^

83 RAILINGS AND BARRIERS

Replace *Reserved* in section 83-2.01B with:

83-2.01B(1) General

83-2.01B(1)(a) Summary

Section 83-2.01B includes specifications for constructing vegetation control around railing and barrier posts.

Constructing minor concrete vegetation control includes clearing, excavation, and backfill.

83-2.01B(1)(b) Definitions

Not Used

83-2.01B(1)(c) Submittals

Submit a mix design for the minor concrete to be used for vegetation control. The mix design must show proportions of:

1. Coarse aggregate
2. Fine aggregate
3. Cementitious material
4. Reinforcing fiber
5. Water

Include compressive strength test results with the mix design.

Submit a certificate of compliance for the crumb rubber aggregate, if used. Include the quantity in pounds of crumb rubber.

83-2.01B(1)(d) Quality Assurance

Not Used

83-2.01B(2) Materials

83-2.01B(2)(a) General

Not Used

83-2.01B(2)(b) Minor Concrete

83-2.01B(2)(b)(i) General

Concrete for vegetation control must comply with the specifications for minor concrete, except the concrete:

1. Must include reinforcing fibers
2. May include crumb rubber aggregate
3. Must contain:
   - 3.1. At least 505 pounds of cementitious material per cubic yard, if crumb rubber aggregate is used
   - 3.2. At least 400 pounds of cementitious material per cubic yard, if crumb rubber aggregate is not used
4. Must have a maximum aggregate size of 3/8 inch

All ingredients must be added at the concrete plant before delivery to the job site.

You may use volumetric proportioning complying with ASTM C685/C685M or as specified.

The minor concrete must have a 28-day compressive strength from 1,400 to 2,500 psi.

83-2.01B(2)(b)(ii) Crumb Rubber Aggregate

Crumb rubber aggregate must consist of ground or granulated scrap tire rubber from automobile and truck tires. Do not use tire buffings.

Crumb rubber aggregate must be ground and granulated at ambient temperature.

The crumb rubber aggregate gradation must comply with the requirements shown in the following table:

Gradation Requirements

Sieve size	Percentage passing
1/2"	100
3/8"	90–100
1/4"	35–45
No. 4	5–15
No. 8	0–5
No. 16	0

Crumb rubber aggregate must not contain more than 0.01 percent of wire by mass and must be free of oils and volatile organic compounds.

Do not commingle crumb rubber from different sources.

The crumb rubber aggregate must be 3.5 ± 0.5 percent by weight of the concrete.

83-2.01B(2)(b)(iii) Reinforcing Fibers

Reinforcing fibers for minor concrete must be:

1. Manufactured specifically for use as concrete reinforcement from one of the following:
   1.1. Polypropylene, polyethylene, or a combination of both.
   1.2. Copolymer of polypropylene and polyethylene.
2. Blended ratio from 4 to 5.67 parts by weight of macro synthetic fibers to 1 part by weight of micro synthetic fibers. Synthetic fibers must be:
   2.1. Nonfibrillated macro fibers with individual fiber lengths less than 2 ± 1/2 inches.
   2.2. Fibrillated or monofilament micro fibers of various lengths and thicknesses.
3. Supplied in sealed, degradable bags of appropriate size for adding whole bags to concrete batches.
4. From a commercial source.

The reinforcing fiber content of the minor concrete must be from 5 to 6 lb/cu yd.

83-2.01B(2)(b)(iv) Coloring Agent

Not Used

The coloring agent must be integral to the concrete mix and added at the concrete plant.

83-2.01B(2)(c) Block-Out Material

The block-out material must be a commercially available expanded polystyrene foam with a compressive strength of 13 ± 5 psi at 10 percent deformation when tested under ASTM D1621.

If authorized, you may substitute an alternative block-out material that complies with the compressive strength requirements of the expanded polystyrene foam.

83-2.01B(2)(d) Backfill Material

Backfill material must be Class 2 aggregate base complying with section 26.

83-2.01B(3) Construction

83-2.01B(3)(a) General

Not Used

83-2.01B(3)(b) Clearing

Clear areas to receive vegetation control of vegetation, trash, and debris. Dispose of the removed material.

83-2.01B(3)(c) Earthwork

Excavate or backfill areas to receive vegetation control.

If the vegetation control abuts the existing surfacing and the edge of the existing surfacing is not on a neat line, cut the surfacing on a neat line to a minimum depth of 2 inches before removing the surfacing.

Perform grading so that the finished elevation of the vegetation control maintains the existing or planned flow lines, slope gradients, contours, and existing surfacing.

Grade the areas to receive vegetation control to a smooth, uniform surface and compact to a relative compaction of at least 95 percent.

83-2.01B(3)(d) Block Outs

For block-out material supplied in more than 1 piece, tape the pieces together to make a smooth surface on the top and sides.

Ensure that the block-out material does not move during concrete placement.

83-2.01B(3)(e) Forming

Forming must comply with section 73-1.03C.

Leave forms in place for at least 12 hours after surface finishing.

83-2.01B(3)(f) Minor Concrete

Strike off and compact the minor concrete with a mechanical or vibratory screed device. Match the finished grade to the adjacent section of vegetation control, pavement, shoulder, or existing grade.

Construct contraction joints by scoring concrete with a grooving tool and rounding corners with an edger tool.

83-2.01B(3)(g) Backfill Material

Backfill material required for vegetation control under existing guardrail or barrier is change order work.

83-2.01B(4) Payment

Not Used

Replace item 2 in the list in the 2nd paragraph of section 83-2.02C(1)(a) with:

2. 6-by-8-by-14-inch wood blocks or 6-by-8-by-14-inch plastic blocks for line posts.

Add to section 83-2.02C(1)(a):

The exposed bolt threads on guardrail beyond the nut that are more than 0.5 inch must be cut off.

Replace *Reserved* in section 83-2.02C(3) with:

The offset from the face of the Type WB-31 transition railing to the hinge point must be at least 3'-6".

The offset from the face of the adjacent midwest guardrail system to the hinge point must be transitioned from the offset at the Type WB-31 transition railing to 4'-0" using a ratio of 6:1.

Replace section 83-2.04B with:

83-2.04B Alternative In-line Terminal Systems

83-2.04B(1) General

83-2.04B(1)(a) Summary

Section 83-2.04B includes specifications for constructing alternative in-line terminal systems.

83-2.04B(1)(b) Definitions

Not Used

83-2.04B(1)(c) Submittals

Submit a certificate of compliance for alternative in-line terminal systems.

83-2.04B(1)(d) Quality Assurance

For each model of alternative in-line terminal system being installed, obtain the manufacturer's check list for the assembly and installation of the alternative in-line terminal systems from the manufacturer's representative or distributor. Notify the Engineer of the alternative in-line terminal systems to be installed at each location before starting installation activities. Complete, sign, and date the check list for each installed in-line terminal system and submit a copy of the completed and signed check list for each installed location, and include the following:

1. Contract number
2. Name of installation Contractor
3. Flare offset used in layout
4. Date of installation
5. Location on the project by post mile, and by station if stationing shown on plans
6. Name and signature of individual completing the checklist.

The Engineer signs and dates the completed check lists, verifying the in-line terminal system at each location was assembled and installed under the manufacturer's instructions and as described.

Use personnel trained by the manufacturer to install in-line terminal systems. A record of training provided by the manufacturer may be requested by the Engineer at any time.

83-2.04B(2) Materials

1. Type SoftStop terminal systems must be SoftStop End Terminal System manufactured by Trinity Highway Products, LLC, and must include the connection components. Type SoftStop terminal system - Type SoftStop terminal system must be a SoftStop terminal with a System length of 50'-9½" for test level 3 and a system length of 38'-3½" for test level 2, manufactured by Trinity Highway Products, LLC, and must include items detailed for SoftStop terminal system, as shown. The SoftStop terminal can be obtained from the manufacturer:

Address	Telephone no.
TRINITY HIGHWAY PRODUCTS LLC PO BOX 99 CENTERVILLE UT 84012	(800) 772-7976

2. Type MSKT - Type MSKT terminal system must be a 31" MSKT Guard Rail End Terminal with a system length of 50'-0" as manufactured by Road Systems, Inc., located in Big Spring, Texas, and must include items detailed for Type MSKT terminal system shown on the plans. The MSKT Guard Rail End Terminal can be obtained from the distributor:

Address	Telephone no.
UNIVERSAL INDUSTRIAL SALES PO BOX 699 PLEASANT GROVE UT 84062	(801) 785-0505
GREGORY INDUSTRIES INC 4100 13TH ST SW CANTON OH 44708	(330) 477-4800

3. Type MAX-Tension Tangent Guardrail End Treatment by Barrier Systems, Inc. is a tangent, re-directive gating guardrail terminal. The MAX-Tension has a length of 55 feet, ½ inch, and can be flared for an offset of 0 to 2 feet at the head. The MAX-Tension terminal can be obtained from the distributor:

Address	Telephone no.
STATEWIDE SAFETY AND SIGNS INC 130 GROBRIC COURT FAIRFIELD CA 94533	(800) 770-2644

83-2.04B(3) Construction

Identify each terminal system by painting the type of terminal system in 2-inch-high, neat, black letters and figures on the backside of the rail element between system posts number 4 and 5. Paint must be metallic acrylic resin type spray paint. Before applying terminal system identification, the surface to receive terminal system identification must be free of all dirt, grease, oil, salt, or other contaminants by washing the surface with detergent or other suitable cleaner. Rinse thoroughly with fresh water and allow to fully dry.

Install Type SoftStop terminal system under the manufacturer's installation instructions. For Type SoftStop terminal system, use W6 x 8.5 steel yielding terminal posts for Posts 1 and 2 and standard W6 x 8.5 steel posts for the other posts. Drive all posts or place them in drilled holes. Backfill the space around the posts with selected earth that is free of rock. Moisten and thoroughly compact each layer. For the terminal with a system length of 50'-9½" or system length of 38'-3½", all blocks must be wood or plastic and must be 8 or 12 inches deep.

For Type MSKT terminal system, install a W6x15 at lower section Post 1 with a soil plate attached and a 6"x6"x ⅛" tube section at upper section Post 1. Install a W6x9 or W6x8.5 post assembly top and post assembly bottom at Post 2. Install W6x9 or W6x8.5 at Posts 3 through 8. Attach a 9'-4 ½" W-beam MGS rail section to Post 3. Use 8" blocks. The posts must be, at the Contractor's option, driven with or without pilot holes, or placed in drilled holes. Do not pound on the side plates when installing lower post #1 and lower post #2. Space around the posts must be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer must be moistened and thoroughly compacted.

Install Type MAX-Tension terminal system under the manufacturer's installation instructions. Use 8” or 12” wood or composite blocks. Install W6x8.5 or W6x9 at post positions after Post 1. Backfill the space around the posts with selected earth that is free of rock. The posts must be, at the Contractor's option, driven with or without pilot holes, or placed in drilled holes. Space around the posts must be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer must be moistened and thoroughly compacted.

83-2.04B(4) Payment

Not Used

Replace section 83-2.10 with:

83-2.10 DECORATIVE RAILING

83-2.10A General

83-2.10A(1) Summary

Section 83-2.10 includes specifications for constructing decorative railing.

Decorative railing work includes metal railing with wire mesh, handrailing, and a decorative motif.

Galvanize all decorative railing components. Apply final coating system to decorative railing components as specified herein.

83-2.10A(2) Definitions

Not Used

83-2.10A(3) Submittals

83-2.10A(3)(a) General

Not Used

83-2.10A(3)(b) Certificate of Compliance

Submit a certificate of compliance for each shipment of powder coated material. Include with the submittal:

1. Application instructions
2. Manufacturer's descriptive data which include complete description, performance data, and installation instruction for the materials

83-2.10A(3)(c) Test Samples

Before fabrication, submit an 8 by 8 inch powder coated decorative panel sample with the color finish applied for authorization.

Test samples must be:

1. Steel panel with the entire powder coating system applied
2. Constructed at an authorized location
3. Constructed and finished using the personnel, materials, equipment, and methods to be used in the work
4. Authorized before starting work

83-2.10A(3)(d) Shop Drawings

Submit 7 copies of shop drawings for the decorative railing.

The shop drawings must include:

1. Details for venting holes in rails, posts, and sleeves
2. Railing layout
3. Complete details for the construction of the work including methods of construction, sequence of shop and field assembly, galvanization, powder coating, painting, and installation procedures.

Allow 25 days for review. Upon authorization, the Engineer returns 2 copies to you for use during construction.

83-2.10A(4) Quality Assurance

Not Used

83-2.10B Materials

83-2.10B(1) General

The tubing, plates, bars, splice sleeves, bolts, threaded rods, nuts and washers must comply with section 83-2.08B.

Handrailing must comply with section 83-2.09. Paint galvanized surfaces of handrailing under section 59-3.

Woven wire mesh must be commercial quality wire galvanized and vinyl coated.

83-2.10B(2) Powder Coated Surfaces

Where powder coating is shown, prepare the surface of the galvanized elements under the powder coat manufacturer's written instructions.

The minimum total dry film thickness of the primer, fluoropolymer powder coat, and the anti-graffiti coating is 2 mils.

Powder coat must be a fluoropolymer type, having the color retention and chalk resistance typical of American Architectural Manufacturers Association Publication 2605. Use a primer recommended by the manufacturer of the powder coat to obtain the following requirements:

Quality Characteristic	Test Method	Requirement
Adhesion to galvanized surface, min	ASTM D 3359, test method B	5B
Hardness, min	ASTM D 3363	H
Salt fog resistance, 4000 hrs	ASTM B 117	Scribe, >7 Blister rating, >8
Impact resistance, 80 in-lb	ASTM D 2794	Pass

Finished surfaces must be smooth and uniform without drips, runs, uneven coloration, pin holes, dust particles or bubbles, must be free from buckles, warps, dents, cockles, burrs, and other defects resulting from fabrication.

83-2.10C Construction

Decorative railing must present a smooth, uniform appearance in its final position, conforming closely to the horizontal and vertical lines shown or ordered.

Before the decorative railing parts are assembled, gently clean the bearing surfaces and surfaces to be in permanent contact without damaging the powder coating. If the railing is mounted on a concrete surface, the post bases must be true and flat to provide uniform bearing.

Carefully handle the materials such that no parts are bent, broken, abraded, or otherwise damaged. Do not use manufacturing, handling, or installation methods that damage or distort the members or damage the galvanization, powder coating, paint or vinyl coating.

Erect railing carefully and true to line and grade. Posts must be normal to the profile grade. Transverse to the profile grade, railings must be plumb within a tolerance not to exceed 0.02 foot in 10 feet. Adjacent rail elements must align with each other within 1/16 inch.

Attach handrailing to the decorative fence as shown.

Attach fence wire mesh to decorative railing as shown. The metal railing posts to which the wire mesh attaches must fit the mounting brackets, pipe sleeves, and other connection fittings. Stretch and fasten the wire mesh securely to the posts and other members. Wherever necessary to conform to horizontal or vertical curvature, rework and fit the mesh to present a smooth, neat, and workmanlike appearance.

After the cleaning, painting, and powder coating processes, protect all the components from exposure to grease, oils, dust, and contaminants.

Handle painted and powder coated elements to prevent damage during shipping and installation. Repair damage to:

1. Galvanizing under section 75-1.02B
2. Paint under section 59-3
3. Powder coat with a liquid recommended by the manufacturer of the powder coat in compliance with the authorized shop drawings.

If the damage to the powder coat is visible to the public and is greater than 2 percent of the total area of any individual element then that element will be rejected and you must reapply the powder coat. The Engineer determines the acceptability of powder coated elements.

83-2.10D Payment

Not Used

Add to the end of section 83-3.02B(1):

Construct Type 60P, 60AP, and 60PR concrete barriers of minor concrete, except the maximum size of aggregate used for extruded or slip formed concrete barrier must be no larger than 3/4 inch and no smaller than 1/2 inch, and the concrete must contain not less than 675 pounds of cementitious material per cubic yard.

Grout used to fill sign posts and post pockets in Type 60P, 60AP, and 60PR concrete barriers must comply with section 51-1.02G.

Replace *Reserved* in section 83-3.03A(1):

For Type 60P, 60AP, and 60PR concrete barriers, construct the sign post under section 82-3 except:

1. Immediately before placing a sign post in a post pocket:
   1.1. Clean out the post pocket and thoroughly saturate it with water.
   1.2. Remove all free water and dry the post pocket to a saturated surface-dry condition.
2. Place grout instead of minor concrete into the post pocket and insert the post. Ensure that grout on the inside and outside of the post is even with the bottom of the post drain hole. If grout blocks the post drain hole, unblock the hole by removing the excess grout. Do not retemper the grout.
3. Immobilize the post and cure the grout for at least 3 days using the curing compound method or by keeping the surface continuously damp.

Add to section 83-3.01A:

4" Plastic pipe at Sound wall 1 must be schedule 40 PVC complying with ASTM D1785.

Filter fabric for Sound wall 1 must be Class A.

Pervious backfill material placed within the limits of the concrete barrier at Sound Wall 1 must comply with section 19-3.02D.

For Sound Wall 1, the aluminum square next to pervious backfill material must be 6 by 6 inches, or the galvanized steel wire hardware cloth must be 1/4 inch mesh with 0.025-inch-diameter wire.

Add to section 83-3.04:

Concrete barrier (Type 842B MODIFIED) is paid for as concrete barrier (Type 842 MODIFIED).

Replace section 83-5.05 with:

83-5.05 ALTERNATIVE CRASH CUSHIONS

83-5.05A General

83-5.05A(1) Summary

Section 83-5.05 includes specifications for constructing alternative crash cushions.

83-5.05A(2) Definitions

Not Used

83-5.05A(3) Submittals

Submit a copy of the manufacturer's plan and parts list for each model of alternative crash cushion as an informational submittal.

Submit a certificate of compliance for each model of alternative crash cushion.

83-5.05A(4) Quality Assurance

Not Used

83-5.05B Materials

The allowable alternatives for a permanent crash cushion shall consist of one of the following or a Department approved equal.

1. Type REACT crash cushions must be manufactured by Energy Absorption Systems, Inc., located at 35 East Wacker Drive, Suite 1100, Chicago, IL 60601-2076. Type REACT crash cushions and additional components must comply with the descriptions shown in the following table:

Bid item description	Manufacturer's product description
Type REACT 9SCBS crash cushion	REACT 350-36 self contained
Type REACT 9CBB crash cushion	REACT 350-36 concrete side mount
Type REACT 62B060 crash cushion	REACT 350 wide system (60") self contained
Type REACT 62B096 crash cushion	REACT 350 wide system (96”) self contained
Type REACT 62B120 crash cushion	REACT 350 wide system (120”) self contained

The Type REACT crash cushions can be obtained from the following distributors:

Address	Telephone and fax nos.
TRAFFIC CONTROL SERVICE INC 8585 THYS COURT SACRAMENTO CA 95828	Telephone: (916) 387-9733 Fax: (916) 387–9734
TRAFFIC CONTROL SERVICE INC 1818 E ORANGETHORPE FULLERTON CA 92831-5324	Telephone: (714) 526-9500 Fax: (714) 526-9561

1. CRASH CUSHION (TYPE SCI-100GM) - Crash cushion (Type SCI-100GM). The Type SCI-100GM crash cushion can be obtained from the following distributors:

Address	Telephone and fax nos.
Work Area Protection Corporation 2500 Production Drive St. Charles IL 60174-9081	Telephone: (800) 327-4417 Fax: (630)377-9270
D&M Traffic Services Inc. 845 Reed Street Santa Clara CA 85050	Telephone: (408) 436-1127 Fax: (800) 953-2636

2. CRASH CUSHION (COMPRESSOR) - Crash cushion (Type Compressor). The Type Compressor can be obtained from the manufacturer:

Address	Telephone and fax nos.
Traffix Devices Inc. 160 Avenida :La Pata San Clemente CA 92673	Telephone: (949) 350-7048 Fax: (949) 361-9205

3. CRASH CUSHION (QUADGUARD ELITE 8-BAY) - Crash cushion (Type Quadguard Elite 8-bay). Type Quadguard Elite 8-bay must comply with the descriptions shown in the following table:

Backup Width	Manufacturer's Product Description
24 inch backup	QS2408E
30 inch backup	QS3008E
36 inch backup	QS3608E
69 inch backup	QS6908E
90 inch backup	QS9008E

The Type QUADGUARD ELITE 8-BAY crash cushion can be obtained from the distributors:

Address	Telephone and fax nos.
TRAFFIC CONTROL SERVICE INC 8585 THYS COURT SACRAMENTO CA 95828	Telephone: (916) 387-9733 Fax: (916) 387–9734
TRAFFIC CONTROL SERVICE INC 1818 E ORANGETHORPE FULLERTON CA 92831-5324	Telephone: (714) 526-9500 Fax: (714) 526-9561

The price quoted for the Type REACT 9SCBS crash cushion includes the concrete anchorage devices, but does not include the concrete anchor slab or the W-beam connection to the barrier.

The price quoted for the Type REACT 9CBB crash cushion includes the concrete anchorage devices, but does not include the concrete anchor slab or the concrete backup block.

The price quoted for the Type REACT 62B060, Type REACT 62B096 and Type REACT 62B120 crash cushion includes the self-contained backup and concrete anchorage devices, but does not include the concrete anchor slab.

Concrete anchorage devices used for attaching the crash cushion to the base slab must be limited to those provided by the manufacturer.

The concrete anchor slab, including bar reinforcing steel, must comply with sections 51 and 52.

The concrete anchor slab and backup block, including bar reinforcing steel, must comply with sections 51 and 52.

Construct the concrete anchor slab using concrete containing at least 590 pounds of cementitious material per cubic yard.

Construct the concrete anchor slab and backup block using concrete containing at least 590 pounds of cementitious material per cubic yard.

For Type REACT 9SCBS crash cushions, W-beam connections to the barrier must comply with section 83-2.02. The HS bolts must comply with ASTM A325 or A325M and the nuts must comply with ASTM A563 or A563M.

83-5.05C Construction

Install Type REACT crash cushions under the manufacturer's instructions.

83-5.05D Payment

Not Used

^^

84 MARKINGS

Replace the 2nd paragraph in section 84-2.03C(2)(e) with:

Apply the stripe at a rate of at least 0.47 lb of thermoplastic per foot of 6-inch-wide solid stripe. The applied thermoplastic traffic stripe must be at least 0.090 inch thick.

Replace section 84-5 with:

84-5 PERMANENT TAPE TRAFFIC STRIPES

84-5.01 GENERAL

84-5.01A Summary

Section 84-5 includes specifications for applying permanent, preformed, self-adhesive traffic tape.

The traffic tape used must be an approved permanent traffic striping and pavement marking tape listed on the Authorized Material List for Prequalified and Tested Signing and Delineation Materials.

84-5.01B Submittals

Submit a certificate of compliance for the traffic tape.

84-5.01C Quality Assurance

Within 14 days of applying the traffic tape, the retroreflectivity must be a minimum of 250 millicandelas per square meter per lux for white stripes and 150 millicandelas per square meter per lux for yellow stripes. Test the retroreflectivity under ASTM D 7585. Have a reflectometer as described in ASTM E 1710 at the job site for making these measurements.

84-5.02 MATERIALS

The traffic tape used must be an approved permanent traffic striping and pavement marking tape. Traffic tape used for striping lane lines on bridge decks and on PCC pavement shall have 1.5-inch wide black contrasting borders on both longitudinal sides of the 6-inch wide traffic stripe.

84-5.03 CONSTRUCTION

The pavement surface to receive the traffic tape should be clean, dry and prepared per the traffic tape manufacturer’s instructions. Prior to traffic tape installation, apply a primer recommended by the tape manufacturer if the manufacturer requires a primer. After installing the traffic tape, roll or tamp the traffic tape in place per the manufacturer’s instructions. A manufacturer's representative or manufacturer-certified contractor must monitor the installation.

84-5.04 PAYMENT

A double permanent tape traffic stripe consisting of two 6-inch wide yellow stripes is measured as 2 traffic stripes.**Replace *Reserved* in section 84-9.03C with:**

Residue from the removal of painted or thermoplastic traffic stripes and pavement markings contains lead from the paint or thermoplastic. The average lead concentrations are less than 1,000 mg/kg total lead and 5 mg/L soluble lead. This residue:

1. Is a nonhazardous waste
2. Does not contain heavy metals in concentrations exceeding the thresholds established by the Health and Safety Code and 22 CA Code of Regs
3. Is not regulated under the Federal Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 et seq.

Management of this material exposes workers to health hazards that must be addressed in your lead compliance plan.

^^^

86-1.02Q(3)(b) RJ-11 Modular Jack

The RJ-11 modular jack must:

1. Be DIN rail mounting
2. Have 6 interface positions
3. Be rated for 120 V and 1 A
4. Have dimensions of 2 inches (D) by 1.5 inches (W) by 3.25 inches (H)
5. Have a screw clamp connection

86-1.02Q(3)(c) RJ-45 Modular Jack

The RJ-45 modular jack must:

1. Be DIN rail mounting
2. Have 8 interface positions
3. Be rated for 120 V and 1 A
4. Have dimensions of 2 inches (D) by 1.5 inches (W) by 3.25 inches (H)
5. Have a screw clamp connection

86-1.02Q(3)(d) DC Terminal Block

The DC terminal block must:

1. Be rated for 250 V(ac)/DC voltage and 30 A current
2. Have an operating temperature from -13 to 122 degrees F
3. Have a maximum size of 3.9 inches (D) by 2.7 inches (W) by 2.7 inches (H)
4. Have a wire size for the input terminals of 26-10 AWG solid/strand
5. Have a wire size for the output terminals of 26-12 AWG solid/strand
6. Have a torque of at least 4.4 in-lb

Add to the list in the 2nd paragraph of section 86-1.02R(4) of the RSS:

4. Be made of plastic

Replace the 1st sentence in the 1st paragraph of section 86-1.02U of the RSS with:

The housing for a push button assembly must be made of UV-stabilized, self-extinguishing structural plastic.

^^

87 ELECTRICAL SYSTEMS

Replace the 1st sentence in the 9th paragraph of the RSS for section 87-1.03A with:

The shutdown of traffic signal systems is allowed only between 0900 and 1500 hours.

Add to the end of the RSS for section 87-1.03A:

Notify the Engineer, and District 3 Traffic Signal Operations at (530) 634-7619, 5 days before working on any loop detectors or video detection. During periods of traffic control at signalized intersections, the signals may be shut down, or set on flashing mode. Submit a schedule of times you will need the signals to either be shut down or set on flashing mode, and the times you will need the signals to be restored to normal operating mode. The Department will perform all changes in signal operation modes.

Replace the 3rd paragraph of the RSS for section 87-1.03B(3)(a) with:

Place a minimum of 2 inches of sand bedding in a trench before installing Type 2 or Type 3 conduit and 4 inches of minor concrete over the conduit before placing additional backfill material. The concrete must contain at least 421 pounds of cementitious material per cubic yard.

Replace the 1st paragraph of the RSS for section 87-1.03D with:

Install the battery backup system cabinet on the right side of the Model 342LX cabinet.

Install the assembled Model 342LX cabinet with battery backup system cabinet on the foundation.

Add to the end of the RSS for section 87-1.03F(1):

Do not install aluminum conductors or aluminum cables.

Replace the 1st paragraph of the RSS for section 87-1.03F(2)(c)(ii) with:

Install a Type B loop detector lead-in cable in conduit.

Replace the 1st paragraph of the RSS for section 87-1.03F(3)(c)(ii) with:

Use a Type 2 loop wire. Use only Type 2 loop wire for Type E loop detectors.

Replace the 2nd paragraph of the RSS for section 87-1.03H(2) with:

Use Method B to insulate a splice.

Add to the end of the RSS for section 87-1.03T:

A manufacturer's representative must program the accessible pedestrian signals shown :

When the extended pushbutton press is used, program the signals with messages for each street as follows:

1. During the pedestrian clearance interval, the message heard must be, *Wait to Cross* . *Wait*.

Add between the 11th and 12th paragraphs of the RSS for section 87-1.03V(2):

Use elastomeric sealant or hot-melt asphalt rubberized sealant to fill slots.

Replace the RSS for section 87-9 with:

87-9 LOCATING AND MAPPING UNDERGROUND FACILITIES

87-9.01 GENERAL

87-9.01A Summary

Section 87-9 includes specifications for performing work on underground facilities. This work includes locating and mapping existing underground facilities and providing digital files of all the existing facilities including the ones installed as a part of the project work.

87-9.01B Definition

Excavation: Any operation in which earth, rock, or other material in the ground is moved, removed, or otherwise displaced by means of tools, equipment, or explosives in any of the following ways: grading, trenching, digging, ditching, augering, tunneling, scraping, cable or pipe plowing and driving, or any other way.

87-9.01C Submittals

Submit the following for review and approval:

1. A memo indicating the number of years of experience
   1.1. The company has in locating underground facilities: a minimum of 3 years of field experience

1.2. The personnel performing the work have in operating the locating equipment. Previous experience from other companies is acceptable
2. The certification of personnel operating all the equipment to be used in the operation
3. Certification of personnel showing at least 300 hours of on the job training
4. 10 business days before disturbing existing grade, a report consisting of the following:
   4.1. A signature from the company personnel in charge and responsible for the work
   4.2. The type of facility, the alignment and profile, and depth from original ground and any anomalies.
   4.3 A layout plan sheet or an aerial photo, identifying the location of the facility, 3 feet on each side of the planned excavation. For a spot location, identify the facility within a 6-foot square.

A signed copy of the report will be returned for your files. The report must be approved before excavation.

Submit the following for the records:

1. A list of the equipment that will be used in locating the underground facility
2. A digital copy of the report to the Engineer

87-9.01D Quality Assurance

Provide certificates of experience for the company and the personnel operating the equipment.

87-9.02 MATERIAL

Not Used

87-9.03 CONSTRUCTION

87-9.03A General

Only certified operators using approved equipment are allowed to locate the underground facilities. Locate all the facilities in the areas affected by your activity using 2 current underground utility locator technologies. Do not damage any underground facilities as a result of your operations. Do not use equipment or devices that may release hazardous material into the ground.

You may use ground penetrating radar, radiography, electromagnetic tracing, ultrasonic tracing and any underground imaging technology. Any other method must be approved.

87-9.03B Pre-Excavation

For excavation at a spot location, mark out the location of the underground facility in a 6-foot square. For excavation other than a spot location, mark out the underground facility 3-feet on each side.

Mark the underground facility identified by the locator on the existing grade before any disturbance of the existing grade. Marking that is obliterated or washed out must be re-identified by the locator. Therefore, the marking of the underground facility must be maintained until the disturbance of the existing grade.

Collect the location and depth data of the located facility and include it in the digital files for the existing facility.

87-9.03C Post Installation

Locate the installed underground facility after the excavation is backfilled to final grade. In the case of boring, jacking, or tunneling methods, obtain the data from the equipment operator or by other approved methods.

Collect the data for the location and depth of the installed facility and include it in the digital files.

87-9.03D Digital Files

Using the NAD 83 global positioning system (GPS) co-ordinates, locate the underground facility within 3-feet accuracy. There must be a minimum of 4 satellites in the vicinity and optimum environmental condition for receiving information from the GPS satellites when using the GPS device.

Provide the depth and the accuracy of depth of the facility.

Email a digital file of the geographic information system (GIS) mapping input. The digital file must contain the GPS coordinates of the underground facility, that includes the depth, type of facility (if available), size and any pertinent information.

The digital file must be created using a computer aided design mapping software (.gdn or .dwg files) or a GIS mapping software. The data must be geo-referenced with attributes.

87-9.03D Demonstration

Make corrections, adjustments, resubmittals, re-marking of the demonstration is not successful. Notify the Engineer 5 business days before the scheduled demonstration.

87-9.04 PAYMENT

Not Used

Replace the RSS for section 87-10 with:

87-10 CLOSED CIRCUIT TELEVISION SYSTEM (CCTV System)

87-10.01 GENERAL

87-10.01A Summary

Section 87-10 includes specifications for construction closed circuit television (CCTV) systems.

CCTV system includes:

1. Foundations
2. Conduit
3. Conductors
4. Controller cabinet
5. Service equipment enclosure
6. Pull boxes
7. High Mast CCTV assembly
8. Camera
9. Universal junction box (UJB)
10. Camera breakout cable (CBC)
11. Camera interconnect cable (CIC)
12. Universal pedestal mount (UPM)

The components of a CCTV system are shown on the project plans.

87-10.01B Definitions

Not Used

87-10.01C Submittals

Submit a schedule of values to the Engineer and to the Regional Transportation Management Center (RTMC) Office of Electrical Systems, 3165 Gold Valley Dr., Rancho Cordova, CA 95742 before procurement. The values must include the following:

1. Camera
2. Universal junction box
3. Universal pedestal mount
4. Camera breakout cable
5. Camera interconnect cable
6. High mast CCTV assembly

Deliver the submittals to the Engineer before ordering the high mast CCTV assembly. Review areas will include structural, welding, electrical and other areas as determined by the Engineer.

1. You must submit descriptive data, design and installation drawings. This information must include aiming directions for each video camera assembly, calculations and structural design, and a list of the material (including counterweight for leveling the camera ring) used for the high mast CCTV assembly. The material list must be complete with the name of the manufacturer, catalog number, size, capacity, finish, pertinent ratings and identification symbols used on the plans or in the special provisions for each unit.
2. Each submittal must consist of 5 copies
3. Plans and detailed drawings must not be larger than 22" X 34"
4. Each separate item submitted must bear a descriptive title and the Department contract number

Notify the Engineer 3 days before taking down any CCTV. Once a CCTV is taken down, make sure it is operational again within 5 days.

87-10.01D Quality Assurance

87-10.01D(1) General

The lowering device will be inspected and tested. Inspection and testing must be performed at a site in California approved by the Engineer. The lowering device system must be demonstrated at your expense. Notification must be given to the Engineer at least 7 days before demonstration.

After the high mast CCTV system is in operation, an instructional video disc (DVD) complete written instructions and a demonstration to State Maintenance personnel on the maintenance of the high mast CCTV assembly, including supporting cable adjustments for the equipment ring and the procedures for the proper raising and lowering of the equipment ring, must be provided.

Deliver part lists and the operating, maintenance and service instructions, packaged with or accompanying the equipment installed on the project to the Engineer before acceptance of the project.

87-10.01D(2) Training

Provide a minimum of 4 hours of operational and maintenance training to Department personnel. Provide enough documentation for up to 8 Caltrans personnel. Provide a two week notice before the start of training. The Department will provide a training facility. Provide any software, special equipment, or programming device for CCTV equipment.

87-10.01D(3) Acceptance Test Procedure

Upon completion of work, each CCTV system must be subjected to post-installation tests as outlined herein. All software must be provided and loaded before the start of testing.

Notify the Engineer to arrange a date for testing. Provide a color monitor capable of displaying the color NTSC video and a computer capable of exercising the Camera functions and displaying the H.264 video using a local network connection. Perform and document the following tests in the presence of the Engineer. Place the results from each location into a binder and deliver to the Engineer.

87-10.01D(3)(i) Iris Auto/Manual Operation

With IRIS Auto/Manual switch in Manual:

1. Open Iris and verify that the video image lightens.
2. Close the Iris and verify that the video image darkens.

Open the Iris to lighten the image and then switch IRIS Auto/Manual switch to auto. Verify that the Camera iris closes to produce the original video image.

Close the Iris to darken the image and then switch IRIS Auto/Manual switch to auto. Verify that the Camera iris opens to produce the original video image.

87-10.01D(3)(ii) Focus Auto/Manual Operation

With FOCUS Auto/Manual switch in Manual, demonstrate that the Camera can focus on objects both near and far in the field of view.

Focus near, then switch FOCUS Auto/Manual switch to auto and demonstrate that the Camera focus adjusts automatically to bring the image back in focus.

Focus far, then switch FOCUS Auto/Manual switch to auto and demonstrate that the Camera focus adjusts automatically to bring the image back in focus.

87-10.01D(3)(iii) Zoom Telephoto/Wide Operation

With the IRIS and FOCUS Auto/Manual switches in Auto, demonstrate the auto IRIS & FOCUS adjustments operate with a focused picture present in the video image as the picture is zoomed near and far.

With IRIS and FOCUS Auto/Manual switch in Manual operate the Zoom from wide angle to Telephoto

to demonstrate that all IRIS & FOCUS adjustments do not operate as if in Auto.

Demonstrate that the analog zoom functions through 30 times the focal length.

87-10.01D(3)(iv) Tilt Operation

Demonstrate that with Iris and Focus in Auto & Zoom in wide mode that the Camera has a tilt range of 360 degrees.

87-10.01D(3)(v) Pan Right/Left Operation

Demonstrate that with Iris and Focus in Auto, and Zoom in wide mode that the Camera can pan 360 degrees.

87-10.01D(3)(vi) Camera Preset Operation

Using Camera control software, demonstrate that the Camera system executes a minimum of 6 unique preset positions employing various degrees of zoom, pan and tilt. The Camera must move freely from one preset position to the next.

The Camera system must move to the next preset position in 4 seconds or less. Once in the preset position, the Camera must not move unless directed by another command.

The Camera control software must automatically and continuously test all 6 preset positions in succession for a minimum of one hour.

87-10.01D(3)(vii) ID Generation

Using Camera ID Generator and vendor supplied Camera control software, demonstrate the insertion of 20 text characters into the video image.

Demonstrate that the text can be cleared using the control software.

87-10.02 MATERIALS

87-10.02A General

The CCTV system must comply with all rules and regulations of the Federal Communications Commission, and these special provisions.

All materials installed must be new, corrosion resistant and in strict accordance with the details shown and these specifications.

The CCTV camera must display High Definition (HD) color digital video and be controlled from the RTMC using an Internet Protocol (IP) network connection.

87-10.02B High Mast CCTV Assembly

87-10.02B(1) General

The high mast assembly includes the foundation, pole, CCTV lowering device system, and a control pedestal, as shown.

87-10.02B(2) High Mast Pole

The pole must include shaft, access hole, access hole cover, support plate, and anchor base.

Pole sections that slip together must have each section permanently marked, visible from a distance of 30 feet, with indexing marks to line up each section with the respective section it slips together with, and marks showing how far the sections must be slipped together.

The pole must have reinforced access hole to allow adequate clearance for maintaining and servicing the lowering device. Access hole reinforcement must provide a bending strength equal to that of the pole without an opening. The access hole must be of sufficient size to allow the removal of all equipment installed in the pole.

There must be no electrical apparatus within the pole except for the motor, power cables, connectors and lighting bonding conductors.

The access hole must have a door hinged to the pole. It must open horizontally 180 degrees, and when in the open position, must not interfere with access to the interior of the pole.

The door must be provided with a handle that operates a closing mechanism and incorporates a pad lock hasp type locking device. No additional hardware, including bolts, must be used to facilitate the door to close or to secure it when closed.

The pole must be installed with the access door towards the 334L TV cabinet.The pole must be erected plumb. The vertical axis of the erected pole must be within 3 inches of the theoretical vertical axis when measured without the action of sunlight or wind.

A lightning arrestor copper cable of No. 8 AWG must be bonded to the pole inside its base and then run in a conduit to a 20 foot-ground rod located within a pull box at the base of the pole. The headframe cover must be equipped with a lightning rod and lighting arrestor on circuit breaker at the base of the pole.

The pole must conform to the requirements of the latest edition and interim revisions of the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." The maximum allowable wind deflection must not exceed 15 percent of the pole height.

An embossed aluminum plate must be attached with rivets to the outside of each pole approximately 2 inches above the access hole. The nameplate must indicate the name of the pole manufacturer and the height of the pole, and the parameters for which the pole was designed, including wind velocity (and wind gust factors) and the maximum number of luminaires (including the weight, projected area and coefficient of drag of the luminaire used to determine it.) Luminaires must be used for calculation purposes although video equipment (not luminaires) will actually be installed. Ten 400 W HPS high mast luminaires must be used for calculation purposes.

87-10.02B(3) Camera Assembly Lowering Device

The equipment lowering device must consist of a head frame, an equipment ring with counterweight device for leveling, and an internal power drive unit.

The maximum effective projected area of the total assembly at the top of the pole, exclusive of the camera unit, must not exceed 5 square feet.

The maximum weight of the head frame, equipment ring and cover must not exceed 750 pounds.

The head frame must be hot rolled steel conforming to the requirements in ASTM Designation: A 36. The head frame must be attached to the pole by means of a steel slipfitter and secured by a minimum of 4 stainless steel setscrews conforming to the requirements in ASTM Designation: F 880, Type 304. The head frame must be hot-dip galvanized in conformance with the provisions in Section 75-1.05, "Galvanizing," of the Standard Specifications.

The head frame must be fitted with at least 6 hoisting cable sheaves, of either galvanized or stainless steel, or aluminum, with a minimum 5-inch pitch diameter. The head frame must be fitted with electrical power cable sheaves or rollers configured to provide a minimum bending radius as specified by the power cable manufacturer or coated by some other method which provides equivalent corrosion resistance and is approved by the Engineer.

The hoisting cable sheaves and electrical power cable sheaves or rollers must be fitted with suitable keepers to keep the cables in their tracks during pole erection and operation. The sheaves must be

supported by stainless steel shafts and must be fitted with oil-impregnated sintered bronze bushings or roller bearings.

At least 3 hoisting cables must be supplied. The cables must be ¼ inch, minimum diameter, 7x19 strand, stainless steel aircraft cable, manufactured in conformance with the requirements in Military Specification MIL-8320B. The hoisting cables and the CCTV Ethernet cable must not rub or scrape against any portion of the system that will cause them mechanical damage.

The head frame must be provided with a cover designed for that device and securely attached with stainless steel machine screws conforming to the requirements in ASTM Designation: F593, Type304 requirements and self-locking nuts meetingthe general chemical requirements of ASTM Designation: F594, Type 304, or a stainless steel clamp band with a safety latch. The shape of the lowering device and cover must be symmetrical about a vertical axis. The maximum weight of cover must be 20 lbs, and its maximum diameter must be 3.50 feet.

The head frame must also include a minimum of 3 latches which support the equipment ring when the lowering device is not in operation. Latching must be accomplished by the alternate raising and lowering of the equipment ring by the winch and hoisting assembly. When the equipment ring is raised to the top of the pole, it must automatically latch and be secure in a locked position. Automatic signaling devices must be visible to indicate that each latch of the equipment ring is safely locked in place. Signaling devices must be 5 inches-minimum diameter.

No moving latch parts or springs must be attached to the head frame. Moving parts of the latching mechanism must be attached to the equipment ring and serviceable from the ground.

The head frame must be provided with appropriate protection device to prevent birds or rodents from entering into the pole or the head frame. The method or device must be approved by the Engineer.

The equipment ring must be fabricated of a 6"x2"x0.179" (7-gage), minimum, steel channel or a member of equal strength, with the appropriate number of 2-inch nominal steel tube or pipe mounting arms to accommodate the number of equipment devices shown on the plans. The pipe must conform to the requirements of ASTM Designation: A 53. The ring must be galvanized in conformance with the provisions in section 75-1.02B Galvanizing, of the Standard Specifications. The mounting arm must be attached to the equipment ring in a manner which allows them to be relocated anywhere along the circumference of the ring without drilling and also allows for additional mounting arms to be symmetrically installed on the ring.

Roller-contact, spring loaded, centering arms must be provided which will center the equipment ring while ascending the full length of designed travel on the pole. The centering system must be capable of keeping the ring concentric with the pole in winds up to 30 mph. The rollers for the centering arms must be a water resistant, non-marking material. Axle shafts for arms and rollers must be stainless steel conforming to the requirements in ASTM Designation: A 276, Type 304. The centering system must not allow the pole to be inadvertently wedged between the rollers and the equipment ring.

87-10.02B(4) Closed Circuit Television Assembly Mounting

A Cat5e Power Over Ethernet (POE) cable with an appropriate quick connect/disconnect connector on its ends must be provided (in conduit) between the 334L TV cabinet and the pole's base and another Cat5e POE cable (main CCTV Cat5e POE cable) from the pole base to the CCTV assembly. You must furnish and install appropriate "Amp-type" connectors. The former cable must be of sufficient length to connect to the main cable via locking type connectors, when the equipment ring is in the raised position and must be of sufficient length to reach outside through the pole's handhole to connect to the receptacle on the equipment ring to test the video camera equipment when the ring is in the lowered position.

Provisions must be made for adjusting the equipment ring hoisting cables while in the lowered position. You must adjust these cables to be equal length between the equipment ring and the head frame upon installation and again before completion of the contract.

All electrical cords must be attached to a weathertight wiring chamber through weathertight cable connections. The CCTV Cat5e POE cable must be continuous and be capable of supporting its full weight when installed.

87-10.02B(5) Internal Power Drive Winch

The internal drive mechanism must be capable of raising and lowering the equipment ring at an approximate speed of 11 feet per minute. The winch must be furnished with 1/4 inch minimum diameter 7x19 strand stainless steel aircraft cable, conforming to the requirements in Military Specification MIL-8320B, of sufficient length to maintain at leastone complete row of cable on the drum with the equipment ring in its fully lowered position. Winch cable must wind uniformly and be prevented from spilling over the winch end flanges by cable guides.

The internal power drive winch unit must include:

1. A heavy duty, totally enclosed, fan cooled, reversible universal type 120V motor, rated at one horsepower minimum, for continuous duty, and provided with overcurrent protection. An embossed metal plate must be attached to the outside of the motor which states the name of the manufacturer, the horsepower, RPM, operating voltage, current, and operating conditions.
2. A torque limiter with ball or roller bearings on all rotating shafts.
3. A remote control reversing switch (labeled "UP" and "DOWN") running in conduit located at the base of the pole.
4. Worm-gear driven winch. The winch must have leak proof oil bath lubrication, steel worm reduction gears, and must include an integral friction drag brake to prevent spooling at the winch drum. The winch gear housing must be provided with easily accessible removable plugs for filling, checking the proper level, or draining the winch lubricating oil with the winch in place. The winch drum shaft must be supported at both ends. The winch drum end flanges must be sized one inch larger in radius than the radius of the fully wound drum. The axis of the winch drum must be set perpendicular to the axis of the pole, and verified by the Engineer after pole installation by you using a bubble level.
5. Mounting frame.
6. Weatherproof step-down transformer, if necessary, of sufficient power to supply the motor and provided with overcurrent protection. The transformer, when installed inside the pole, must be removable without removing other components.
7. Other equipment as necessary.

All internal power drive winch unit components must be removable through the access hole as a unit for repair or replacement.

87-10.02C CCTV Camera

The CCTV system must deliver both digital video and analog video simultaneously. The Camera must also be controlled using both IP and the asynchronous serial communication standard TIA-422. The Camera must also have a built in web server to allow for administrative, setup, control, and viewing capabilities. The Camera command instruction protocol must be selectable between at least the ONVIF, NTCIP and COHU i-View 3965 series Camera control protocol. The Camera must meet or exceed the following general specifications:

Specifications	Description
Camera	
Image Sensor	1/3in 2 megapixel
Digital Image Resolution	1080p/1080i/720p
Analog Image Resolution	NTSC
Lens	30x optical zoom
Iris	Auto or manual
Focus	Auto or manual
Image Stabilization	On/Off
S/N Ratio	>50dB
IP VIDEO/NETWORK	
IP Video Streams	2 individually configured + Analog
Video Codec	H.264 and MJPEG
Codec Resolution	D1,VGA,HVGA,QVGA,2CIF, NTSC,SDTV
Frame Rates	30, 15, 7, 4, 2, 1
Data Rates	64Kb/sec to 5Mb/sec
Connection Types	Multicast or Unicast
Network Protocols	RTP, RTSP, UDP, TCP, IP, HTTP, ARP
On Screen Display	Logo or OSD overlay video
On Screen Titling	Up to 24 characters
On Screen Azimuth Display	Indicates viewing direction
POSITIONING DRIVE	
Pan Range	continuous 360 degrees
Tilt Range	+90 to -90 degrees or continuous 360 degrees
Compass setting	True North
Preset	64 preset positions
Tours	8 tours of 32 presets with individual dwell times
Protocol	ONVIF, COHU, NTCIP
Control	TIA-422 and IP
Configuration and Setup	Web Server
Firmware	Upgradeable flash memory
CAMERA CABLE (ELECTRICAL/ENVIRONMENTAL)	
Power Input	120 VAC
Cable Length	3ft
Cable Connector	Mil-Spec Circular
Operating Temperature	-29 to +165 degrees F
Heater	Yes
Protection Rating	IP-67

87-10.02D Universal Junction Box (UJB)

The UJB must be a NEMA-3R enclosure mounted to the Universal Pedestal Mount (UPM). The details for the UJB are shown.

The universal junction box will contain the following items: Ethernet extender, Wireless Serial Ethernet Modem (WSEM), data surge suppressor, video surge suppressor, power surge suppressor, NEMA-15 duplex outlet, and 15A circuit breaker. All components must be mounted on a DIN rail bracket.

87-10.02E Camera Breakout Cable (CBC)

The CBC is a 2-ft long cable that will connect to the mil-spec connector on the camera cable and terminate in the universal junction box. The CBC will also have the following terminations: mil-spec on one end and RJ-45, BNC, and a NEMA-15 plug on the other end.

87-10.02E Camera Interconnect Cable (CIC)

The Camera Interconnect Cable must be either of the following:

1. A multi-conductor cable with an outdoor rated common outer jacket containing: TIA 538B CAT6 cable, three-AWG 14 (white, black, green) wires, and a 75 ohm coaxial cable with bare copper shielding.
2. Three discrete cables each with an outdoor rated outer jacket: TIA 538B CAT-6 cable, three-AWG 14 (white, black, green) wires, and a RG-59 coaxial cable.

The Camera must be terminated at the 334L cabinet with a NEMA-15 plug, RJ-45 connector, and BNC connector. The CIC must be terminated at the pole mounted universal junction box with the three 14 AWG wires (white, black, green) stripped and tinned, RJ-45, and BNC connector. The CIC must have a strain relief located towards the top of the CCTV pole and hung using a cable grip on the CCTV pole's j-hook. Wiring must run continuous from the universal junction box to the 334L cabinet. No splices are allowed. Verify CIC cable length before ordering of materials.

87-10.02F Universal Pedestal Mount (UPM)

The UPM must mount to either a 5" or 7" diameter end of the CCTV pole depending on the size of the top of the existing pole being used. The UPM must also allow for mounting of the universal junction box. The details for the UPM are shown.

87-10.03 CONSTRUCTION

87-10.03A General

Inform the Engineer one week before installation and testing.

The CCTV system must be installed and tested as a complete and operational system. The installation includes any ancillary components not detailed and required to make the CCTV system operate such as power supplies, cables, cable adapters, and mounting brackets.

The CCTV system must be installed and tested per the CCTV system manufacturer requirements.

The cable run between components must be continuous without splices. A minimum of 3 feet of slack must be provided at each pull box, junction box or vault, and a minimum of 9 feet at each cabinet.

87-10.03B High Mast CCTV Assembly

Installation of the lowering device on each pole must be made under the supervision of a trained representative of the lowering device manufacturer at the job site.

Before acceptance of the contract, a trained representative of the lowering device manufacturer must demonstrate that each high mast CCTV assembly operates properly. The demonstration must consist of a minimum of 3 complete cycles of raising and lowering the equipment ring (complete with video apparatus and counterweight) the full length of the ring's travel, as designed, within one working day, prior to acceptance of the project.

The lowering device system must be demonstrated at the Contractor's expense. Notification must be given to the Engineer at least 7 days before the demonstration.

The pole foundation must conform to Caltrans Standard Plans.

87-10.03C CCTV Camera

You will be provided an IP configuration for each camera location. The camera must be configured with the appropriate IP address before the acceptance test procedure (ATP).

The camera compass setting must also be set for true North before the camera ATP.

The Camera must be mounted using a universal pedestal pole top mounted adapter (18" adaptor post) along with a universal junction box as shown and under these special provisions.

The Camera must connect to the Camera Interface Cable using connections provided within the universal junction box.

87-10.04 PAYMENT

Not Used

Replace the RSS for section 87-13 with:

87-13 VIDEO IMAGE VEHICLE DETECTION SYSTEM (VIVDS)

87-13.01 GENERAL

87-13.01A Summary

Section 87-13 includes specifications for constructing and installing the Video Image Vehicle Detection System.

The components of the VIVDS are shown.

87-13.01B Definitions

Video Detection Unit (VDU): Processor unit that converts the video image from the camera and provides vehicle detection in defined zones. Unit includes an image processor, extension module, and communication card.

Video Image Sensor Assembly (VIS): An enclosed and environmentally-protected camera assembly used to collect the video image.

Video Image Vehicle Detection System (VIVDS): A system that detects video images of vehicles and bicycles in defined zones and provides video output.

VPN: Virtual Private Network

WAN: Wide Area Network

87-13.01C Submittals

For the VIVDS, submit the following before installation:

1. Certificate of Compliance.
2. Site Analysis Report: Written analysis for each detection site, per the manufacturer's representative, recommending the optimum video image sensor assembly placement approved by the manufacturer.
3. Lane Configuration: Shop drawing showing:
   - 3.1. Detection zone setback
   - 3.2. Detection zone size
   - 3.3. Camera elevation
   - 3.4. Selected lens viewing angle
   - 3.5. Illustration of detection zone mapping to reporting contact output
   - 3.6. Illustration of output connector pin or wire terminal for lane assignment.
4. Configuration Record: Windows 7 PC compatible CD containing:
   - 4.1. Proposed zone designs
   - 4.2. Calibration settings
5. Mounting and Wiring Information: Manufacturer approved wiring, video cable and service connection diagrams.
6. Communication Protocol: Industry standard available in public domain. Document defining:
   - 6.1. Message structure organization
   - 6.2. Data packet length
   - 6.3. Message usability
   - 6.4. Necessary information to operate a system from a remote, Windows based personal computer.
7. Programming Software: CD containing set up and calibration software that observes and detects the vehicular traffic, including bicycles, motorcycles, and sub-compact cars, with overlay of detection zones and allows adjustment of the detection sensitivity for a traffic signal application.
8. Detector Performance DVD or Blu-Ray or encrypted USB drive or encrypted hard drive recordings and Analysis: Performance analysis based on 24-hour DVD recording of contiguous activity for each approach. Include:
   - 8.1. Two contiguous hours of sunny condition, with visible shadows projected a minimum of 6 feet into the adjacent lanes

8.2. Two 1-hour night periods with vehicle headlights present.

9. Preventative Maintenance Parts Documentation: List of equipment replacement parts for preventative maintenance, including:
   9.1. Electrical parts, wiring and video cable
   9.2. Mechanical parts
   9.3. Assemblies.

Allow 7 days for the Engineer to review the documentation submittal.

If the Engineer requires revisions, submit a revised submittal within 5 days of receipt of the Engineer's comments and allow 5 days for the Engineer to review. If agreed to by the Engineer, revisions may be included as attachments in the resubmittal. The Engineer may conditionally approve, in writing, resubmittals that include revisions submitted as attachments, in order to allow construction activities to proceed.

Upon the Engineer's approval of the resubmittal, submit copies of the final documents (with approved revisions incorporated) to the Engineer.

Submit an acceptance testing schedule for approval 15 days before starting acceptance testing.

When beginning acceptance testing of VIVDS and detector performance and analysis, submit approved copies of the following:

1. Configuration Record: Windows 7 PC compatible mass storage containing:
   1.1. Final zone designs
   1.2. Calibration settings to allow reinstallation.
2. Mounting and Wiring Information: Final wiring and service connection diagrams.
   2.1. One copy for the Engineer
   2.2. A second copy wrapped in clear self-adhesive plastic, be placed in a heavy-duty plastic envelope, and secured to the inside of the cabinet door.

87-13.01D Quality Assurance

87-13.01D(1) Acceptance Testing

VIVDS and support equipment required for acceptance testing must be new and as specified in the manufacturer's recommendations. Date of manufacture, as shown by date codes or serial numbers of electronic circuit assemblies, must not be older than 12 months from the scheduled installation start date. Material substitutions must not deviate from the material list approved by the Engineer.

87-13.01D(2) Training

You must provide a minimum of 8 hours of training by a factory authorized representative for a maximum of 8 Department employees. Submit training material to the Engineer for approval at least 30 days before the proposed training. Training material content must include instructions for aligning, programming, adjusting, calibrating, and maintaining VIVDS. You must provide all materials and equipment for the training. Notify the Engineer 20 days in advance of the proposed training to obtain approval of place and time of the training. If agreement cannot be reached, the Engineer will determine the time and place.

87-13.02 MATERIALS

87-13.02A General

VIVDS must include the necessary firmware, hardware, and software for designing the detection patterns or zones at the intersection or approach. Detection zones must be created with a graphic user interface designed to allow anyone trained in VIVDS setup to configure and calibrate a lane in less than 15 minutes.

The VIVDS equipment must be new.

System elements must comply with the manufacturer's recommendations and be designed to operate continuously in an outdoor environment.

All equipment, cables, and hardware must be part of an engineered system that is designed by the manufacturer to fully interoperate with all other system components. Mounting assemblies must be corrosion resistant. Connectors installed outside the cabinets and enclosures must be corrosion resistant, weather proof, and watertight. Exposed cables must be sunlight and weather resistant.

87-13.02B Physical and Mechanical Requirements

VIVDS must include:

1. VIS and mounting hardware. Use a clamping device as mounting hardware on a pole or mast-arm.
2. VDU
3. Power supply
4. Surge suppression
5. Cables
6. Connectors
7. Wiring for connecting to the Department-furnished Model 332L or 342 LX traffic controller cabinet.
8. Communication card

87-13.02C Electrical Requirements

VIVDS must operate between 90 to 135 V(ac) service as specified in NEMA TS-1. VIS, excluding the heater circuit, must draw less than 10 W of power**.** Power supply or transformer for the VIVDS must meet the following minimum requirements:

Minimum Requirements for Power Supply and Transformers

Item	Power Supply	Transformer
Power Cord	Standard 120 V(ac), 3 prong cord, 3 feet minimum length (may be added by Contractor)	Standard 120 V(ac), 3 prong cord, 3 feet minimum length (may be added by Contractor)
Type	Switching mode type	Class 2
Rated Power	Two times (2x) full system load	Two times (2x) full system load
Operating Temperature	From -37 to 74 °C	From -37 to 74 °C
Operating Humidity Range	From 5 to 95 percent	From 5 to 95 percent
Input Voltage	From 90 to 135 V(ac)	From 90 to 135 V(ac)
Input Frequency	60 ± 3 Hz	60 ± 3 Hz
Inrush Current	Cold start, 25 A Max. at 115 V(ac)	N/A
Output Voltage	As required by VIVDS	As required by VIVDS
Overload Protection	From 105 to 150 percent in output pulsing mode	Power limited at >150 percent
Over Voltage Protection	From 115 to 135 percent of rated output voltage	N/A
Setup, Rise, Hold Up	800ms, 50ms,15ms at 115 V(ac)	N/A
Withstand Voltage	I/P-0/P:3kV, I/P-FG:1.5kV, for 60 s.	I/P-0/P:3kV, I/P-FG:1.5kV, for 60 s
Working Temperature	Not to exceed 70°C at 30 percent load	Not to exceed 70 °C at 30 percent load
Safety Standards	UL 1012, UL 60950	UL 1585

Field terminated circuits must include transient protection as specified in IEEE Standard 587-1980, Category C. Video connections must be isolated from ground.

87-13.02D Technical Requirements

Camera and zoom lens assembly must be housed in an environmentally sealed enclosure that complies with NEMA 4 standards. Enclosure must be watertight and protected from dust. Enclosure must include a thermostat controlled heater to prevent condensation and to ensure proper lens operation at low temperatures. Adjustable sun shield that diverts water from the camera's field of view must be included. Connectors, cables and wiring must be enclosed and protected from weather. An environmentally sealed (protected from dust and moisture ingress) connector must be used at the rear plate of the housing. Wiring to the connector must be sealed with silicone or putty compound.

Each camera and its mounting hardware must be less than 10 pounds and less than 1 square foot equivalent pressure area. Only one camera must be mounted on a traffic signal or luminaire arm. Top of camera must not be more than 12 inches above top of luminaire arm or 30 inches above top of traffic signal arm.

VIS must use a charge-coupled device (CCD) element, support National Television Standards Committee (NTSC) and RS170 video output formats, and have a horizontal resolution of at least 360 lines. VIS must include an auto gain control (AGC) circuit, have a minimum sensitivity to scene luminance from 0.01 to 930 foot-candle, and produce a usable video image of vehicular traffic under all roadway lighting conditions regardless of the time of day. VIS must have a motorized lens with variable focus and zoom control with an aperture of f/1.4 or better. Focal length must allow ± 50 percent adjustment of the viewed detection scene.

A flat panel video display with a minimum 8-inch screen and that supports NTSC video output must be enclosed in the Model 332L or 342LX cabinet for viewing video detector images and for performing diagnostic testing. Display must be viewable in direct sunlight. Each VIVDS must have video system connections that support the NTSC video output format, can be seen in each camera's field of view, and has a program to allow the user to switch to any video signal at an intersection. A metal shelf or pull-out document tray with metal top capable of supporting the VDU and monitor must be furnished and placed on an EIA 19-inch rack with 10-32 "Universal Spacing" threaded holes in the Model 332L or 342LX cabinet. System must allow independent viewing of a scene while video recording other scenes without interfering with the operation of the system's output.

Mounting hardware must be powder-coated aluminum, stainless steel, or treated to withstand 250 hours of salt fog exposure as specified in ASTM B 117 without any visible corrosion damage.

VDU must operate between –37 to +74 degrees C and from 0 to 95 percent relative humidity.

VDU front panel must have indicators for power, communication, presence of video input for each VIS, and a real-time detector output operation. Hardware or software test switch must be included to allow the user to place either a constant or momentary call for each approach. Indicators must be visible in daylight from 5 feet away.

VDU must have a serial communication port, EIA 232/USB 2.0 that supports sensor unit setup, diagnostics, and operation from a local PC compatible laptop with Windows XP or later version operating system. VIVDS must have an Ethernet communication environment, including Ethernet communication card. VIVDS must include central and field software to support remote real-time viewing and diagnostics for operational capabilities through wide area network (WAN).

VDU, image processors, extension modules, and video output assemblies must be inserted into the controller input file slots using the edge connector to obtain limited 24 V(dc) power and to provide contact closure outputs. Cabling the output file to a "D" connector on the front of the VDU is acceptable. If the VDU is capable of simultaneously processing information from two video image sensor assemblies, the VDU will only process one through lane phase. No rewiring to the standard Model 332L or 342LX cabinet is allowed. Controller cabinet resident modules must comply with the requirements in Chapter 1 and Sections 5.2.8, 5.2.8.1, 5.2.8.2, 5.4.1, 5.4.5, 5.5.1, 5.5.5, and 5.5.6 of TEES.

87-13.02E Functional Requirements

VIVDS must support normal operation of existing detection zones while a zone is being added or modified. Zone must flash or change color on a viewing monitor when vehicular traffic is detected. Length and width of each detection zone for each lane must be approved by the Engineer.

Software and firmware must detect vehicular traffic presence, provide vehicle counts, set up detection zones, test VIVDS performance, and allow video scene and system operation viewing from the local traffic management center/office. VIVDS must support a minimum of 2 separate detection patterns or zones that can be enacted by a remote operator at the signal controller cabinet.

VIVDS detection zone must detect vehicles by providing an output for presence and pulse. At least one detection output must be provided for each detection zone. One spare detection output must be provided for each approach. Detection performance must be achieved for each detection zone with a maximum of 8 user-defined zones for every camera's field of view.

VIVDS must detect the presence of vehicles under all types of adverse weather and environmental conditions, including snow, hail, fog, dirt, dust or contaminant buildup on the lens or faceplate, minor camera motion due to winds, and vibration. Under low visibility conditions, the VIVDS must respond by selecting a fail-safe default pattern, placing a constant call mode for all approaches. VIVDS outputs must assume a fail-safe "on" or "call" pattern for presence detection if video signal or power is not available and must recover from a power failure by restoring normal operations within 3 minutes without manual intervention. If powered off for more than 90 days, system must maintain the configuration and calibration information in memory.

Detection algorithm must be designed to accommodate naturally occurring lighting and environment changes, specifically the slow-moving shadows cast by buildings, trees, and other objects. These changes must not result in a false detection or mask a true detection. VIVDS must not require manual interventions for day-night transition or for reflections from poles, vehicles or pavement during rain and weather changes. VIVDS must suppress blooming effects from vehicle headlights and bright objects at night.

Vehicle detection must call service to a phase only if a demand exists and extend green service to the phase until the demand is taken care of or until the flow rates have reduced to levels for phase termination. VIVDS must detect the presence of vehicular traffic at the detection zone positions and provide the call contact outputs to the Model 170E or Model 2070 controller assembly with the following performance:

Detector Performance

Requirements	Performance during AMBER and RED interval	Performance during GREEN interval
Average response time after vehicle enters 3 feet into detection zone or after exiting 3 feet past detection zone	≤ 1 s	≤ 100 ms
Maximum number of MISSED CALLS in 24-hour duration, where MISSED CALLS are greater than 5 s during AMBER and RED intervals and greater than 1 s during GREEN intervals (upon entering 3 feet of detection zone or after exiting 3 feet past detection zone).	0	10
Maximum number of FALSE CALLS in 24-hour duration (calls greater than 500ms without a vehicle present)	20	20

VIVDS must be able to locally store, for each lane, vehicle count data in 5, 15, 30, and 60-minute intervals for a minimum period of 7 days and be remotely retrievable. VIVDS must count vehicular traffic in detection zone with a 95 percent accuracy or better for every hour counted over a morning or an evening peak hour. VIVDS detection zone tested must have a minimum range of 50 feet behind the limit line for each approach. Testing period will be pre-approved by the Engineer 48 hours in advance.

87-13.03 CONSTRUCTION

Install VDU in a Department-furnished 342LX controller cabinet. Install VIS power supply or transformer on a standard DIN rail using standard mounting hardware and power conductors wired to DIN rail mounted terminal blocks in the controller cabinet.

Wiring must be routed through end caps or existing holes and sealed. New holes for mounting or wiring must be shop-drilled.

Wire each VIS to the controller cabinet with a wiring harness that includes all power, control wiring, and coaxial video cable. Attach harness with standard MIL type and rated plugs. Cable type and wire characteristics must comply with manufacturer's recommendations for the VIS to cabinet distance. Wiring and cables must be continuous, without splices, between the VIS and controller cabinet. Coil a minimum of 7 feet of slack in the bottom of the controller cabinet. For setup and diagnostic access, terminate serial data communication output conductors at TB-0 and continue for a minimum of 10 feet to a DB9F connector. Tape ends of unused and spare conductors to prevent accidental contact to other circuits.

Label conductors inside the cabinet for the functions depicted the approved detailed diagrams. Label cables with permanent cable labels at each end.

Adjust the lens to view 110 percent of the largest detection area dimension. Zones or elements must be logically combined into reporting contact outputs that are equivalent to the detection loops and with the detection accuracy required.

Verify the performance of each unit, individually, and submit the recorded average and necessary material at the conclusion of the performance test. Determine and document the accuracy of each unit, individually, so that each unit may be approved or rejected separately. Failure to submit necessary material at the conclusion of testing invalidates the test. The recorded media serves as acceptance evidence and must not be used for calibration. Calibration must have been completed before testing and verification.

Verify the detection accuracy by observing the VIVDS performance and recorded video images for a contiguous 24-hour period. The recorded video images must show the viewed detection scene, the detector call operation, the signal phase status for each approach, the vehicular traffic count, and time-stamp to 1/100 of a second, all overlaid on the recorded video. Transfer the 24-hour analysis to DVD or Blu-Ray, or encrypted USB or encrypted hard drive.

VIVDS must meet the detection acceptance criterion specified in table titled "Detector Performance."

Calculate the VIVDS's vehicular traffic count accuracy as 100[1-(|TC-DC|/TC)], where DC is the detector's vehicular traffic count and TC is the observed media-recorded vehicular traffic count and where the resulting fraction is expressed as an absolute value.

The Engineer will review the data findings and accept or reject the results within 7 days. Vehicle anomalies or unusual occurrences will be decided by the Engineer. Data or counts not agreed by the Engineer will be considered errors and count against the unit's calibration. If the Engineer determines that the VIVDS does not meet the performance requirements, you must re-calibrate and retest the unit, and resubmit new test data within 7 days. After 3 failed attempts, you must replace the VIVDS with a new unit.

Notify the Engineer 20 days before the unit is ready for acceptance testing. Acceptance testing must be scheduled to be completed before the end of a normal work shift. You must demonstrate that all VIS and VDUs satisfy the functional requirements.

87-13.04 PAYMENT

Not Used

Replace the RSS for section 87-15 with:

87-15 MICROWAVE VEHICLE DETECTION SYSTEM (MVDS)

87-15.01 GENERAL

87-15.01 Summary

Section 87-15 includes specifications for constructing the Microwave Vehicle Detection System.

MVDS includes:

1. Conductors and cable
2. Conduit
3. Sensor units
4. Controller cabinets
5. Poles
6. Termination assemblies

The components of the MVDS are shown.

87-15-.01B Definitons

Not Used

87-15.01C Submittals

Submit:

1. Detailed drawings.
2. A list of equipment to be used.
3. A manufacturer's approved site analysis report that includes a review of each detection site and analysis recommending the optimum sensor placement and pole location.
4. Lane configuration diagram showing:
   4.1. The system's connector pins or wire terminals corresponding to the respective lanes and microwave beam coverage of the traffic lanes
   4.2. Lane identification by direction, such as NB, SB, EB, WB, and lane number
5. Mounting and wiring diagrams showing service connections for each system. The diagrams must be covered with clear self-adhesive plastic and placed in a heavy-duty plastic envelope.
6. Documentation of the communication protocol including the message structure organization, data packet length, and all information necessary to make use of the messages.
7. Software for operating, calibrating, tuning, aligning, and programming the system from a remote Windows-compatible PC. The software must be on a read-only CD, DVD or other Engineer-authorized data-storage device with a Windows-compatible PC. The documentation must contain files that allow replacement equipment to be loaded with the same configuration. The files must be formatted to match the equipment calibration or alignment.
8. A schedule for the functional test of the system 15 days before performing the test.

Within 15 days of performing a functional test of the system, submit the test data, including:

1. Analysis of the system's accuracy
2. Original video recordings as well as read-only DVD or other Engineer-authorized data-storage device of the video images covering the analysis periods
3. Speed and traffic volume data

Submit copies of the training materials 30 days before the training.

87-15.01D Quality Assurance

87-15.01D(1) Training

You must provide a minimum of 8 hours of training by a factory authorized representative for a maximum of 8 Department employees. Submit training material to the Engineer for approval at least 30 days before the proposed training. Training material content must include instructions for aligning, programming, adjusting, calibrating, and maintaining the VIVDS and MVDS. You must provide all materials and

equipment for the training. Notify the Engineer 20 days in advance of the proposed training to obtain approval of place and time of the training. If agreement cannot be reached, the Engineer will determine the time and place.

87-15.02 MATERIALS

87-15.02A General

The system must:

1. Be configurable for polling cycles with a range from 30 seconds to 24 hours
2. Store vehicle count, speed, classification, and occupancy data in intervals from 10 seconds to 15 minutes
3. Be installed such that each unit operates independently and does not interfere with other units or other equipment in the vicinity
4. Operate over a temperature range from -30 to 70 degrees C in up to 95 percent relative humidity

The system and supporting equipment must have been commercially available and stocked locally for at least 3 months before its installation and be designed for outdoor use.

The system must:

1. Have a TIA-232, TIA-485, or Ethernet communication port that supports the NTCIP
2. Provide simultaneous vehicle-detection data, including vehicle presence, volumes and counts, speed, classification, and occupancy for a minimum of 8 lanes of traffic
3. Provide a separate zone per lane and detect vehicles from 10 to 200 feet from the sensor
4. Monitor traffic lanes in the presence of barrier railing, guardrail, and other obstacles

If installed at least 10 feet from the nearest lane and at least 17 feet above the roadway detection zone, the system detection criteria must have an accuracy of at least:

1. 95 percent for the average 5-minute volume for all lanes combined for any selected 15-minute period
2. 90 percent for the average 30-second volume in every lane for any selected 5-minute period
3. 95 percent for the average 30-second speed in any lane for any selected 5-minute period
4. 85 percent for the average 5-minute occupancy for any lane for any selected 15-minute period
5. 90 percent for the vehicle count in any lane and at least 95 percent for the vehicle count for all lanes combined

The accuracy criteria account for errors in the start and finish of the system.

The communication protocol must be open and freely available for use in the public domain. The system must be addressable and download count, speed, and occupancy data when polled by the traffic management center's computer. The system must allow set up via:

1. Remote desk top computer and standard modem
2. Windows-compatible laptop in the field

The system's software must detect the vehicular traffic and automatically assign detection lanes and adjust the sensor's sensitivity. The system and its software must be designed such that a trained Department employee can configure and calibrate the system in less than 15 minutes per lane once the sensor unit is installed.

The system must automatically restore normal operation within 3 minutes after a power failure and without manual intervention. The system must retain the configuration and calibration information in nonvolatile memory for at least 90 days when powered off.

87-15.02B Sensor Units

The sensor unit must:

1. Include a directional microwave transmitter, antenna, microwave receiver, processor, memory, and communication interface
2. Not weigh more than 11 lb

3. Have an optically isolated relay contact for each detection zone that follows the presence of vehicles in each traffic lane and sends signals to the controller with the required accuracy

The sensor's enclosure must be weatherproof with a NEMA 3R rating.

87-15.02C Microwave Sensor Interface Cards

The system must include a microwave sensor interface card when a Model 170E/2070L controller is used. The card must emulate inductive loop outputs from the sensor unit to the controller. The card must have LED indicators for power, communication, and the real-time operation of each detection contact output. The card must comply with TEES.

87-15.02D Termination Assemblies

The system's termination assembly must be a single circuit board unless 2 to 4 sensors are installed in the cabinet.

If 2 to 4 sensors are installed in the cabinet, the termination assembly must be a set of modular DIN-rail rack-mounted assemblies and have terminations with screw cable lugs.

Each lane detection zone must have an LED that indicates the presence of a vehicle and be visible from 5 feet in daylight with a minimum viewing angle of 50 degrees. The system's power connection must have a fast-blow, AGC-type fuse or a resettable circuit breaker so that a loss of system power due to overcurrent does not affect the operation of connected systems.

The termination assembly must have a DE9 male connector for every connected system for the TIA-232 or TIA-485 to communicate with a laptop computer for performing setup, diagnostics, and remote communications.

87-15.02E Power Supplies and Transformers

The power supply and transformer for the sensor unit must have a rated power for twice the full system load. The output voltage must be that required by the system.

The power supply and transformer must be a standard 120 V(ac), 3-prong, 40-inch-long power cord.

The power supply and transformer for the sensor unit must comply with the requirements shown in the following table:

Power Supply and Transformer Requirements

Quality characteristic	Requirement
Operating temperature (°C)	-35–74
Operating humidity range (%)	5–95
Input voltage (V(ac))	90–135
Input frequency (Hz)	60 ± 1
Withstand voltage for 60 s I/P-O/P: (kV) I/P-FG: (kV)	 3 1.5
Working temperature at 30% load (°C)	Maximum 70

The power supply must comply with the requirements shown in the following table:

Power Supply Requirements

Quality characteristic	Requirement
Maximum cold start inrush current at 115 V(ac) (A)	25
Overload protection in output pulsing mode (%)	105–150
Over voltage protection of rated output voltage (%)	115–135
Setup time at 115 V(ac) (ms) Rise time at 115 V(ac) (ms) Hold up time at 115 V(ac) (ms)	800 50 15

The power supply must be a switching-mode type and comply with UL 1012 and UL 60950.

The transformer must be:

1. Class 2
2. Power limited at greater than 150 percent
3. UL 1585 listed

87-15.02F Cables, Connectors, and Wiring

The system's connectors must be a standard MIL type with a rated plug.

The cable must:

1. Have an outside diameter maximum 3/4 inch
2. Be shielded
3. Have a copper drain wire
4. Have a chrome PVC jacket with a minimum thickness of 53 mils

The cable must have conductors for the number of detection zones shown and 2 future zones per manufacturer's instructions. The conductors must be stranded copper equal to or exceeding the minimum strands and wire dimensions for the wiring distance involved. The conductors must be covered with a minimum 12-mil PVC insulation rated for 300 V at 105 degrees C.

87-15.02G Cabinet Assemblies

If the sensor's contact outputs are not connected to a Model 170E/2070L controller, provide a cabinet assembly for the system.

The cabinet must comply with section 86-1.02D(3).

87-15.02H Poles

Comply with section 56-3.

87-15.03 CONSTRUCTION

Do not install a system older than 6 months at the time of the scheduled installation date.

Include transient protection for field-terminated circuits that complies with IEEE Standard 587, Category C.

Ensure that placement of the sensor unit for each proposed pole location complies with the installation instructions of the system manufacturer. Confirm the correct placement of the sensor unit with the manufacturer before performing work at the proposed pole location. If the manufacturer's analysis indicates a new pole location must be used, schedule a meeting with the manufacturer and the Engineer to select the new location.

Do not install the system until the new pole location is approved.

Mount the sensor and direct it perpendicular to the flow of traffic lanes.

Connect the system sensors with a connectorized cables.

If a Department-furnished Model 170E/2070L controller cabinet assembly is used, insert the microwave sensor interface card into the controller input file slots using the edge connector to obtain limited 24 V(dc) power and to provide contact closure outputs. Do not rewire the Model 170E/2070L controller cabinet.

If 2 to 4 sensors are installed in a cabinet, install a termination assembly. Provide enough clearance for routing the cables and label the connected sensors. Route the power from the assembly to each system through a fuse or breaker. Provide access to the fuses or breakers without removing cables, connectors, or other terminations in the cabinet. Label the connectors and provide internal routing of data between the DE9 connectors and the system's terminal block.

Mount the sensor unit's power supply or transformer vertically on the rack using standard mounting hardware.

Attach the power conductors to terminal blocks mounted in the DIN rack of the Model 170E/2070L controller cabinet. Terminate the serial-data communication-output conductors at TB-0 and continue for a minimum of 10 feet to a DE9F connector for setup and diagnostic access. Terminate the contact-pair output conductors at terminal block TB-2. Coil and tape the ends of unused and spare conductors to prevent accidental contact with other circuits. Label the conductors inside the cabinet for the functions as shown on mounting and wiring diagrams.

Supply the cable and connectors for connecting the communication modem.

Do not splice the cables between the sensor and controller cabinet. Terminate the cables at terminal blocks. Label the cables.

Coil a minimum slack of 6 feet of the cable at the bottom of the controller cabinet. Provide slack in other cabinets.

Connect the system and termination assembly.

Securely attach the heavy-duty plastic envelope containing wiring diagrams to the inside of the cabinet door.

Furnish the equipment to set up, calibrate, test, and maintain the system during construction. Make the necessary calibration adjustments to obtain the specified detection accuracy.

Replace the RSS for section 87-16 with:

87-16 WIRELESS VEHICLE DETECTION SYSTEM (WVDS)

87-16.01 GENERAL

87-16.01A Summary

Section 87-16 includes specifications for constructing Wireless Vehicle Detection Systems (WVDS).

WVDS consists of:

1. Vehicle sensor nodes (VSN)
2. Wireless repeater
3. Access points

Components of WVDS are shown.

87-16.01B Definitions

VSN: Vehicle sensor nodes

WVDS: Wireless vehicle detection system

87-16.01C Submittals

For the WVDS provide the following to the Engineer for review:

1. Manufacturer's name and contact information

2. Shop drawings
3. Manufacturer's data sheets

Allow 10 days for review.

87-16.01D Quality Assurance

Not Used

87-16.02 MATERIALS

87-16.02A General

Each WVDS must consist of one or more Vehicle Sensor Node(s) (VSN) installed in the roadway; Wireless Repeater(s) (RP), as needed, mounted on standards along the roadway shoulder; one Access Point (AP), mounted on a standard along the roadway shoulder.

The WVDS must provide vehicle detection at various locations and have its data sent to the Regional Transportation Management Center (RTMC).

The date of manufacture, as shown by date codes or serial numbers of electronic circuit assemblies, must not be more than six months from the scheduled start date of this installation.

The WVDS system communications must be:

A. Wireless between the VSN and the AP.
B. Wireless between RP and AP,
C. Wireless or hardwired between AP and FEPT (Field Element Protocol Translator) in the RTMC.

The communications link between the AP, RP, and VSN must conform to the following:

A. The wireless communications link must be FCC-approved.
B. The VSN, RP and AP must be reconfigurable by a user over the wireless interface. Reconfiguration must avoid interference from other users of the communications band. A minimum of 16 channels must be provided for this purpose per location.
C. The link budget must be 93 dB or greater.
D. The RP to AP Radio Frequency 'Line of Sight' communication distance must be at least 750 feet when both units are installed 18 feet above the roadway.
E. After an AP is powered on, the associated VSN(s) must respond within 100 seconds.

The WVDS system must provide the following measurements per lane:

A. Vehicle count in a data collection interval, in units of vehicles
B. Percent occupancy in a data collection interval, in units of 0.05%
C. Vehicle speeds, when more than one VSN is installed in a lane:

    1. Per vehicle, in units of miles per hour (mph)
    2. Median speed in a data collection interval, in units of mph
    3. Mean speed in a data collection interval, in units of mph
    4. Distribution of speeds; in bins of <= 35 mph, 36-40 mph, 41-45 mph, …, 81-85 mph, and > 85 mph; in units of vehicles

D. Vehicle Length, when more than one VSN is installed in a lane:
    1. Per vehicle, in units of 0.1-feet
    2. Distribution of lengths; in bins of < 20.0 feet, 20.0-39.9 feet, 40.0-59.9 feet, and >= 60.0 feet; in units of vehicles.

The time interval for data collection must be user-selectable at a minimum of 30-second intervals. The time interval for reporting must be user selectable from a list containing at minimum, 30 seconds, 1 minute, 5 minutes, 15 minutes, 1 hour and 24 hours.

Each VSN must have the following programmable event reporting parameters:

A. Transmit interval from a minimum value of 6 seconds.
B. Reporting latency from a minimum range of 6 to 30 seconds.
C. Presence and Pulse modes.
D. RF watchdog timer.
E. Synchronize event reporting to AP clock or to detection events.
F. Speed Trap: measurement/time interval between 2 consecutive VSN.

The WVDS must have the capability of outputting the state of each detector (1 or 0) in real time in sync with each vehicle passage event for the traffic. This data will be available electronically via the EIA-232 or EIA-485 or Ethernet communication port in a well-documented file format.

Typical Physical Properties are as follows:

Tensile Strength (PSI)	ASTM D412	2950
Elongation (%)	ASTM D412	350
Hardness (Shore A)	ASTM D2240	95A
Flexibility 1/8” Mandrel	ASTM D1737	Pass
Taber Abrasion (mg loss) CS18 Wheel 1 kg per 1000 cycles	ASTM D4060	25
Gel Time	Minutes	2
Tack Free Time	Minutes	5
Open to Traffic	Minutes	15

WVDS components must be manufactured by Sensys Networks, Inc. or approved equal.

87-16.02B Access Point (AP)

Each AP must be housed in a NEMA 4 enclosure. The enclosure with AP and surge protection must be 12 inches tall by 12 inches wide by 6 inches deep, with a maximum weight of 5 pounds.

The AP must operate continuously over a temperature range of 35 to 165 degrees F.

Each AP must be capable of communicating with and collecting data from a minimum of 64 VSNeither directly or via RP.

87-16.02C Vehicle Sensor Nodes (VSN)

Each VSN must consist of a magnetometer sensor, a microprocessor with firmware in non-volatile memory, a wireless transceiver and a battery within a single housing.

The magnetometer sensor must detect the presence of a vehicle by a change in the vertical component of the earth’s magnetic field within the detection zone corresponding to a 6-foot by 6-foot Type A inductive loop, with the VSN at the center. Each VSN must continuously report the presence of the vehicle until the vehicle leaves the detection zone, whereupon the VSN must report the absence of presence within 5 +/- 1 millisecond.

The VSN must automatically recalibrate in the event of a detector lock within 5 minutes.

Each VSN must be individually addressable with a unique identifier, and capable of transmitting its data to the AP. Each VSN must also be capable of receiving detector parameters, microprocessor firmware and other commands from the AP without loss of data.

Each VSN must have the following programmable detection parameters:

A. Onset sensitivity and delay
B. Off sensitivity
C. Holdover time
D. Adaptable orientation
E. Auto-recalibration timeout

The housing must be fully encapsulated to provide a minimum of 8 years of operation, over a temperature range of 35 to 165 degrees F. The housing must be capable of being installed in a cylindrical hole that is no larger than 4.00 inches in diameter and 3.00 inches high.

87-16.02D Sealant

The sealant for the installation of the wireless detector senor units in concrete must be a two component, 100% solids, polyurea based joint sealant and approved by the manufacturer of the wireless detector sensor. It must be a self-leveling joint sealant and will be applied at a minimum temperature of 32 F. The surface to be bonded must be free of debris, moisture and anything else that will interfere with the sealant bond.

87-16.02E Ethernet Interface

Ethernet interface must be:

A. 10/100 BaseT
B. Internet Protocol (IP) address via Dynamic Host Configuration Protocol (DHCP) or static IP
C. TIA/EIA-568B bulkhead connector
D. TCP / IP Support: Protocols supported: Telnet, ftp, http, ppp, pptp

87-16.02F Power

Power must be:

1. 9 V(dc) to 24 V(dc) or 36 V to 60 V input
2. Power over Ethernet (POE) injector with 110 V(ac) to 240 V(ac) 50 Hz-60 Hz direct current supply 12 VDC.

The AP must be addressable and must download vehicle count, percent occupancy and speed (only when two sensors are used per lane) when polled by the FEPT. The console port protocol must support unit setup from a local Windows 2007or newer compatible laptop or from a remote location with a desktop computer.

87-16.02G Configuration Software

The WVDS must include the software and documentation necessary to configure the VSN, the RP the AP and store and retrieve detection data.

87-16.02H Repeater (RP)

Each RP and its battery must be housed in a NEMA 4 enclosure. The enclosure with RP and battery must be 12 inches tall by 12 inches wide by 6 inches deep, with a maximum weight of 5 pounds.

The RP must operate continuously over a temperature range of -37C to +74C.

The battery must have a minimum life of 2 years and must be field-replaceable with the use of common hand tools only.

Each RP must be capable of communicating with and retransmitting data from a minimum of 16 VSN.

87-16.03 CONSTRUCTION

87-16.03A Pre-construction Site Analysis

Before beginning any construction perform the pre-construction site analysis:

A. Ensure that the installed WVDS components will not cause harmful interference to radio communication in the vicinity as required by FCC Part 15 requirements.
B. Ensure that each WVDS component will be installed such that each operates independently and does not interfere with WVDS components at another site or other equipment in the vicinity.
C. Ensure that each VSN will be installed within range of its corresponding AP, using RP as needed. All VSN assigned to either an RP or AP must be located with a +/- 60-degree horizontal cone, measured from perpendicular. The maximum distances between a VSN and the AP are as follows:

AP mounting height	Maximum distance from VSN to AP
12 feet	75 feet
18 feet	105 feet
24 feet	150 feet

87-16.03B Installation and Calibration

A. Do not proceed with the installation of any WVDS component without the written approval from the Engineer of the Pre-construction Site Analysis.
B. Provide personnel skilled in the installation and calibration of WVDS components.
C. Configure and demonstrate successful communication between each VSN, and the AP to the Engineer prior to the installation of any component.
Because the WVDS uses the same frequencies as WiFi, any WiFi may introduce interference in the WVDS only during periods of heavy WiFi usage. Therefore it is recommended that contractor record the WiFi usage and frequency channels for a week at each potential site to ascertain the probability that WiFi will disable the WVDS, and choose WVDS channels accordingly.
D. Install each VSN in the roadway per manufacturer's recommendations and as shown on the plans. Holes cored in the pavement must be cleaned and thoroughly dried before installing VSN. Residue resulting from core drilling must not be permitted to flow across shoulders or lanes occupied by public traffic and must be removed from the pavement surface by vacuuming or other approved method before any residue flows off of the pavement surface. Residue from core drilling must be disposed of . The cored pavement must be back-filled per manufacturer's recommendations. Youmust remove any excess epoxy from the roadway without the use of solvents and dispose it .
E. Install each mounting standard as specified in section 87-1.03J.
F. Install each AP and, if necessary, each RP, per manufacturer's recommendations and as shown.
G. After installation of all components, re-configure and demonstrate successful communication between each VSN, the RP (if necessary) and the AP to the Engineer.
H. You are responsible for and must perform the following:
    1. Installation and materials must conform to the requirements of the manufacturer and these special provisions. All equipment, cables and hardware must be part of an engineered system that is specifically designed by the manufacturer to fully interoperate with all other system components. Mounting assemblies must be corrosive-resistant. Connectors installed outside the cabinets and enclosures must be corrosive-resistant, weather-proof and watertight. Exposed cables must be sunlight- and weather-resistant. Cables must be labeled with permanent cable labels at each end.
    2. Verify the performance of each site and submit recorded medium and other materials to the Engineer at the conclusion of the performance test. The accuracy of each site must be determined and documented so that each site may be approved or rejected separately by the Engineer. Failure to submit the materials at the conclusion of testing invalidates the test. The recorded medium serves as acceptance evidence and must not be used for calibration. The calibration must have been completed prior to testing and verification.
    3. All software needed for the analysis must be provided by the Contractor

The WVDS must be a fully documented, tested and operational system upon the completion of the installation.

Install the WVDSas shown, per the,manufacturer's instructions, and adjusted per field conditions as directed by the Engineer.

Upon the approval of the Engineer, you can provide separate Ethernet Extenders and Ethernet Switches that meet the functional requirements of both switches and extenders.

Excess sealant must be removed from the roadway and disposed of outside the State highway right of way.

87-16.04 PAYMENT

Not Used

Replace the RSS for section 87-17 with:

87-17 EMERGENCY VEHICLE DETECTION SYSTEM

87-17.01 GENERAL

87-17.01A Summary

Section 87-17 includes specifications for constructing the Emergency Vehicle Detection System (EVDS).

EVDS includes:

1. Optical emitter assembly
2. Optical detector assembly

The components of the EVDS are shown.

87-17.01B Definitions

EVP: Emergency vehicle pre-emption

87-17.01C Submittals

Not Used

87-17.01D Quality Assurance

87-17.01D(1) Quality Control

Perform range tests between the optical emitter and the optical detector using a:

1. Class I signal at a distance of 1,000 feet
2. Class II signal at a distance of 1,800 feet

Set the range adjustments on the discriminator module to maximum for each test. Perform each test for 1 hour during which, the optical emitter must operate for 30 cycles each, consisting of 1-minute 'ON' interval and 1-minute 'OFF' interval. For the entire test period, the optical emitter signal must cause the proper response from the Model 170E/2070L controller unit during each 'ON' interval and no improper operation of either the controller unit of the monitor during each 'OFF' interval.

87-17.02 MATERIALS

87-17.02A General

The EVDS must:

1. Include an optical emitter assembly and optical detector assemblies located at the traffic signal
2. Be a frequency based system
3. Comply with Veh Code § 25352

87-17.02B Optical Emitter Assemblies

The optical emitter assembly must: produce Class I (mass transit) and Class II (emergency) signals.

The modulation frequencies of light must be:

1.1 9.639 ± 0.110 Hz for Class I signal

1.2 14.035 ± 0.250 Hz for Class II signal

The emitter must:
1. Be controlled by a single maintained-contact switch on the respective emitter control unit. The switch must be located such that it is readily accessible to the vehicle driver.
2. Transmit the signal in only one direction.
3. Have hardware to allow mounting on various types of vehicles.
4. Have means for aligning and locking into position.
5. Include a filter for eliminating visible light.
6. Have a pilot light to indicate whether the emitter is energized.
7. Generate only one modulation frequency at a time, either for Class I of Class II signal.

87-17.02C Optical Detector Assemblies

87-17.02C(1) General

The emergency vehicle detection system's optical detector assembly must detect a Class I signal at ranges of up to 1,000 feet from the optical detector and Class II signal at ranges up to 1,800 feet from the optical detector.

87-17.02C(2) Detector Units

The detector unit includes a housing, 2 photocells, electronics and a base.

The unit must weigh less than 2.5 pounds and have a maximum wind load area of 36 square inches.

The housing must be waterproof.

The photocell assemblies must detect signal from 2 different directions and be adjustable to a minimum of 180 degrees horizontally.

The reception angle for each photocell assembly must be a maximum of 8 degrees in all directions about the aiming axis of the unit.

The internal circuitry must be solid state powered by the discriminator module.

The base must have an opening to allow mounting on a mast arm or a vertical pipe nipple, or suspension from a span wire. The mounting opening must have female threads for 3/4-inch conduit. A cable entrance must be provided which must have male threads and gaskets to allow a waterproof cable connection.

87-17.02C(3) Detector Cables

The cable must have 3 LDPE insulated conductors No.20 stranded tinned copper. The minimum thickness of the conductors must be 25 mils and color code must be: 1 yellow, 1 blue, and 1 orange.

The cable shield must be either tinned copper braid or aluminized polyester film with a nominal 20 percent overlap. Where film is used, a No.20 stranded tinned bare drain wire must be provided.

The cable jacket must be rated 600 V(ac) and 80 degrees C and be black PVC with a minimum thickness of 43 mils.

The outside diameter of the cable must not exceed 0.25 inch.

The capacitance between any conductor and the other conductors and the shield must not exceed 48 pF per foot at 1,000 HZ.

87-17.02C(4) Discriminator Modules

The discriminator module must be compatible with a Department furnished Model 170E/2070L controller unit and comply with Chapter 1 of the TEES. Slots 12 and 13 of the input file *J* are each wired to accept a 2-channel module.

The discriminator module must:

1. Have a single connector board and occupy one slot width of the input file.
2. Be capable of operating 2 channels, each of which must provide an independent output for each separate input.

3. Prevent transients received by the optical detector from affecting the Model 170E/2070L controller assembly.
4. Consider a Class I or II valid only when received for more than 0.50 second. Once a valid signal is detected, the effect must be held by the module in the event of a temporary loss of signal for a selected period. The period must be programmable from 4.5 to 11 seconds.
5. Provide an output for each channel that will result in a low or grounded condition of the appropriate input of a Model 170E/2070L controller unit. For Class I, the output must be a 6.25Hz ± 0.1 percent rectangular waveform with a 50 percent duty cycle. For Class II, the output must be a steady signal.

Each channel with its detectors must draw not more than 100mA at 24 V(dc) or more than 100mA at 120 V(ac). The power for the module, one detector input, and one detector output for each channel must be terminated at the edge connector pins as shown in the following table:

Edge Connector Pins Power Terminations

Pin	Assignment	Pin	Assignment
A	DC ground	-	--
B	+24 V(dc)	P[c]	--
C[c]	--	-	--
D	Detector Input, Channel A	R[c]	--
E	+24 V(dc) to detectors	S[c]	--
F	Channel A output[a]	T[c]	--
-	--	U[c]	--
H	Channel A output[b]	V[c]	--
J	Detector input, channel B	W	Channel B output[a]
K	DC ground to detectors	X	Channel B output[b]
L	Chassis ground	Y[c]	--
M	AC-	Z[c]	--
N	AC+	-	--

[a]Optp-isolated collector, slotted for keying
[b]Opto-isolated emitter, slotted for keying
[c]Not connected. May not be used by the manufacturer for any purpose

Two auxiliary inputs for each channel must enter the module through the front panel connector. The pin assignments for the connectors must be as follows:

1. Auxiliary detector 1 input, Channel A
2. Auxiliary detector 2 input, Channel A
3. Auxiliary detector 1 input, Channel B
4. Auxiliary detector 2 input, Channel B

Each channel output must be an opto-isolated NPN open collector transistor capable of sinking 50 mA at 30 V(ac) and compatible with the Model 170E/2070L controller unit inputs.

The front panel module must have:

1. A handle to facilitate withdrawal
2. A control to set 3 separate range adjustments for each class
3. A control to trigger a test signal for each class
4. Signal and call indications for each class

The signal indication of the module must be activated when a valid signal has been received. The call indication must be activated when a steady signal has been received. These 2 indications may be accomplished with a single lamp that flashes to denote a signal and stays steady to denote a call.

The front panel must have a single circular, bayonet-captured, multipin connector for 2 auxiliary detector inputs for each channel. The connector must have a mechanical configuration complying with MIL-C-26482 for a 10-4 insert arrangement. The connector must consist of:

1. Wall-mounting receptacle with gold-plated pins
2. Plug with gold-plated sockets, cable clamp, and strain relief to allow a right angle turn within a maximum of 2 1/2 inches from the front panel's surface.

87-17.03 CONSTRUCTION

87-17.03A General

Provide an optical emitter assembly for testing the system

Perform the system tests in the presence of the Engineer

87-17.03B Optical Detector Assemblies

Install the detector units on the signal heads.

Aim each optical detector under the manufacturer's instructions.

Install cables between each optical detector and the controller cabinet. Do not splice the cable. Terminate the cable under the manufacturer's instructions.

Except for the 24 V(dc) power, field wire the primary optical detectors to terminate on the terminal TB-9 in the controller cabinet as shown in the following table:

Position	Assignment
4	Channel A detector input, 1st module (Slot J-12)
5	Channel B detector input, 1st module (Slot J-12)
7	Channel A detector input, 2nd module (Slot J-13)
8	Channel B detector input, 2nd module (Slot J-13)

Field wire the auxiliary optical detectors to terminate TB-0 in the controller cabinet as shown in the following table:

For module 1 (J-12)		For module 2 (J-13)	
Position	Assignment	Position	Assignment
1	+24 V(dc) from (J-12E)	7	+24 V(dc) from J-13E)
2	Detector ground from (J-12K)	8	Detector ground from (J-13K)
3	Channel A auxiliary detector input 1	9	Channel A auxiliary detector input 1
4	Channel A auxiliary detector input 2	10	Channel A auxiliary detector input 2
5	Channel B auxiliary detector input 1	11	Channel B auxiliary detector input 1
6	Channel B auxiliary detector input 2	12	Channel B auxiliary detector input 2

87-17.04 PAYMENT

Not Used

Add to the list of the RSS for section 87-18:

4. Fiber optic cable system

Replace the RSS for section 87-19 with:

87-19 FIBER OPTIC CABLE SYSTEMS

87-19.01 GENERAL

87-19.01A Summary

Section 87-19 includes specifications for constructing fiber optic cable systems.

A fiber optic cable system includes:

1. Conduit and accessories
2. Splice vaults
3. Warning tape
4. Fiber optic cables
5. Fiber optic splice enclosures
6. Fiber distribution units
7. Fiber optic markers
8 Fiber optic connectors and couplers
9. Pull boxes
10. Conductors
11. Department furnished controller cabinets
12. Aggregate network interface switch (ANIS)
13. Interconnect termination unit (ITU)
14. Media converter units
15. Aggregate network interface switch (ANIS)
16. Intermediate network interface switch (INIS)
17. Remote network interface switch (RNIS)
18. Testing the traffic operations systems field elements
19. Rack mounted air distribution unit

The components of a fiber optic system are shown on the project plans.

87-19.01B Definitions

ASCII: American Standard Code for Information Interchange

Breakout: The cable "breakout" is produced by (1) removing the jacket just beyond the last tie-wrap point, (2) exposing 0.9 to 1.8 meters of the cable buffers, aramid strength yarn and central fiberglass strength member, and (3) cutting the aramid yarn, central strength member and the buffer tubes to expose the individual glass fibers for splicing or connection to the appropriate device.

Connector: A mechanical device used to provide a means for attaching to and decoupling from a transmitter, receiver, or another fiber (such as on a patch panel).

Connectorized: A term that describes a fiber to which a connector has been affixed.

Connector Module Housing (CMH): A patch panel used in the FDF to terminate single mode or multimode 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, feedthroughs, and barrels. They are normally located within FDFs mounted in panels. They may also be used unmounted, to join 2 simple fiber runs.

DIN: Top Hat Type 35mm

DTE: Data Terminal Equipment

End-to-End Loss: The maximum permissible end-to-end system attenuation is the total loss in a given link. This loss could be the actual measured loss, or calculated using typical (or specified) values. This number will determine the amount of optical power (in dB) needed to meet the System Performance Margin.

Fiber Distribution Frame (FDF): A rack mounted system that is usually installed in the TMC, that consists of a standard equipment rack, fiber routing guides, horizontal jumper troughs, and fiber distribution units (FDU). The FDF serves as the "home" for the passive fiber optic components from cable breakout, for connection by jumpers, to the electronics.

Fiber Distribution Unit (FDU): An enclosure containing both a Connector Module Housing (CMH) and a Splice Module Housing enclosure.

F/O: Fiber optic

FOIP: Fiber optic inside plant cable

FOP: Fiber optic outside plant cable

FOTP: Fiber optic test procedure(s) as defined by EIA/TIA Standards.

FPC: Fiber pigtail cable.

FTC: Fiber trunk line cable

HUB: Network focal point

Hyper terminal: Terminal emulation program used for data communication via serial port communication or TCP/IP Winsock

IEC: International Electro-technical Commission

Interconnect/Termination Unit (ITU): A patch panel used to terminate fibers with most common connector types. It includes a jumper storage shelf and a hinge door.

Jumper: A short fiber optic cable that has connectors installed on both ends.

Light Source: Portable fiber optic test equipment that, in conjunction 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.

Link: A passive section of the system, the ends of which are connectorized. A link may include splices and couplers. For example, a data link may be from a UTP to SMFO media converter to a UTP to SMFO media converter.

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 filled buffer tubes to isolate them from outside forces (stress). A flooding compound is applied to the interstitial cable core to prevent water migration and penetration. This type of cable is primarily for outdoor applications.

Mid-span Access Method: A procedure in which fibers from a single buffer tube are accessed and spliced to an adjoining cable without cutting the unused fibers in the buffer tube, or disturbing the remaining buffer tubes in the cable.

MM: Multimode.

MMFO: Multimode fiber optic cable.

NEMA: National Electrical Manufacturer's Association

OM: Optical mode.

Optical Time Domain Reflectometer (OTDR): Fiber optic test equipment (similar in appearance to an oscilloscope) that is used to measure the total amount of power loss between two points and the corresponding distance. It provides a visual and printed display of the relative location of system components such as fiber sections, splices and connectors and the losses that are attributed to each component or defect in the fiber.

Patchcord: A short jumper used to join 2 Connector Module Housing (CMH) couplers or a CMH and an active device (electronics).

Pigtail: Short fiber optic cable that has a connector installed on only one end.

Plenum Cable: NEC approved cable installed in air plenums without the use of conduit.

Power Meter: Portable fiber optic test equipment that, in conjunction 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.

Riser Cable: NEC approved cable installed in a riser (a vertical shaft in a building connecting one floor to another).

RTMC: Regional Transportation Management Center

Segment: A section of F/O cable that is not connected to any active device and may or may not have splices per the design.

SM: Single mode.

SMFO: Single mode Fiber Optic.

Splice Closure: Normally installed in a splice vault, a splice closure is 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): The SMH stores splice trays as well as pigtails and short cable lengths.

Splice Tray: A container used to organize and protect spliced fibers.

Splice Vault: A splice vault is used to house splice closures and F/O cable slack.

System Performance Margin: A calculation of the overall "End to End" permissible attenuation from the fiber optic transmitter (source) to the fiber optic receiver (detector). The system performance margin should be at least 6dB. This includes the difference between the active component link loss budget, the passive cable attenuation (total fiber loss) and the total connector/splice loss.

TCP/IP: Transmission Control Protocol/Internet Protocol

Tera Term: Terminal emulator (communications) program used for telnet, SSH 1&2 and serial port connections.

Tight Buffered, Non-Breakout Cable (Tight Buffer Cable): Type of cable construction where each glass fiber is tightly buffered (directly coated) with a protective thermoplastic coating to 900 µm (compared to 250 µm for loose tube fibers). Increased buffering is desirable over loose tube cables because of its resulting ease of handling and connectorization (increased physical flexibility, smaller bend radius requirements), and ability to meet NEC flammability requirements.

87-19.01C Submittals

At least 15 days before cable installation, submit:

1. Manufacturer's procedures for pulling fiber optic cable
2. Test reports from a laboratory accredited to International Standards Organization/International Electrotechnical Commission 17025 by the American Association for Laboratory Accreditation (A2LA) or the ANSI-ASQ National Accreditation Board (ANAB) for:
   - 2.1. Water penetration
   - 2.2. Cable temperature cycling
   - 2.3. Cable impact
   - 2.4. Cable tensile loading and fiber strain
   - 2.5. Cable compressive loading
   - 2.6. Compound flow
   - 2.7. Cyclic flexing
3. Proof of calibration for the test equipment including:
   - 3.1. Name of calibration facility
   - 3.2. Date of calibration
   - 3.3. Type of equipment, model number and serial number
   - 3.4. Calibration result

Submit the data file and software from the OTDR with the test results for all OTDR tests. The software must support Windows 7 or better computer operating systems.

After performing the OTDR and the power meter and light source tests, submit within 4 business days:

1. Cable Verification Worksheet (Appendix A)
2. Segment Verification Worksheet
3. Link Loss Budget Worksheet (Appendix B)

The worksheets are available elsewhere in these specifications . Submittals must be in Microsoft Excel format. Include hard copies and copies in an electronic format.

87-19.01D Quality Assurance

87-19.01D(1) General

The fiber optic cable test procedures are defined under TIA/EIA standards.

The fiber optic cable must comply with TIA-492 and ICEA S-87-640.

Fiber optic cable identification and marking must comply with Part 6 of ICEA S-87-640

Test the fiber optic cable for attenuation before installation while on the shipping reel.

Perform the following tests on the fiber optic cable assembly:

1. Test elements of the passive fiber optic components:
   1.1. After cable installation
   1.2. After cable termination and breakout
   1.3. After cable system completion.
2. After the cable has been pulled but before breakout and termination, test 100 percent of all the fibers with an OTDR for attenuation (splice loss must be less than 0.07 dB)
3. Test single mode fibers at 1310 nm and 1550 nm after cable installation. Record attenuation readings for each direction on the cable data sheet.
4. Upon installation of the complete cable assembly, and it is ready for activation:
   4.1 Test 100 percent of the fiber links with the OTDR for attenuation. The Contractor shall use a Launch Cable or a dead-zone box when measuring end-to-end loss, fiber loss, connector loss and reflectance of optical fiber links. The Launch Cable or dead-zone box shall be of fiber and connectors of a matching type to the fiber under test. To measure the loss at the front-end connection, the Launch Cable shall provide 20 times the shortest length of the OTDR's pulse width. To measure the loss at the far end connection, a terminator with the same type of polished end face as the connector under test shall be used. Test results must be submitted through either Compact Disks or Flash Drives as well as hard copy printouts to the Engineer. The printouts must include at least link number, fiber color, buffer color and cable number. You must record and date test results.
   4.2 The Contractor must submit to the Engineer a licensed copy of the OTDR application program software under which the fiber test was performed as stated elsewhere in these specifications.
   4.3 After the final OTDR testing, test 100 percent of all fiber links end to end, with a power meter and light source. Comply with EIA Optical Test Procedure 171 and use the same wavelengths specified for the OTDR tests. Conduct these tests in both directions. Record and date test results, prove that it is within the design link loss budgets, and file data with the other recordings of the same links.
5. After all outdoor splices at test locations, test all splices with the OTDR, and Power Meter and Light Source, in both directions before they are enclosed and sealed for system verification at completion. Test splices in segments at 1310 nm and at 1550 nm. Individual fusion splice losses must be less than 0.07dB.
6. The Link Loss Budget and test results must be recorded in Worksheets shown in Appendices A and B for 100 percent of all links in the fiber optic cable assembly, using the data gathered during cable verification. Include the completed worksheets as part of the system documentation. The design system gain margin must be at least 6dB for each active link. If the design system gain margin is less than 6dB, the Engineer must be notified and informed of the Contractor's plans to meet the design requirement.

7. Test Failures: If during any of these system verification tests, the results prove to be unsatisfactory, the fiber optic cable will not be accepted. The unsatisfactory segments of cable must be replaced with a new segment of cable at the Contractor's expense. The new segment of cable must undergo the same testing procedure to determine acceptability. Copies of the test results must again be submitted to the Engineer. The removal and replacement of a segment of cable must be interpreted as the removal and replacement of a single contiguous length of cable connecting 2 splices, 2 connectors or a splice and a connector. The removal of only the small section containing the failure and therefore introducing new unplanned splices will not be allowed.

87-19.01D(2) Quality Control

Notify the Engineer 4 days before performing field tests. Include exact location of the system or components to be tested. Do not proceed with the testing until authorized. Perform each test in the presence of the Engineer.

The OTDR test consists of:

1. Inspecting the cable segment for physical damage.
2. Measuring the attenuation levels for wavelengths of 1310 nm and 1550 nm in both directions for each fiber using a light source at one end and OTDR at the other end.
3. Comparing the test results with the data sheet provided with the shipment. If there are attenuation deviations greater than 5 percent, the test will be considered unsatisfactory and the cable segment will be rejected. The failure of any single fiber is a cause for rejection of the entire segment. Replace any rejected cable segments and repeat the test.

If the OTDR test results for the fiber optic cable assembly, indicate any of the following:

1. Attenuation of the fiber optic link is unsatisfactory,
2. Design link loss budget for the fiber optic cable link exceeds link loss budget
3. Link loss measured from the OTDR exceeds the calculated link loss for the fiber optic cable link
4. Actual location of the fiber ends does not agree with the expected location of the fiber ends (as would occur with a broken fiber)
5. The OTDR tests results are unsatisfactory

Replace the cable link, or unsatisfactory segments of cable or splices with a new segment of cable without additional splices, at your expense. Test the new splice or new link or new segment of cable to demonstrate acceptability.

The power meter and light source test consists of:

1. Testing each fiber in a link using a light source at one end of the link and a power meter at the other end
2. Measuring and recording the power loss for wavelengths of 1310 nm and 1550 nm in both directions

Index matching gel is not allowed in connectors during power meter and light source test.

Test results must be generated from test equipment software and recorded, compared and proven to be within the calculated link loss budget, and filed with the other recordings of the same link.

Installation and splicing of the fiber optic cable system must be performed by a certified fiber optic installer.

The OTDR test and the power meter and light source test must be performed by a certified fiber optic technician.

The certification for the fiber optic installer and fiber optic technician must be from an organization recognized by the International Certification Accreditations Council and must be current through the installation of the fiber optic system.

After fiber optic cables are connected to the new and existing TOS field elements, send proper data to the District’s Transportation Management Center (TMC) located at 3165 Gold Valley Drive, Rancho Cordova,

CA 95742 to verify all of the hardware and fiber optic cable are properly connected and responding to the assigned IP addresses.

87-19.01D(3) Training

Develop a training course and submit it to the Engineer or designated personnel. The training will be held in District 3's Regional Transportation Management Center (TMC), 3165 Gold Valley Dr., Rancho Cordova, CA 95742. Provide all materials and instructors for the course. The duration of the course must be 32 hours in four days excluding lunch and breaks. No more than 15 State Engineer and Maintenance personnel will attend the course. Each trainee must receive a training manual. The training manual must be written especially for the Traffic Operations System elements (TOS) communications system. The manual must provide complete procedures for operating, maintaining, and troubleshooting the cable plant, TOS element assembly, communication hub assembly, and Model 2070 controller interface. The maintenance section of the training course must cover preventive, routine, and emergency maintenance procedures. The emergency maintenance discussion must provide recommendations for the provisioning and use of emergency repair kits to assist maintenance crews. Copies of the project manual must be given to the Engineer.

Following the 4-day course, provide a maintenance manual, which must be written so that maintenance personnel will be able to use the manual in troubleshooting, installing, preventive maintenance, and designing future fiber optic systems. Provide each trainee with the manual and 9 extra copies of the manual (4 copies for Design, 3 copies for construction, and 2 copies for operations).

The 4-day part of the training course must consist of 20 hours of class work and 12 hours of hands-on lab work.

Classroom must consist of the following:

Introduction of Fiber Optics	Fiber Optics Installations
Applications	Optical Testing
Fiber Optic Theory	Fiber Optics Maintenance
Optical Fiber	Fiber Optics Restoration
Connectors	Fiber Optic Safety
Patch Panels	Advance Technologies Review
Splices/Splicing	Light Sources
Detectors	Repeaters
Physical Plant Systems Design	Design Examples

Classroom Lab must consist of the following (Hands-On):

Acceptance Testing	Optical Testing
Cable Preparation	Patch Panel Preparation
Connectorization	OTDR Testing
Splicing	Test Documentation

The lab groups or stations must consist of not more than 3 people per station.

The course must also include field training using operational equipment at chosen communication hubs, and TOS element locations. The field training must include operational checkout of a TOS field element site and must discuss the location of access to the various system field elements. The field training must cover how the different systems were installed, problems with the installation (if any), and troubleshooting and maintenance tips for the different systems.

The field training must be in groups not larger than 5 but may be performed in more than one day upon choice of the Contractor.

The training course must be designed to assist maintenance and other personnel in troubleshooting and understanding not only the system that was installed but also existing and future projects.

The course must also include "hands on" field training using operational equipment at the communications hub and at field element sites. The field training must include the operational checkout of from a field element site to TMC.

The information for this course must be separated into appropriately titled sections such as:

A. System Design
B. Hardware
C. Software
D. Operation
E. Maintenance
F. Operating System

Provide an evaluation sheet to be completed by the attendees. The evaluation sheets will be turned in to the Engineer and a copy will be provided to the Contractor. The evaluation sheets need not be signed by the attendees.

One copy of the manual for this course must be delivered to the Engineer for approval at least 8 weeks prior to the scheduled class time. The Engineer will notify the Contractor of the number of State personnel who will attend. The course must be completed prior to the acceptance of the contract.

87-19.02 MATERIALS

87-19.02A General

Install 144 SMFO cable in one of the orange HDPE conduits. Install pull tape in the other HDPE conduit.

Install Fiber optic cable in conduitsystem or cable tray system as shown. Comply with manufacturer instruction for cable installation.

Fiber optic cable, jumpers and pigtails must be products of the same manufacturer. The cable used for cable assemblies must be made of fiber meeting the performance requirements for the FO cable being connected.

Pigtails must be of simplex (one fiber) construction, in 900 µm tight buffer form with a PVC jacket with manufacturer identification information, and a nominal outer jacket diameter of 0.12 inch. Single mode simplex cable jackets must be yellow in color. All pigtails must be factory terminated and tested and at least 3 feet in length.

Jumpers may be of simplex or duplex design. Duplex jumpers must be of duplex round cable construction, and must not have Zipcord (Siamese) construction. All jumpers must be at least 6.6 feet in length, sufficient to avoid stress and allow orderly routing.

The outer jacket of duplex jumpers must be colored according to the single mode color (yellow) specified above. The 2 inner simplex jackets must be contrasting colors to provide easy visual identification for polarity.

Each fiber optic cable must be all-dielectric armored, non-gel water blocking materials, duct type, with loose buffer tubes. Cables with single mode fibers must contain single mode (SM) dual-window (1310 nm and 1550 nm) fibers in the quantities shown below and on the plans. The contractor must install fibers of 12, 24, 48, 96 and 144 counts as specified elsewhere in these specifications and/or as shown on the plans.

The fiber optic cable must include:

1. Central strength member
2. Buffer tube that contain water blocking swellable polymer yarn or tape. Buffer tubes containing fibers must be color coded with distinct and recognizable colors according to the following:

Buffer Tube Color Code	
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)

3. Outer strength member
4. Core wrap
5. Ripcord that contain a minimum of one ripcord under the jacket for easy sheath removal
6. Jacket

Fiber optic cable marking must be placed on the cable jacket.

Detail specifications for Class IVa dispersion unshifted single mode optical fibers as described by TIA-492CAAAXBBQB is shown in the following table:

Fiber Optic Cable Specifications			
Property	FOTP(s)	Test conditions	Requirement
Cladding diameter µm	45 or 48 or 176		125 ± 1.0
Cladding non-circularity	45 or 48 or 176		< 1.0 %
Core/cladding concentricity error µm	45 or 176		< 1.0
Coating diameter µm	55 or 163 or 173		250 ± 15
Coating/cladding concentricity error µm	55 or 163 or 173		< 20
Tensile strength proof test	31		100 kips
Coating strip force lbf	400	1.2 in length	1.0 min, 9.0 max
Attenuation coefficient dB/mi	78 or 61 or 120	@ 1310 nm	0.8
	78 or 61 or 120	@ 1500 nm	0.6
Mode field diameter	164 or 165 or 167	@ 1310 nm	9.1 ± 0.5

The fiber optic cable must:

1. Be packaged on reels before shipment.
2. Be wrapped in weather and temperature resistant covering with both ends
   2.1. Sealed to prevent the ingress of moisture.
   2.2. Securely fastened to the reel to prevent the cable from coming loose during transit
3. Have six feet of cable length accessible for testing on each end of the cable.
4. Have a durable weatherproof label or tag showing
   4.1. The manufacturer's name, the cable type, the actual length of cable on the reel,
   4.2 Your name, the contract number, and the reel number.
5. Have a minimum hub diameter of the reel 30 times the diameter of the cable.
6. Must be in one continuous length per reel with no factory splices in the fiber.
7. Have each reel marked to indicate the direction the reel must be rolled to prevent loosening of the cable.

Pull tape must be a flat, woven, lubricated, soft-fiber, polyester tape. The tape must have sequential measurement markings every three (3) feet.

The Contractor must label all fiber optic cabling in a consistent manner. Fiber optic cable labels must be made of a material designed for permanent labeling. Metal tags must be constructed of stainless steel. Metal tags are required for use on fiber optic cables. Use nonmetal label materials only if approved. Labels and imprinting must be weatherproof. Handwritten labels must not be allowed.

All metal components of the fiber optic cable system must be corrosion resistant.

All connectors must be factory-installed and tested.

Patch cords, pigtails and connectors must comply with ANSI/TIA-568.

Pigtails must have a minimum 80 N pull out strength.

Each cable reel must be labeled as specified in ANSI/ICEA S-87-640 including:

1. Contractor's name
2. Contract number
3. Cable diameter
4. Number of fibers
5. Cable attenuation loss per fiber at 1310 nm and 1550 nm

The information must be on a weatherproof label or tag and in a shipping record in a weatherproof envelope. The envelope must be removed only by the Engineer.

87-19.02B Splice Vaults

A splice vault must:

1. Comply with section 86 1.02C, AASHTO HS 20-44 and AASHTO M 306.
2. Be a minimum of 4 feet wide by 4 feet high by 4 feet long nominal inside dimensions or a minimum of 4 feet outside diameter for round splice vaults.
3. Be precast either modular or monolithic.
4. Have cable racks installed on the interior sides. A rack must:
   - 4.1. Be fabricated from ASTM A36 steel plate
   - 4.2 Support a minimum of 100 pounds per rack arm.
   - 4.3 Support a minimum of 4 splice enclosures and a minimum of 4 cables with a minimum slack of 50 feet each.
   - 4.4 Be hot-dip galvanized after manufacturing.
   - 4.5 Be bonded and grounded.
5. Have a minimum of 4 knockouts for cable entry points. Entry points must not cause the cable to exceed its maximum bend radius.
6. Have a minimum 2 inch diameter drain hole at the base.
7. Be weatherproof.
8. Have cable accesses with rubber grommets or similar material to prevent the cable from coming in contact with the bare metal.

The cover must:

1. Be in two-piece torsion-assisted sections for non-rounded enclosures.
2. Be galvanized steel with a minimum of 30 inches diameter for round enclosures.
3. Have inset lifting pull slots.
4. Have markings "CALTRANS FIBER OPTIC" on each section.

87-19.02C Fiber Optic Cable

The fiber optic cable must:

1. Comply with 7 CFR 1755.900 to 1755.902 and ANSI/ICEA S-87-640
2. Be a single mode, zero-dispersion, and have non-gel loose type buffer tubes
3. Have no splices, including factory splices
4. Have a Type H or Type M outer jacket

The fiber optic cable must:

1. Be shipped on a reel
2. Have 10 feet of length on each end of the cable accessible for testing

The fiber optic riser cable must:

1. Comply with ICEA S-104-696
2. Be rated for underground and riser application
3. Have a minimum of 4 fibers.
4. Be singlemode and operate at wavelengths of 1310 and 1550 nanometers

Fiber optic cable must be identified as shown in the following table:

Cable Identification

No.	Description	Code
1	Fiber Type	**S:** Singlemode
2	Fiber Count	**048 (example):** Actual number of fibers
3	Begin Point	T: TMC H: Hub V: Video Node D: Data Node C: Cable Node TV: CCTV Camera CM: CMS E: Traffic Signal RM: Ramp Meter TM: Traffic Monitoring/ Count Station/Vehicle Count Station (VDS, TMS) HA: Highway Advisory Radio EM: Extinguishable Message Sign RW: Roadway Weather Information System WM: Weigh In Motion WS: Weigh-Station Bypass System SV: Splice Vault or Fiber Optic Vault SC: Splice Cabinet
4	Begin Point County Abbreviation	Examples: Orange (Ora), San Mateo (SM). County abbreviations are available Plans Preparation Manual at Division of Design website.
5	Begin Point Route Number	Examples 005, 082, 114
6	Begin Point Post Mile	02470 (example 024.70): Actual PM value to the 1/100 value
7	End Point	In the same manner as for Begin Point
8	End Point County Abbreviation	
9	End Point Route Number	
10	End Point Post Mile	

87-19.02D Fiber Optic Splice Enclosures

A fiber optic splice enclosure must:

1. Be suitable for a direct burial or pull box application.
2. Allow splitting or routing of fiber cables from multiple locations.
3. Must be non-filled thermoplastic case, rodent proof, water and moisture proof, chemical and UV resistant, re-enterable, and environmentally sealed container.
4. Must be expandable from 2 cables to 8 cables per end by using adapter plates.
5. Be a maximum of 36 by 8 inches
6. Accommodate a minimum of 8 internal splice trays.
7. Have 1/4 to 1 inch diameter cable entry ports to accommodate cables.

8. Have brackets, clips and cable ties.
9. Have means to anchor the dielectric member of the fiber optic cable.
10. Include multiple grounding hardware/straps.
11. Must accommodate up to 8 splice trays.
12. Must be suitable for "butt" or "through" cable entry configurations.
13. Must organize, protect without placing stress on finished splices within the splice trays.

87-19.02E Fiber Distribution Units

The Fiber Distribution Unit (FDU) consists of a housing, a patch panel, a minimum of 12 multicolor pigtails (unless otherwise specified), and a splice tray.

The FDU must be self-contained and pre-assembled.

The housing must:

1. Be a 19-inch rack mountable modular metal enclosure
2. Be a one rack unit
3. Have cable clamps to secure fiber optic cables to the chassis
4. Have cable accesses with rubber grommets or similar material to prevent the cable from coming in contact with the bare metal
5. Be weatherproof
6. Have a hinged top door with a latch or thumbscrew to hold it in the closed position

A patch panel must have a minimum of 12 single-fiber type connector sleeves.

A pigtail must:

1. Be a simplex single mode fiber in a 900 µm tight buffer with a 0.12 inch outer diameter PVC jacket
2. Have a fiber optic connector attached on one end and bare fiber on the other end
3. Be at least 3 feet in length
4. Have the manufacturer's part number on the jacket

Pigtails must be single-fiber or ribbon type.

Patch cords must:

1. Be a single mode fiber in a 900 µm tight buffer with a 0.12 inch outer diameter PVC jacket
2. Have fiber optic connectors attached on both ends
3. Be at least 6 feet in length
4. Have manufacturer's part number on the jacket

Duplex patch cords must be of round cable structure, and not have zip-cord structure.

Splice trays must:

1. Have brackets to spool incoming fibers a minimum of 2 turns.
2. Have means to secure and protect incoming buffer tubes, pigtails, and a minimum of 12 heat shrink fusion splices.
3. Be stackable with a snap-on or hinged cover. The cover may be transparent.
4. Accommodate a minimum of 12.
5. Place no stress on completed splices within the tray.
6. Be secure buffer tubes and pigtails entering the tray.
7. Organize and protect spliced fibers
8. Be labeled after splicing is completed.
9. Allow for a minimum bend radius of 2 inches

A splice cassette may be used in place of a pigtail and a splice tray.

87-19.02F Fiber Optic Markers

Fiber optic markers must be:

1. Type K-2 (CA) object markers for splice vaults or pull boxes.
2. Type G retroreflective pavement markers for paved areas and transition points from unpaved to paved areas.
3. Non-reflective Class 1, Type F, flexible post delineators for unpaved areas.

Fiber optic markers must be labeled as shown including phone number (916) 859-7800.

87-19.02G Fiber Optic Connectors and Couplers

Singlemode fiber optic connectors must have a yellow strain relief boot or a yellow base.

Connectors must be:

1. 0.1-inch ceramic ferrule pre-radiused type
2. Capped when not used
3. SC, , LC, and as shown

Couplers must be made of the same material as the connector's housing and have ceramic sleeves.

87-19.02H Transportation Management Center Cable Installation

Not Used

87-19.02I Aggregate Network Interface Switch (ANIS Media Converter)

Install a 19-inch mountable aggregate Carrier Ethernet 2.0 Certified 10 gigabyte-capable network device chassis with mounting brackets, 14 fiber SFP modules (inserted). For specifications on the SFP module, see elsewhere in this document. For compatibility, the SFP module must be manufactured by the same manufacturer of the ANIS-Media Converter.

Deliver the equipment to the Engineer for configuration and testing.
After installation, the Department will test the equipment as part of the local area field network system, Caltrans Wide Area Network (WAN) system, and for inter-operability with existing Caltrans fiber infrastructure.

The ANIS media converter must:

1. Be rated for operation in an extended temperature range (-40° to 167°F), fanless and cooled by convection with no moving parts.
2. Be hardened for vibration, shock, surge, and electrical noise immunity
3. Possess two redundant AC power supplies and support Power-over-Ethernet (PoE), if needed.
4. Possess at least 16 SFP fiber ports to accommodate 16 SFP transceiver modules. At least 4 of the 16 fiber ports must be designated as UPLINK ports. The 16 SFP transceiver modules must be included in the ANIS switch purchase. For specifications on the SFP transceiver modules, see elsewhere in this document. For compatibility, the SFP transceiver modules must be manufactured by the same manufacturer of the ANIS Media Converter.
5. Possess at least 12 Copper 10/100/1000 mbps-capable ports
6. Be licensed to operate with the Enhanced Interior Gateway Routing Protocol (EIGRP).
7. Be installed in the 334L cabinet’s 19-inch rack per manufacturer’s instructions.

The ANIS must meet or exceed the following:

Description	10/100/1000BASE-T 100/1000/10GBASE-X Fiber Aggregation Network Interface Switch and Network Interface Device (NID)
Management Protocols	Telnet, SNMP, SSH, Serial Console
Ethernet Frame Size	Up to 10,056 bytes
UTP cable	EIA/TIA 568A/B, Category 5 and higher
Fiber Cables	Single Mode: 9/125µm LC-type
Connecting Interfaces: Copper Fiber Serial Out-Of-Band Mgmt.	 RJ-45 x 3 (includes a dedicated management port) 100/1000BASE-X (SFP) x 12 10GBASE-R (SFP+) x 2 Serial RJ-45 x 1
AC power Cord(s)	NEMA 5-15P to C13 x 2
AC power (2, modular power supplies)	80-264VAC~ 50-60Hz 0.8A @ 110VAC
DC Power Requirements	3-Pin Terminal, 1.2A @ 48VDC (56W Max)
Controls	LED indicators
Humidity	5 to 95% (non-condensing)
Operating Temperature	-40°F to +167°F
Weight with 2 redundant power supplies	9.0 lbs
Dimensions	9.0” D x 17.15” W x 1.7” H
Compliance	UL, CE, FCC Class A. NEBS Level 3 RoHS2
Warranty	3 Years

87-19.02J Intermediate Network Interface Switch (INIS Media Converter)

The INIS must meet or exceed the following:

Description	10-Port 10/100BASE-T and 100/1000BASE-X Industrial Ethernet Aggregation Network Interface Switch.
Management Protocols	Telnet, SNMP, SSH, Serial Console
Network protocols	802.1Q VLAN trunk support, VTPv3, CDP, LLDP, UDLD
UTP cable	EIA/TIA 568A/B, Category 5 and higher
Fiber Cables	Single Mode: 9/125µm LC-type
Memory	256 MB DRAM, 64 MB onboard flash memory
Forwarding/Switching Bandwidth	3.8Gbps/7.6Gbps
Mounting hardware	19 " DIN Rail mount kit required
10/100 RJ-45 TX Connecting Interfaces: Compatibility Interfaces (Allow use of either the built-in RJ-45 Copper or SFP slots for fiber SFP mini-gbics) Serial Out-Of-Band Mgmt.	Eight (8) Two (2) Serial RJ-45 x 1
Power Requirements	DC, 15 – 20 Watts
Humidity	5 to 95% (non-condensing)
Operating Temperature	-40°F to +167°F
Weight with no power supply installed	2.75 lbs.
Dimensions	5.26" D x 3.6" W x 5.1" H
Industry Standards Compliance	EN 61000-6-4 Class A

87-19.02K Remote Network Interface Switch (RNIS-Media Converter)

Install the remote site stand-alone Network Interface Switch and media converter, which will provide stand-alone remote UTP (unshielded twisted-pair copper) to SMFO (single-mode fiber optic) media conversion at various locations. The RNIS must also have 1 fiber SFP module (inserted). See elsewhere in this in this document for specifications on the SFP module. For compatibility, the SFP module must be manufactured by the same manufacturer of the RNIS-Media Converter.

Submit manufacturer data sheets for approval before installation.

The RNIS must meet or exceed the following:

Description	10/100/1000BASE-T copper UTP to 1000BASE-X Stand-Alone Fiber Media Converter and Network Interface Device
Protocols	10/100/1000BASE-T UTP to 1000BASE-X with 10,240 bytes max. frame size
UTP cable	EIA/TIA 568A/B, Category 5 and higher
Fiber Cables	Single Mode: 9/125µm
Connectors: UTP SFP Serial Management Port	RJ-45 LC (SFP module to be provided per specification) 6-Pin Din
AC power Adapter	100 to 240VAC, 50/60Hz, 0.06A @ 120VAC
Controls	Dip-switches and LEDs
Humidity	5 to 95% (non-condensing)
Operating Temperature	-40°F to +167°F
Weight without power adapter	1 lb
Dimensions (Standalone)	4.8” D x 3.1” W x 1.0” H
IP-Based Management	Telnet, SNMPv1, SNMP v2c, SNMP v3; IEEE 802.3ah (OAM)
Compliance	UL,CE, FCC Class A, NEBS Level 3
Mounting Option	Wall Mountable with 4 screw holes.

87-19.02L Small form-factor Pluggable (SFP) Optical Transceiver

The contractor must install the SFP optical transceivers that will be installed in both the Aggregate Network Interface Switch (ANIS) and Remote Network Interface Switch (RNIS). The SFP Optical Transceiver must be compatible with the both the ANIS and RNIS.

The contractor must submit manufacturer data sheets for approval before installation.

The SFP Optical Transceiver must meet or exceed the following:

Description	
Protocols	Complies with IEEE 802.3u Fast Ethernet and 802.3z Gigabit Ethernet specifications
Compliance	Compliant with MSA SFF-8472 and INF-8077i standards for interoperability with other network devices.
Fiber Type	SM/DF
Compatible Fiber Cable Connector	LC
Wavelength	1310 nm
Spec Distance	34 km
Min TX Power (dBm)	-5
Max TX Power (dBm)	0
Min RX Power (dBm)	-24
Max RX Power (dBm)	-3
Min Attenuation (dB)	3
Link Budget (dB)	19
Enclosure	Low EMI metal
Operating Temperature	-40ºF to +185ºF

87-19.02M Rack Mounted Air Distribution Unit

The rack mounted air distribution unit must have dual independently controller fans that provide equalized airflow from the top to bottom of the ITScabinet assembly housing #3, redundant power input feeds, air filtration that improves the quality of air reaching the equipment by providing 30% efficient filtration as per the ASHRAE 52.1-1992 standard. The unit's depth must fit ITS cabinet assembly housing #3 with a removable bottom plate. The rack mounted air distribution unit must meet the following requirements.

A. Nominal input voltage 120 V
B. Input Power 200 watts
C. Input frequency 60 Hz +/- 3 Hz
D. Air Flow 505.0 CFM
E. UL Approved

87-19.02N Ethernet Extender Switch Combination Unit

The Ethernet extender switch combination unit must meet the following requirements:

1. Provide a hardened managed 6-port 10/100Base Fast Ethernet switch and 2-port copper pair Ethernet extender and 2-Gigabit Ethernet combo switch ports. Two Single-Mode (1310/1550 nm) high-temperature-rated (185 Fahrenheit) SFPs must be included with each Ethernet extender switch combination unit. These SFPs must be fully compatible with the switch into which they will be inserted for operation.
2. Include everything needed to quickly deploy a 6-port switch and two high-speed point-to-point Ethernet links over extended distances to deliver data to remotely located networked devices
3. Be compact, industrial grade and designed for outdoor applications
4. Utilize existing phone lines or any network-grade twisted pair cable and only require one (1) twisted pair (2 wires) to operate
5. Plug and play ready at default extender line rate of 1 Mbps up to 100Mbps
6. Connect to network equipment on both sides of the link
7. Establish link automatically on power up when both units are connected to the power source

Description	Specifications
Ethernet Interface	10/100Base-TX
Ports	(6 Min) RJ-45 auto-cross, (2 Min) RJ-11, (2 Min) Terminal Block, DB9 TIA-232 console port, (2 Min) Gigabit Ethernet combo switch ports. 2 Single-Mode (1310/1550nm) SFP gbics.
LED Indicators	Unit Power; Ports: Link, Activity, Speed
Memory	2Mbits packet buffer
Manage Functions	SNMP/v1/v2/v3, VLAN, QoS, RSTP, IGMP, LACP
Security	MAC address filtering, port enable/disable
Alarm Contact	One relay contact (1A @ 24Vdc
Input Voltage	12 - 48V(dc) Terminal Block; 12 V(dc) (DC Jack)
Protection	Over current and Reverse polarity
Installation	DIN Rail mount
Dimensions (max)	3.0” (W) x 5.0” D) x 6” (H)
Weight (max)	3.0 lbs
Operating Temp	-40°F to +167°F
Ambient Relative Humidity	5% to 95% (non-condensing)
Agency Compliance	FCC Part 15B, Class A

87-19.02O Remote Ethernet Power Controller Switch

The Ethernet power controller switch must provide Remote Power Management and Control using two methods for accessing configuration and switching functions:

1. The Web Browser Interface method which consist of a series of simple, easy-to-use web page menus that allow the selection of configuration parameters or initiation of switching operations using the Ethernet network.
2. The Command Line Interface must be an ASCII menu system, which allows configuration and operation of the Ethernet power controller switch via telnet over TCP/IP network, via modem connection or via local PC using a terminal program such as Hyperterminal or Tera Term.

The Ethernet power controller switch must meet or exceed the following requirements:

1. Web Browser Access for easy setup and operation
2. Encrypted password security
3. Expandable to five individual outlets
4. Each Outlet can Switch a 15 Amp Load
5. On/Off/Reboot switching
6. IP addressed, 10Base-T interface
7. EIA-232 Modem / Console Port
8. Network Security features
9. Manual power control button
10. Telephone Control through phone keypads with access for control
11. Power Input / Output:
    A. AC Inputs: 15 Amperes (maximum)
    B. Voltage: 105 - 120 V(ac), 60 Hz
    C. Connectors: IEC-320 Inlet, Line Cord (supplied)
    D. AC Outputs: One, Expandable to five
    E. Connector: NEMA 5-15 Outlet
    F. Load: 15 Amperes (total)
12. Console / Modem Port Interface
    A. Connector: DB9M, EIA232C, DTC (9-to-9 Pin provided)
    B. Coding: Serial ASCII, 8 Bits, No Parity
13. Physical / Environmental:
    A. Size:
        1. Width: 19"
        2. Height: 3.5"
        3. Depth: 7.00"
    B. Operation Temperature:
        32°F to 122°F
    C. Humidity:
        10 percent to 90 percent (relative humidity)

87-19.02P Category 6 Ethernet Patch Cables

Category 6 cables must be the unshielded and have a bandwidth of 550MHZ or greater.

The length of Category 6 Patch cable must be 6 feet long. Category 6 Patch cables must have factory installed RJ 45 Modular Jack. It must have a snagless cable boot and the plug retaining clip.

Category 6 cables must meet the following:

1. The cable must contain 8 conductors, each of which must be no. 24, minimum, solid bare copper conductors. Each conductor must be insulated with polyolefin, polyethylene, polyvinyl chloride or fluorinated ethylene propylene material.
2. The cable jacket must be rated for a minimum of 300 V(ac) and 140 degrees F and must be polyvinyl chloride, polyethylene, polyolefin or fluorinated ethylene propylene. The jacket must be black, gray, or blue.
3. The finished outside diameter of the cable must not exceed 1/2-inch.

87-19.03 CONSTRUCTION

87-19.03A General

Install 144 SMFO cable in one of the orange HDPE conduits. Install pull tape in the other HDPE conduit.

Install Fiber optic cable in conduitsystem or cable tray system as shown. Comply with manufacturer instruction for cable installation.

Perform the OTDR test:

1. On the fiber optic cable upon its arrival to the job site and before its installation. Complete the Cable Verification Worksheet (Appendix A). Do not install the fiber optic cable until the Engineer's written approval is received.
2. After the fiber optic cable segments have been pulled but before breakout and termination. Complete the Segment Verification Worksheet.
3. Once the passive cabling system has been installed and is ready for activation. If the measured individual fusion splice losses exceed -0.30 dB, re-splice and retest. At the conclusion of the OTDR test, perform the power meter and light source test. If the measured link loss exceeds the calculated link loss, replace the unsatisfactory cable segments or splices and retest. Complete the Link Loss Budget Worksheet (Appendix B).

APPENDIX A
Cable Verification Worksheet

End-to-End Attenuation (Power Meter and Light Source) Testing and OTDR Testing

Contract No. _____ Contractor: _____

Operator: _____ Date: _____

Link Number: _____ Fiber Number: _____

Test Wavelength (Circle one): 1310 nm 1550 nm

Expected Location of fiber ends: End 1: _____ End 2: _____

Power Meter and Light Source Test Results:

Power In:	_____	dBm	1A
Output Power:	_____	dBm	1B
Insertion Loss [1A - 1B]:	_____	dB	1C

OTDR Test Results:

Forward Loss:	_____	dB	2A
Reverse Loss:	_____	dB	2B
Average Loss [(2A + 2B)/2]:	_____	dB	2C

To Be Completed by Caltrans:
Resident Engineer's Signature: _____
Cable Link Accepted: _____

APPENDIX B

Fiber System Performance Margin Calculations Worksheet

A. Calculate the Passive Cable Attenuation

1. Calculate Fiber Loss at Operating Wavelength: _____ nm	Cable Distance (times) Individual Fiber Loss (equal) @ 1310 nm (0.4dB/km) @ 1550 nm (0.3dB/km)	_____km x ___ dB/km =
	Total Fiber Loss:	_____ dB

B. Calculate the Total Connector/Splice Loss

2. Calculate Connectors/couplers Loss: (exclude Tx and Rx connectors)	Individual Connector Loss (times) Number of Connector Pairs (equal) **Total Connector Loss:**	0.4 dB x ____ = _____ dB
3. Calculate Splice Loss:	Individual Splice Loss (times) Number of Splices (equal) **Total Splice Loss:**	0.1 dB x ____ = _____ dB
4. Calculate Other Components Loss:	**Total Components:**	_____ dB
5. Calculate Total Losses:	Total Connector Loss (plus) Total Splice Loss (plus) Total Components (equal)	+ dB + dB + dB =
	Total Connector/Splice Loss:	_____ dB

C. Calculate Active Component Link Loss Budget

System Wavelength: Fiber Type: Average Transmitter Output (Launch Power):		_____ nm single mode _____ dBm
Receiver MAX Sensitivity (10^9 BER) (minus) Receiver MIN Sensitivity (equal)	**Receiver Dynamic Range:**	_____ dBm - _____ dBm = _____ dB
6. Calculate Active Component Link Loss Budget:	Average Transmitter Output (Launch Power) (minus) Receiver MAX Sensitivity (equal)	_____ dBm - _____ dBm =
	Active Component Link Loss Budget:	_____ dB

D. Verify Performance

7. Calculate System Performance Margin to Verify Adequate Power:	Active Component Link Loss Budget **[C]** (minus) Passive Cable Attenuation **[A]** (minus) Total Connector/Splice Lost **[B]** (equal)	_____ dB - _____ dB - _____ dB =
	System Performance Margin:	_____ dB

87-19.03B Splice Vaults Installation

Install a splice vault as shown and with the side facing the roadway a minimum of 2 feet from the edge of pavement or back of dike, away from traffic.

Install the top of the vault flush with surrounding grade in paved areas and 2 inches above the surrounding grade in unpaved areas.

Place minor concrete around and under vaults. In unpaved areas, finish top of concrete at a 2 percent slope away from cover. In paved areas, finish top of concrete to match existing slope.

Bolt the steel cover to the vault when not working in it.

87-19.03C Fiber Optic Cable Installation

Install fiber optic cable under manufacturer's instructions. Fiber optic cable must be installed by a certified installer or a representative from the fiber optic cable manufacturer must be present during installation.

For installation of fiber optic cable using mechanical aids:

1. Maintain a cable bend radius at least twenty times the outside diameter of the cable.
2. Cable grips have a ball bearing swivel.
3. Pulling force on a cable must not exceed 500 pound-foot or manufacturer’s recommended pulling tension, whichever is less.

Cable installed using the air blown method must withstand a static air pressure of 110 psi.

Lubricate the cable using a lubricant recommended by the cable manufacture.

Use only a non-abrasive pull tape.

Install fiber optic cable without splices except where shown or authorized.

Provide a minimum of 65 feet of slack for each fiber optic cable at each splice vault unless specified on the plans. Divide the slack equally on each side of the splice enclosure.

Install tracer wires in the fiber optic conduits and innerducts as shown. Provide a minimum 5 feet of slack tracer wire in each pull box and splice vault from each direction. You may splice tracer wire at intervals of not less than 500 feet and only inside splice vaults or pull boxes.

If a fiber optic cable and tracer wire is installed in an innerduct, pulling a separate fiber optic cable into a spare duct to replace damaged fiber will not be allowed.

Apply a flooding material to fiber optic cable openings.

Seal the ends of conduit after cables are installed.

Install strain relief for fiber optic cable entering a fiber optic enclosure.

Identify fibers and cables by direct labeling, metal tags, or bands fastened in such a way that they will not move. Use mechanical methods for labeling.

Provide identification on each fiber or each group of fibers in each splice vault and near the end of terminated fibers.

Place labels on the cables at the following points:

1. Fiber optic splice vault entrance and exit
2. Splice enclosures entrance and exit
3. FDU entrance

For fiber optic riser cable inside controller cabinets, lace and secure the cable to the cage.

Support the fiber optic riser cable within 6 inches from a termination and every 2 feet.

Secure fiber optic cables to the cable racks. Store excess cable in a figure 8 fashion.

87-19.03C(1) Air blown installation:

You may install the fiber cable using air blown method. If integral innerduct is used, the duct splice points or any temporary splices of innerduct must withstand a static air pressure of 110 psi.

The fiber installation equipment you use, must incorporate a mechanical drive unit or pusher that feeds cable into the pressurized innerduct to provide a sufficient push force on the cable, coupled with the drag force created by the high-speed airflow. The unit must be equipped with controls to regulate the flow rate of compressed air entering the duct and any hydraulic or pneumatic pressure applied to the cable. It must accommodate longitudinally ribbed or smooth wall ducts from nominal 0.625 to 2-inch inner diameter. You may use only the mid assist or cascading of equipment for the installation of long cable runs. The equipment must incorporate safety shutoff valves to disable the system in the event of sudden changes in pneumatic or hydraulic pressure.

The equipment must not require the use of a piston or any other air capturing device to impose a pulling force at the front end of the cable. It must incorporate the use of a counting device to determine the speed of the cable during installation and the length of the cable installed.

87-19.03D Fiber Optic Cable Splices

Use fusion splicing for fiber optic cables.

Splice single-buffer tube cable to multi-buffer tube cable using the mid-span access method under manufacturer's instructions. Any mid-span access splice or FDU termination must involve only those fibers being spliced as shown.

Place fiber splices in the splice enclosures installed in the splice vaults.

87-19.03E Splice Enclosures Installation

Maintain an equal amount of slack on each side of the splice enclosure.

Secure the fiber optic splices in splice tray.

Secure the splice trays to the inner enclosure.

Label cables and buffer tubes.

Do not seal fiber splice enclosure until authorized and the power meter and light source test is performed. Seal the enclosure under manufacturer's recommendation.

Flash test the outer enclosure under manufacturer's instructions in the presence of the Engineer. Visually inspect the enclosure. If bubbles are present, identify the locations where the bubbles are present, take corrective actions and repeat the flash test until no bubbles are present.

Attach the splice enclosure to the side wall of a splice vault or hub with a minimum 2 feet distance between the ground and the bottom of the enclosure.

Secure fiber optic cables to the chassis using cable clamps for fiber optic units.

Connect a minimum of one bonding conductor to a grounding electrode after mounting the fiber optic enclosure to the wall. If there are multiple bonding conductors, organize the conductors in a neat manner.

87-19.03F Fiber Optic Distribution Unit Installation

Spool incoming buffer tubes 2 feet in the splice tray and expose 1 foot of individual fibers.

Maintain a minimum 2-inch-bend radius during and after installation in the splice tray.

Splice incoming fibers in the splice tray.

Restrain each fiber in the splice tray. Do not apply stress on the fiber when located in its final position.

Secure buffer tubes near the entrance of the splice tray.

Secure splice trays under manufacturer's instructions.

Label splice tray after splicing is completed.

Install patch cords in FDUs and patch panels. Permanently label each cord and each connector in the panel with the system as shown.

87-19.03G Fiber Optic Markers Installation

Install fiber optic markers at 12-inch offset on the side furthest away from the edge of travel way:

1. For fiber optic cable at 500 feet apart in areas where the distance between splice vaults or pull boxes is greater than 500 feet
2. Adjacent to pull boxes and splice vaults
3. For fiber optic cable turns at:
   3.1. Beginning of the turn
   3.2. Middle of the arc
   3.3. End of the turn

When a fiber optic cable crosses a roadway or ramp, install a Type G marker over the conduit on:

1. Every shoulder within 6 inches from the edge of pavement
2. Delineated median
3. Each side of the barrier

Install markers under section 81 except each retroreflective face must be parallel to the road centerline and facing away from traffic.

87-19.03H Transportation Management Center Cable Installation

Notify Engineer 7 days before scheduling any work. Schedule work within the hours shown in the following table:

Transportation Management Center Time Requirements

Location	Times of operations (except on legal holidays)
Communication Hub	7 am to 4 pm, Monday to Friday 7 am to 3:30 pm, Saturday to Sunday

Do not block access to the equipment in the communication hub. Maintain a neat workspace.

Access only hardware, electronics, and peripheral equipment necessary to perform the work.

87-19.04 PAYMENT

Not Used

Add to the end of section 87-21.03C of the RSS for section 87:

Modifying a lighting system includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Luminaires
7. Service equipment enclosure
8. Photoelectric control
9. Fuse splice connectors

Modifying a sign illumination system includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit

4. Conductors
5. Sign lighting fixtures
6. Enclosure for the disconnect circuit breaker
7. Service equipment enclosure

Modifying a signal and lighting system includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Cables
6. Standards
7. Signal heads
8. Internally illuminated street name signs
9. Service equipment enclosure
10. Department-furnished controller assembly
11. Detectors
12. Telephone demarcation cabinet
13. Accessible pedestrian signals
14. Push button assemblies
15. Pedestrian signal heads
16. Luminaires
17. Photoelectric control
18. Fuse splice connectors
19. Battery backup system
20. Flashing beacons
21. Flashing beacon control assembly
22. Microwave video detection system (MVDS)
23. Video image vehicle detection system (VIVDS)
24. Emergency vehicle detection system (EVDS)
25. Fiber optic cable system

Modifying a ramp metering system includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Signal heads
7. Service equipment enclosure
8. Department-furnished controller assembly
9. Detectors
10. Telephone demarcation cabinet
11. Flashing beacons
12. Fiber optic cable system

Modifying a traffic monitoring station includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit
4. Cables
5. Conductors
6. Service equipment enclosure
7. Controller cabinet
8. Detectors
9. Telephone demarcation cabinet
10. Wireless vehicle detection system (WVDS)

11. Fiber optic cable system

Modifying a flashing beacon system includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Service equipment enclosure
7. Signal heads
8. Flashing beacon control assembly
9. Fiber optic cable system

Modifying a changeable message sign system includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Service equipment enclosure
6. Department-furnished controller cabinet
7. Department-furnished changeable message sign
8. Department-furnished wiring harness
9. Sign disconnect
10. Fiber optic cable system

Modifying interconnection conduit and cable includes removing, adjusting, or adding:

1. Pull boxes
2. Conduit
3. Signal interconnect cables
4. Fiber optic cable system

Modifying a CCTV system includes removing, adjusting, or adding:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Cables
6. Camera
7. Service equipment enclosure
8. Fiber optic cable system

^^^

Replace the row for bridge deck concrete in the table in the 1st paragraph of section 90-1.02A with:

Bridge deck and joint reconstruction concrete	0.032

Add to section 90-1.02H:

Concrete at Bridge no.s 24-0262, 24-0296, 24E0021, and 24E0022 is in a corrosive environment.

For concrete at the precast piling at Bridge No.s 24-0262 and 24-0296, the cementitious material must be composed of one of the following, by weight:

1. 20 percent natural pozzolan or fly ash with a CaO content of up to 10 percent, 5 percent silica fume, and 75 percent portland cement
2. 12 percent silica fume, metakaolin, or UFFA, and 88 percent portland cement
3. 50 percent GGBFS and 50 percent portland cement

For concrete at the locations shown in the below table, the ratio of the quantity of free water to the quantity of cementitious material must not exceed 0.40:

Bridge no. 24-0296	Abutments, piling, and footings
Bridge no. 24-0262	Abutments, piling, and footings
Bridge no. 24E0021	Shotcrete, structural concrete, concrete barrier
Bridge no. 24E0022	Shotcrete, structural concrete, concrete barrier

Add to section 90-1.02:

90-1.02K Polymer Fibers

Fibers must comply with ASTM D7508. Microfibers must be from 1/2 to 2 inches long. Macrofibers must be from 1 to 2-1/2 inches long.

^^

96 GEOSYNTHETICS

Add to section 96-1.02B:

Filter fabric for Sound wall 1 and geocomposite drain at Bridge no.s 24-0262 must be Class A.

REVISED STANDARD SPECIFICATIONS APPLICABLE TO THE 2015 EDITION OF THE STANDARD SPECIFICATIONS

REVISED STANDARD SPECIFICATIONS DATED 04-20-18

ORGANIZATION

Revised standard specifications are under headings that correspond with the main-section headings of the *Standard Specifications*. A main-section heading is a heading shown in the table of contents of the *Standard Specifications*. A date under a main-section heading is the date of the latest revision to the section.

Each revision to the *Standard Specifications* begins with a revision clause that describes or introduces a revision to the *Standard Specifications*. For a revision clause that describes a revision, the date on the right above the clause is the publication date of the revision. For a revision clause that introduces a revision, the date on the right above a revised term, phrase, clause, paragraph, or section is the publication date of the revised term, phrase, clause, paragraph, or section. For a multiple-paragraph or multiple-section revision, the date on the right above a paragraph or section is the publication date of the paragraphs or sections that follow.

Any paragraph added or deleted by a revision clause does not change the paragraph numbering of the *Standard Specifications* for any other reference to a paragraph of the *Standard Specifications*.

^^^

07-21-17

traffic break: Traffic operation performed by a California Highway Patrol officer or other law enforcement officer to slow or stop traffic within the traveled way.

Replace the 1st row of the table in section 1-1.11 with:

07-21-17

Authorized Facility Audit List	http://www.dot.ca.gov/hq/esc/Translab/OSM/documents/smdocuments/Internet_auditlisting.pdf	--	--
Authorized Material List	http://www.dot.ca.gov/hq/esc/approved_products_list/	--	--
Authorized Material Source List	http://www.dot.ca.gov/hq/esc/Translab/authorized_material_source_list/	--	--
Authorized Material Systems List	http://www.dot.ca.gov/hq/esc/Translab/authorized_systems_list/	--	--
Authorized Laboratory List	http://www.dot.ca.gov/hq/esc/Translab/authorized_laboratories_list/	--	--

12-02-16

Delete the row for Bidders' Exchange in the table of section 1-1.11.

^^

2 BIDDING

07-21-17

Replace the headings and paragraphs of section 2 with:

12-02-16

2-1.01 GENERAL

Section 2 includes specifications related to bid eligibility and the bidding process.

2-1.02 BID INELIGIBILITY

A firm that has provided architectural or engineering services to the Department for this contract before bid submittal for this contract is prohibited from any of the following:

1. Submitting a bid
2. Subcontracting for a part of the work
3. Supplying materials

2-1.03 CONTRACTOR REGISTRATION

No contractor or subcontractor may be listed on a bid proposal for a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].

01-20-17

2-1.04 PREBID OUTREACH MEETING

Section 2-1.04 applies if a mandatory prebid meeting is shown on the *Notice to Bidders*.

The Department will conduct a meeting to provide small businesses, including DVBEs and DBEs, the opportunity to meet and interact with prospective bidders in an effort to increase their participation in the performance of contracts.

Each bidder must attend the meeting. The bidder's representative must be a company officer, project superintendent, or project estimator. For a joint venture, one of the parties must attend the mandatory prebid meeting.

The Department does not accept a bid from a bidder who did not attend the meeting.

A sign-in sheet will be used to identify the attendees. Each bidder must include the name and title of the company representative attending the meeting.

The Department may hold a single prebid meeting for more than one contract. Sign the sign-in sheet for the contract you intend to bid on. If you are bidding on multiple contracts, sign each sign-in sheet for each contract you intend to bid on. The sign-in sheets, with the names of all companies in attendance at each prebid meeting, will be made available at the website shown on the *Notice to Bidders* for bidder inquiries.

The successful bidder is required to report each small business hired to work on this Contract as a result of the meeting.

2-1.05 RESERVED

12-02-16

2-1.06 BID DOCUMENTS

2-1.06A General

The *Bid* book includes bid forms and certifications, including forms not submitted through the electronic bidding service.

The *Notice to Bidders and Special Provisions* includes the *Notice to Bidders*, revised standard specifications, and special provisions.

The *Bid* book, including *Bid* book forms not available through the electronic bidding service, *Notice to Bidders and Special Provisions*, project plans, and any addenda to these documents may be accessed at the Department's Office of Construction Contract Awards website.

The *Standard Specifications* and *Standard Plans* may be viewed at the Department's Office of Construction Contract Awards website and may be purchased at the Publication Distribution Unit.

2-1.06B Supplemental Project Information

The Department makes supplemental information available as specified in the special provisions.

Logs of test borings are supplemental project information.

07-21-17

If an *Information Handout* or electronic design files are available, you may view them at the Contract Plans and Special Provisions link at the Department's Office of Construction Contract Awards website. Electronic design files contain design information such as cross sections, digital models, and roadway design alignments and profiles.

12-02-16

If rock cores are available, you may view them by sending a request to Coreroom@dot.ca.gov.

If other supplemental project information is available for inspection, you may view it by phoning in a request.

Make your request at least 7 days before viewing. Include in your request:

1. District-County-Route
2. Contract number
3. Viewing date
4. Contact information, including telephone number

For rock cores, also include the bridge number in your request.

If bridge as-built drawings are available:

1. For a project in District 1 through 6 or 10, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357
2. For a project in District 7, 8, 9, 11, or 12, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357, and they are available at the Office of Structure Maintenance and Investigations, Los Angeles, CA, telephone (213) 897-0877

As-built drawings may not show existing dimensions and conditions. Where new construction dimensions are dependent on existing bridge dimensions, verify the field dimensions and adjust the dimensions of the work to fit the existing conditions.

2-1.06C–2-1.06D Reserved

2-1.07 JOB SITE AND DOCUMENT EXAMINATION

Examine the job site and bid documents. Notify the Department of apparent errors and patent ambiguities in the plans, specifications, and Bid Item List. Failure to do so may result in rejection of a bid or rescission of an award.

Bid submission is your acknowledgment that you have examined the job site and bid documents and are satisfied with:

1. General and local conditions to be encountered
2. Character, quality, and scope of work to be performed
3. Quantities of materials to be furnished
4. Character, quality, and quantity of surface and subsurface materials or obstacles
5. Requirements of the contract

2-1.08 RESERVED

2-1.09 BID ITEM LIST

Submit a bid based on the bid item quantities shown on the Bid Item List.

2-1.10 SUBCONTRACTOR LIST

On the Subcontractor List form, list each subcontractor that will perform work in an amount in excess of 1/2 of 1 percent of the total bid or $10,000, whichever is greater (Pub Cont Code § 4100 et seq.).

For each subcontractor listed, the Subcontractor List form must show:

1. Business name and the location of its place of business.
2. California contractor license number for a non-federal-aid contract.
3. Public works contractor registration number.
4. Portion of work it will perform. Show the portion of the work by:
   - 4.1. Bid item numbers for the subcontracted work
   - 4.2. Percentage of the subcontracted work for each bid item listed
   - 4.3. Description of the subcontracted work if the percentage of the bid item listed is less than 100 percent

2-1.11 RESERVED

2-1.12 DISADVANTAGED BUSINESS ENTERPRISES

2-1.12A General

Section 2-1.12 applies to a federal-aid contract.

Under 49 CFR 26.13(b):

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

(1) Withholding monthly progress payments;
(2) Assessing sanctions;
(3) Liquidated damages; and/or
(4) Disqualifying the contractor from future bidding as non-responsible.

Include this assurance in each subcontract you sign with a subcontractor.

2-1.12B Disadvantaged Business Enterprise Goal

2-1.12B(1) General

Section 2-1.12B applies if a DBE goal is shown on the *Notice to Bidders*.

The Department shows a goal for DBEs to comply with the DBE program objectives provided in 49 CFR 26.1.

Make work available to DBEs and select work parts consistent with the available DBEs, including subcontractors, suppliers, service providers, and truckers.

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

You are responsible to verify at bid opening the DBE firm is certified as a DBE by the California Unified Certification Program and possesses the work codes applicable to the type of work the firm will perform on the Contract.

Determine that selected DBEs perform a commercially useful function for the type of work the DBE will perform on the Contract as provided in 49 CFR 26.55(c)(1)–(4). Under 49 CFR 26.55(c)(1)–(4), the DBE must be responsible for the execution of a distinct element of work and must carry out its responsibility by actually performing, managing, and supervising the work.

All DBE participation will count toward the Department's federally mandated statewide overall DBE goal.

Credit for materials or supplies you purchase from DBEs will be evaluated on a contract-by-contract basis and counts toward the goal in the following manner:

1. 100 percent if the materials or supplies are obtained from a DBE manufacturer.
2. 60 percent if the materials or supplies are obtained from a DBE regular dealer.
3. Only fees, commissions, and charges for assistance in the procurement and delivery of materials or supplies if they are obtained from a DBE that is neither a manufacturer nor a regular dealer. 49 CFR 26.55 defines *manufacturer* and *regular dealer*.

You receive credit toward the goal if you employ a DBE trucking company that is performing a commercially useful function. The Department uses the following factors in determining whether a DBE trucking company is performing a commercially useful function:

- 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 DBE goals.
- The DBE must itself own and operate at least one fully licensed, insured, and operational truck used on the contract.
- The DBE receives credit for the total value of the transportation services it provides on the Contract using trucks it owns, insures, and operates using drivers it employs.
- 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.
- The DBE may lease trucks without drivers from a non-DBE truck leasing company. If the DBE leases trucks from a non-DBE truck leasing company and uses its own employees as drivers, it is entitled to credit for the total value of these hauling services.
- 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.

[49 CFR 26.55(d)]

2-1.12B(2) DBE Commitment Submittal

Submit DBE information under section 2-1.33.

Submit a copy of the quote from each DBE shown on the DBE Commitment form that describes the type and dollar amount of work shown on the form. Submit a DBE Confirmation form for each DBE shown on the DBE Commitment form to establish that it will be participating in the Contract in the type and dollar amount of work shown on the form. If a DBE is participating as a joint venture partner, submit a copy of the joint venture agreement.

2-1.12B(3) DBE Good Faith Efforts Submittal

You can meet the DBE requirements by either documenting commitments to DBEs to meet the Contract goal or by documenting adequate good faith efforts to meet the Contract goal. An adequate good faith effort means that the bidder must show that it took all necessary and reasonable steps to achieve a DBE goal that, by their scope, intensity, and appropriateness to the objective, could reasonably be expected to meet the DBE goal.

If you have not met the DBE goal, complete and submit the DBE Good Faith Efforts Documentation form under section 2-1.33 showing that you made adequate good faith efforts to meet the goal. Only good faith efforts directed toward obtaining participation by DBEs are considered.

Submit good faith efforts documentation within the specified time to protect your eligibility for award of the contract in the event the Department finds that the DBE goal has not been met.

Refer to 49 CFR 26 app A for guidance regarding evaluation of good faith efforts to meet the DBE goal.

The Department considers DBE commitments of other bidders in determining whether the low bidder made good faith efforts to meet the DBE goal.

2-1.13–2-1.14 RESERVED

2-1.15 DISABLED VETERAN BUSINESS ENTERPRISES

2-1.15A General

Section 2-1.15 applies to a non-federal-aid contract.

Take necessary and reasonable steps to ensure that DVBEs have the opportunity to participate in the Contract.

Comply with Mil & Vet Code § 999 et seq.

2-1.15B Projects $5 Million or Less

Section 2-1.15B applies to a project with an estimated cost of $5 million or less.

Make work available to DVBEs and select work parts consistent with the available DVBE subcontractors and suppliers.

Meet the goal shown on the *Notice to Bidders*.

Complete and submit the Certified DVBE Summary form under section 2-1.33. List all DVBE participation on this form.

If a DVBE joint venture is used, submit the joint venture agreement with the Certified DVBE Summary form.

List each 1st-tier DVBE subcontractor on the Subcontractor List form regardless of its percentage of the total bid.

2-1.15C Projects More Than $5 Million

2-1.15C(1) General

Section 2-1.15C applies to a project with an estimated cost of more than $5 million.

The Department encourages bidders to obtain DVBE participation to ensure the Department achieves its State-mandated overall DVBE goal.

If you obtain DVBE participation:

1. Complete and submit the Certified DVBE Summary form under section 2-1.33. List all DVBE participation on this form.
2. List each 1st-tier DVBE subcontractor on the Subcontractor List form regardless of its percentage of the total bid.

If a DVBE joint venture is used, submit the joint venture agreement with the Certified DVBE Summary form.

2-1.15C(2) DVBE Incentive

The Department grants a DVBE incentive to each bidder who achieves a DVBE participation of 1 percent or greater (Mil & Vet Code 999.5 and Code of Regs § 1896.98 et seq.).

To receive this incentive, submit the Certified DVBE Summary form under section 2-1.33.

Bidders other than the apparent low bidder, the 2nd low bidder, and the 3rd low bidder may be required to submit the Certified DVBE Summary form if the bid ranking changes. If the Department requests a Certified DVBE Summary form from you, submit the completed form within 4 business days of the request.

2-1.15C(3) Incentive Evaluation

The Department applies the small business and non–small business preference during bid verification and proceeds with the evaluation specified below for the DVBE incentive.

The DVBE incentive is a reduction, for bid comparison only, in the submitted total bid by the lesser of the following amounts:

1. Percentage of the DVBE achievement rounded to 2 decimal places of the verified total bid of the low bidder
2. 5 percent of the verified total bid of the low bidder
3. $250,000

The Department applies the DVBE incentive and determines whether the bid ranking changes.

A non–small business bidder cannot displace a small business bidder. However, a small business bidder with a higher DVBE achievement can displace another small business bidder.

The Department proceeds with awarding the contract to the new low bidder and posts the new verified bid results at the Department's website.

2-1.16–2-1.17 RESERVED

2-1.18 SMALL BUSINESS AND NON–SMALL BUSINESS SUBCONTRACTOR PREFERENCES

2-1.18A General

Section 2-1.18 applies to a non-federal-aid contract.

The Department applies small business preferences and non–small business preferences under Govt Code § 14835 et seq. and 2 CA Code of Regs § 1896 et seq.

Any contractor, subcontractor, supplier, or service provider who qualifies as a small business is encouraged to apply for certification as a small business by submitting its application to the Department of General Services, Office of Small Business and DVBE Services.

Contract award is based on the total bid, not the reduced bid.

2-1.18B Small Business Preference

The Department allows a bidder certified as a small business by the Department of General Services, Office of Small Business and DVBE Services, a preference if:

1. Bidder submitted a completed Request for Small Business Preference or Non–Small Business Preference form with its bid
2. Low bidder did not request the preference or is not certified as a small business

The Bidder's signature on the Request for Small Business Preference or Non–Small Business Preference form certifies that the Bidder is certified as a small business at the date and time of bid or has submitted a complete application to the Department of General Services. The complete application and any required substantiating documentation must be received by the Department of General Services by 5:00 p.m. on the bid opening date.

The Department of General Services determines whether a bidder was certified on the bid opening date. The Department of Transportation confirms the Bidder's status as a small business before applying the small business preference.

The small business preference is a reduction for bid comparison in the total bid submitted by the small business contractor by the lesser of the following amounts:

1. 5 percent of the verified total bid of the low bidder
2. $50,000

If the Department determines that a certified small business bidder is the low bidder after the application of the small business preference, the Department does not consider a request for non–small business preference.

2-1.18C Non–Small Business Subcontractor Preference

The Department allows a bidder not certified as a small business by the Department of General Services, Office of Small Business and DVBE Services, a preference if:

1. Bidder submitted a completed Request for Small Business Preference or Non–Small Business Preference form with its bid
2. Certified Small Business Listing for the Non–Small Business Preference form shows that you are subcontracting at least 25 percent to certified small businesses

Each listed subcontractor and supplier must be certified as a small business at the date and time of bid or must have submitted a complete application to the Department of General Services. The complete application and any required substantiating documentation must be received by the Department of General Services by 5:00 p.m. on the bid opening date.

The non–small business subcontractor preference is a reduction for bid comparison in the total bid submitted by the non–small business contractor requesting the preference by the lesser of the following amounts:

1. 5 percent of the verified total bid of the low bidder
2. $50,000

2-1.19–2-1.26 RESERVED

2-1.27 CALIFORNIA COMPANIES

Section 2-1.27 applies to a non-federal-aid contract.

Under Pub Cont Code § 6107, the Department gives preference to a *California company*, as defined, for bid comparison purposes over a nonresident contractor from any state that gives or requires a preference to be given to contractors from that state on its public entity construction contracts.

Complete a California Company Preference form.

The California company's reciprocal preference amount is equal to the preference amount applied by the state of the nonresident contractor with the lowest responsive bid unless the California company is eligible for a small business preference or a non–small business subcontractor preference, in which case the preference amount is the greater of the two, but not both.

If the low bidder is not a California company and a California company's bid with reciprocal preference is equal to or less than the lowest bid, the Department awards the contract to the California company on the basis of its total bid.

2-1.28–2-1.30 RESERVED

2-1.31 OPT OUT OF PAYMENT ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS

You may opt out of the payment adjustments for price index fluctuations specified in section 9-1.07. To opt out, submit a completed Opt Out of Payment Adjustments for Price Index Fluctuations form under section 2-1.33.

2-1.32 RESERVED

2-1.33 BID DOCUMENT COMPLETION AND SUBMITTAL

2-1.33A General

Complete the forms in the *Bid* book.

Use the forms provided by the Department except as otherwise specified for a bidder's bond.

Do not fax forms except for the copies of forms with the public works contractor registration number submitted after the time of bid. Fax these copies to (916) 227-6282.

Failure to submit the forms and information as specified may result in a nonresponsive bid.

If an agent other than the authorized corporate officer or a partnership member signs the bid, file a Power of Attorney with the Department either before opening bids or with the bid. Otherwise, the bid may be nonresponsive.

Complete and submit the *Bid* book under the *Electronic Bidding Guide* at the Department's Office of Construction Contract Awards.

Your authorized digital signature is your confirmation of and agreement to all certifications and statements contained in the *Bid* book.

On forms and certifications that you submit through the electronic bidding service, you agree that each form and certification where a signature is required is deemed as having your signature.

2-1.33B Bid Form Submittal Schedules

2-1.33B(1) General

The *Bid* book includes forms specific to the contract. The deadlines for the submittal of the forms vary depending on the requirements of each contract. Determine the requirements of the contract and submit the forms based on the applicable schedule specified in section 2-1.33B.

Bid forms and information on the form that are due after the time of bid may be submitted at the time of bid.

2-1.33B(2) Federal-Aid Contracts

2-1.33B(2)(a) General

Section 2-1.33B(2) applies to a federal-aid contract.

2-1.33B(2)(b) Contracts with a DBE Goal

2-1.33B(2)(b)(i) General

Section 2-1.33B(2)(b) applies if a DBE goal is shown on the *Notice to Bidders*.

2-1.33B(2)(b)(ii) Non-Informal-Bid Contract

For a non-informal-bid contract, submit the bid forms according to the schedule shown in the following table:

03-03-17

Bid Form Submittal Schedule for a
Non-Informal Bid Federal-Aid Contract with a DBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid except for the public works contractor registration number
Copy of the Bid to the Department of Transportation as submitted at the time of bid with the public works contractor registration number	10 days after bid opening
Subcontractor List	Time of bid except for the public works contractor registration number
Copy of the Subcontractor List as submitted at the time of bid with the public works contractor registration number	10 days after bid opening
Small Business Status	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid
DBE Commitment	No later than 4 p.m. on the 5th day after bid opening[b]
DBE Confirmation	No later than 4 p.m. on the 5th day after bid opening[b]
DBE Good Faith Efforts Documentation	No later than 4 p.m. on the 5th day after bid opening[b]

[a]Submit only if you choose the option.
[b]If the last day for submitting the bid form falls on a Saturday or holiday, it may be submitted on the next business day with the same effect as if it had been submitted on the day specified.

12-02-16

2-1.33B(2)(b)(iii) Informal-Bid Contract

For an informal-bid contract, submit the bid forms according to the schedule shown in the following table:

03-03-17

Bid Form Submittal Schedule for an
Informal-Bid Federal-Aid Contract with a DBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid
Subcontractor List	Time of bid
Small Business Status	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid
DBE Commitment	No later than 4 p.m. on the 5th day after bid opening[b]
DBE Confirmation	No later than 4 p.m. on the 5th day after bid opening[b]
DBE Good Faith Efforts Documentation	No later than 4 p.m. on the 5th day after bid opening[b]

[a]Submit only if you choose the option.
[b]If the last day for submitting the bid form falls on a Saturday or holiday, it may be submitted on the next business day with the same effect as if it had been submitted on the day specified.

12-02-16

2-1.33B(2)(c) Contracts without a DBE Goal

2-1.33B(2)(c)(i) General

Section 2-1.33B(2)(c) applies if a DBE goal is not shown on the *Notice to Bidders*.

2-1.33B(2)(c)(ii) Non-Informal-Bid Contract

For a non-informal-bid contract, submit the bid forms according to the schedule shown in the following table:

Bid Form Submittal Schedule for a Non-Informal-Bid Federal-Aid Contract without a DBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid except for the public works contractor registration number
Copy of the Bid to the Department of Transportation as submitted at the time of bid with the public works contractor registration number	10 days after bid opening
Subcontractor List	Time of bid except for the public works contractor registration number
Copy of the Subcontractor List as submitted at the time of bid with the public works contractor registration numbers	10 days after bid opening
Small Business Status	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid

[a]Submit only if you choose the option.

2-1.33B(2)(c)(iii) Informal-Bid Contract

For an informal-bid contract, submit the bid forms according to the schedule shown in the following table:

Bid Form Submittal Schedule for an Informal-Bid Federal-Aid Contract without a DBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid
Subcontractor List	Time of bid
Small Business Status	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid

[a]Submit only if you choose the option.

2-1.33B(2)(d)–2-1.33B(2)(h) Reserved

2-1.33B(3) Non-Federal-Aid Contracts

2-1.33B(3)(a) General

Section 2-1.33B(3) applies to non-federal-aid contracts.

2-1.33B(3)(b) Contracts with a DVBE Goal

2-1.33B(3)(b)(i) General

Section 2-1.33B(3)(b) applies if a DVBE goal is shown on the *Notice to Bidders*.

2-1.33B(3)(b)(ii) Non-Informal-Bid Contract

For a non-informal-bid contract, submit the bid forms according to the schedule shown in the following table:

Bid Form Submittal Schedule for a
Non-Informal-Bid Non-Federal-Aid Contract with a DVBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid except for the public works contractor registration number for a joint-venture contract
For a joint-venture contract, copy of the Bid to the Department of Transportation as submitted at the time of bid with the public works contractor registration number	10 days after bid opening
Subcontractor List	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid
Certified DVBE Summary	No later than 4 p.m. on the 4th business day after bid opening
California Company Preference	Time of bid
Request for Small Business Preference or Non–Small Business Preference[a]	Time of bid
Certified Small Business Listing for the Non–Small Business Preference[a]	No later than 4 p.m. on the 2nd business day after bid opening

[a]Submit only if you choose the option or preference.

2-1.33B(3)(b)(iii) Informal-Bid Contract

For an informal-bid contract, submit the bid forms according to the schedule shown in the following table:

Bid Form Submittal Schedule for an
Informal-Bid Non-Federal-Aid Contract with a DVBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid
Subcontractor List	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid
Certified DVBE Summary	Time of bid
California Company Preference	Time of bid
Request for Small Business Preference or Non–Small Business Preference[a]	Time of bid
Certified Small Business Listing for the Non–Small Business Preference[a]	Time of bid

[a]Submit only if you choose the option or preference.

2-1.33B(3)(c) Contracts without a DVBE Goal

2-1.33B(3)(c)(i) General

Section 2-1.33B(3)(c) applies if a DVBE goal is not shown on the *Notice to Bidders*.

2-1.33B(3)(c)(ii) Non-Informal-Bid Contract

For a non-informal-bid contract, submit the bid forms according to the schedule shown in the following table:

Bid Form Submittal Schedule for a
Non-Informal-Bid Non-Federal-Aid Contract without a DVBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid except for the public works contractor registration number for a joint-venture contract
For a joint-venture contract, copy of the Bid to the Department of Transportation as submitted at the time of bid with the public works contractor registration number	10 days after bid opening
Subcontractor List	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid
California Company Preference	Time of bid
Certified DVBE Summary[b]	No later than 4 p.m. on the 4th business day after bid opening
Request for Small Business Preference or Non–Small Business Preference[a]	Time of bid
Certified Small Business Listing for the Non–Small Business Preference[a]	No later than 4 p.m. on the 2nd business day after bid opening

[a]Submit only if you choose the option or preference.
[b]Submit only if you obtain DVBE participation or you are the apparent low bidder, 2nd low bidder, or 3rd low bidder and you choose to receive the specified incentive.

2-1.33B(3)(c)(iii) Informal-Bid Contract

For an informal-bid contract, submit the bid forms according to the schedule shown in the following table:

Bid Form Submittal Schedule for an
Informal-Bid Non-Federal-Aid Contract without a DVBE Goal

Form	Submittal deadline
Bid to the Department of Transportation	Time of bid
Subcontractor List	Time of bid
Opt Out of Payment Adjustments for Price Index Fluctuations[a]	Time of bid
Certified DVBE Summary[b]	Time of bid
Request for Small Business Preference or Non–Small Business Preference[a]	Time of bid
Certified Small Business Listing for the Non–Small Business Preference[a]	Time of bid

[a]Submit only if you choose the option or preference.
[b]Submit only if you obtain DVBE participation or you are the apparent low bidder, 2nd low bidder, or 3rd low bidder and you choose to receive the specified incentive.

2-1.33B(3)(d)–2-1.33B(3)(h) Reserved

2-1.33B(4)–2-1.33B(9) Reserved

2-1.34 BIDDER'S SECURITY

Submit one of the following forms of bidder's security equal to at least 10 percent of the bid:

1. Cash
2. Cashier's check
3. Certified check
4. Signed bidder's bond by an admitted surety insurer
5. Electronic bidder's bond by an admitted surety insurer submitted using an electronic registry service approved by the Department

Submit cash, cashier’s check, certified check, or bidder's bond to the Department's Office of Construction Contract Awards before the bid opening time.

Submit an electronic bidder's bond with the electronic bid.

If using a bidder's bond, you may use the form in the *Bid* book. If you do not use the form in the *Bid* book, use a form containing the same information.

2-1.35–2-1.39 RESERVED

2-1.40 BID WITHDRAWAL

Bids are not filed with the Department until the date and time of bid opening.

A bidder may withdraw or revise a bid after it has been submitted to the electronic bidding service if this is done before the bid opening date and time.

2-1.41–2-1.42 RESERVED

2-1.43 BID OPENING

The Department publicly opens and reads bids at the time and place shown on the *Notice to Bidders*.

2-1.44–2-1.45 RESERVED

2-1.46 DEPARTMENT'S DECISION ON A BID

The Department's decision on the bid amount is final.

The Department may reject:

1. All bids
2. A nonresponsive bid

07-21-17

3. A bid from any entity that is a parent, affiliate, or subsidiary, or that is under common ownership, control, or management with any other entity submitting a bid on the project

12-02-16

2-1.47 BID RELIEF

The Department may grant bid relief under Pub Cont Code § 5100 et seq. Submit any request for bid relief to the Office Engineer. The Relief of Bid Request form is available at the Department's website.

2-1.48 RESERVED

2-1.49 SUBMITTAL FAILURE HISTORY

The Department considers a bidder's past failure to submit documents required after bid opening in determining a bidder's responsibility.

2-1.50 BID RIGGING

Section 2-1.50 applies to a federal-aid contract.

The US Department of Transportation (DOT) provides a toll-free hotline to report bid rigging activities. Use the hotline to report bid rigging, bidder collusion, and other fraudulent activities. The hotline number is (800) 424-9071. The service is available 24 hours 7 days a week and is confidential and anonymous. The hotline is part of the DOT's effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General.

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5 CONTROL OF WORK

04-20-18

Replace section 5-1.12 with:

01-20-17

5-1.12 ASSIGNMENT

The performance of the Contract or any Contract part may be assigned only with prior written consent from the Department. To request consent, submit a Contractor Action Request - Assignment of Contract

Performance form. The Department does not consent to any requested assignment that would relieve you or your surety of the responsibility to complete the work or any part of the work.

If you assign the right to receive Contract payments, the Department accepts the assignment upon the Engineer's receipt of a Contractor Action Request - Assignment of Contract Monies, Assignee Change of Name/Address form. Assigned payments remain subject to deductions and withholds described in the Contract. The Department may use withheld payments for work completion whether the payments are assigned or not.

Add to section 5-1.13B:

07-21-17

5-1.13B(3) Use of Joint Checks

You may use a joint check between the Contractor or lower-tier subcontractor and a DBE subcontractor purchasing materials from a material supplier if you obtain prior approval from the Department for your proposed use of joint checks upon submittal of a DBE Joint Check Agreement Request form.

To use a joint check, the following conditions must be met:

1. All parties, including the Contractor, must agree to the use of a joint check
2. Entity issuing the joint check acts solely to guarantee payment
3. DBE must release the check to the material supplier
4. Department must authorize the request before implementation
5. Any party to the agreement must provide requested documentation within 10 days of the Department's request for the documentation
6. Agreement to use a joint check must be short-term, not to exceed 1 year, allowing sufficient time needed to establish or increase a credit line with the material supplier

A request for a joint check agreement may be initiated by any party.

If a joint check is used, the DBE remains responsible for all elements of 49 CFR 26.55(c)(1).

Failure to comply with section 5-1.13B(3) disqualifies DBE participation and results in no credit and no payment to the Contractor for DBE participation.

A joint check may not be used between the Contractor or subcontractor and a DBE regular dealer, bulk material supplier, manufacturer, wholesaler, broker, trucker, packager, manufacturer’s representative, or other persons who arrange or expedite transactions.

Replace section 5-1.20E with:

04-20-18

5-1.20E Water Meter Charges

Reserved

01-20-17

Delete item 1 in the list in the paragraph of section 5-1.23C.

Replace section 5-1.36 with:

01-20-17

5-1.36 PROPERTY AND FACILITY PRESERVATION

5-1.36A General

Preserve and protect:

1. Highway improvements and facilities
2 Adjacent property

3. Waterways
4. ESAs
5. Lands administered by other agencies
6. Railroads and railroad equipment
7. Nonhighway facilities, including utilities
8. Survey monuments
9. Department's instrumentation
10 Temporary work
11. Roadside vegetation not to be removed

Comply with Govt Code § 4216 et seq. Notify the Engineer at least 3 business days before you contact the regional notification center. Failure to contact the notification center prohibits excavation.

Immediately report damage to the Engineer.

If you cause damage, you are responsible.

The Department may make a temporary repair to restore service to a damaged facility.

Install suitable safeguards to preserve and protect facilities from damage.

Install temporary facilities, such as sheet piling, cribbing, bulkheads, shores, or other supports, necessary to support existing facilities or to support material carrying the facilities.

5-1.36B Railroad Property

If working on or adjacent to railroad property, do not interfere with railroad operations.

For an excavation on or affecting railroad property, submit work plans showing the system to be used to protect the railroad facilities. Instead of the 15 days specified in section 5-1.23B, allow 65 days for the review of the plans.

If the Contract does not include an agreement with a railroad company, do not allow personnel or equipment on railroad property.

Prevent material, equipment, and debris from falling onto railroad property.

5-1.36C Nonhighway Facilities

5-1.36C(1) General

Before starting work that could damage or interfere with underground infrastructure, locate the infrastructure described in the Contract, including laterals and other appurtenances, and determine the presence of other underground infrastructure inferred from visible facilities, such as buildings, meters, and junction boxes.

Underground infrastructure described in the Contract may be in different locations from those described, and additional infrastructure may exist.

Upon discovering an underground main or trunk line not described in the Contract, immediately notify the Engineer and the infrastructure owner. The Engineer orders the locating and protecting of the infrastructure. The locating and protecting is change order work. If ordered, repair infrastructure damage. If the damage is not due to your negligence, the repair is change order work.

Immediately notify the Engineer of a delay due to the presence of main-line underground infrastructure not described in the Contract or in a substantially different location.

Notify the Engineer if the infrastructure described in the Contract cannot be found. If after giving the notice, you find the infrastructure in a substantially different location from that described, finding the infrastructure is change order work.

5-1.36C(2) Nonhighway Facility Protection

Reserved

5-1.36C(3) Nonhighway Facility Rearrangement

The Department may rearrange a nonhighway facility during the Contract. Rearrangement of a nonhighway facility includes installation, relocation, alteration, or removal of the facility.

The Department may authorize facility owners and their agents to enter the highway to perform rearrangement work for their facilities or to make connections or repairs to their property. Coordinate activities to avoid delays.

If necessary rearrangement of underground infrastructure is not described in the Contract, the Engineer may order you to perform the work. The rearrangement is change order work.

Immediately notify the Engineer of a delay due to a rearrangement different from that described in the Contract.

If you want infrastructure rearrangement different from that described in the Contract:

1. Notify the Engineer
2. Make an arrangement with the infrastructure owner
3. Obtain authorization for the rearrangement
4. Pay the infrastructure owner any additional cost

The Department does not adjust time or payment for a rearrangement different from that described the Contract.

5-1.36D Survey Monuments

Protect survey monuments on and off the highway. Upon discovery of a survey monument not identified and located by the Department, immediately:

1. Stop work near the monument
2. Notify the Engineer

Do not resume work near the monument until authorized.

5-1.36E Landscape

If you damage plants not to be removed:

1. Dispose of them unless the Engineer authorizes you to reduce them to chips and spread the chips within the highway at locations designated by the Engineer
2. Replace them

Replace plants with plants of the same species.

Replace trees with 24-inch-box trees.

Replace shrubs with no. 15-container shrubs.

Replace ground cover plants with plants from flats. Replace *Carpobrotus* ground cover plants with plants from cuttings. Plant ground cover plants 1 foot on center.

If a plant establishment or permanent erosion control establishment period is specified, replace plants before the start of the plant establishment or permanent erosion control establishment period; otherwise, replace plants at least 30 days before Contract acceptance.

Water each plant immediately after planting. Saturate the backfill soil around and below the roots or the ball of earth around the roots of each plant. Water as necessary to maintain plants in a healthy condition until Contract acceptance.

07-21-17

5-1.36F Irrigation Facilities

Keep existing irrigation facilities in place that are described to be removed, relocated, or modified until the Engineer determines they are no longer needed.

Maintain the existing water supply. If the existing water supply is interrupted for more than 3 consecutive days, provide an alternative water supply. Water the existing plants in the area irrigated from that water supply, including those maintained by the Department, as necessary to maintain healthy plant growth.

If you and the Department irrigate existing plants from the same water supply, furnish enough water to the Department for watering plantings on and off the highway as necessary to maintain a healthy condition through Contract acceptance.

If you damage irrigation facilities not to be removed:

1. Remove and dispose of them.
2. Repair and replace damaged facilities within 10 days.
3. Use similar commercial-quality components from the same manufacturer or components that are compatible with the existing irrigation system if authorized.
4. After completing the repair or replacement of the facilities, perform an operational test in the presence of the Engineer. If you repair or replace the remote control valves, conduct the test with the irrigation controller in the automatic mode.

Notify the Engineer:

1. At least 4 business days before shutting off the water supply to any portion of the existing irrigation system
2. Immediately after restoring the water supply to any portion of the existing irrigation system

Add to the end of the 1st paragraph of section 5-1.39C(1):

01-20-17

or permanent erosion control establishment

Replace section 5-1.43E with:

01-20-17

5-1.43E Alternative Dispute Resolution

5-1.43E(1) General

5-1.43E(1)(a) General

Section 5-1.43E applies to a contract with 100 or more original working days.

The ADR process must be used for the timely resolution of disputes that arise out of the work.

You must comply with section 5-1.43E to pursue a claim, file for arbitration, or file for litigation.

The ADR process is not a substitute for submitting an RFI or a potential claim record.

Do not use the ADR process for disputes between you and subcontractors or suppliers that have no grounds for a legal action against the Department. If you fail to comply with section 5-1.43 for a potential claim on behalf of a subcontractor or supplier, you release the Department of the subcontractor's or supplier's potential claim.

Do not use the ADR process for quantification of disputes for overhead expenses or costs. For a dispute for overhead expenses or costs, comply with section 9-1.17D.

Each party and the DRA or DRB must complete the Dispute Resolution Advisor Agreement form or Dispute Resolution Board Agreement form and comply with the provisions of the agreement. For these forms, go to the Department's Division of Construction website.

No DRA- or DRB-related meetings are allowed until each party and the DRA or DRB, execute the agreement. However, each party and the DRA or DRB, may agree to sign and execute the agreement at the 1st meeting.

5-1.43E(1)(b) Definitions

dispute meeting: Traditional and informal dispute meeting.

DRA: 1-member board established by the parties to assist in resolving disputes.

DRB: 3-member board established by the parties to assist in resolving disputes.

party: You or the Department.

1. **the parties:** You and the Department jointly.
2. **each party:** You and the Department severally.

outside technical services: Consultants with no prior direct involvement in the Contract.

5-1.43E(1)(c) Establishment of Procedures

Upon selecting the DRA or DRB, the parties must meet with the DRA or DRB to establish and agree to procedures for:

1. Submitting documents
2. Conducting hearings
3. Providing recommendations
4. Associated tasks

The established procedures must comply with the Contract and the Dispute Resolution Advisor Agreement or Dispute Resolution Board Agreement. The procedures need not comply with laws of evidence.

5-1.43E(1)(d) Progress Meetings

The parties must periodically meet with the DRA or DRB at the job site so the DRA or DRB members can keep abreast of construction activities and become familiar with the work in progress.

The meetings must be held at the start of job site activities and at least once every 3 months after that.

The parties must attend each meeting.

The parties may agree to waive the scheduled meetings when the only work remaining is plant establishment work or permanent erosion control establishment work.

5-1.43E(1)(e) Dispute Meetings

You must follow the traditional dispute meeting process to pursue a potential claim.

Either party may refer a dispute to the DRA or DRB. To request a dispute meeting, a party must submit a copy of the referral and supporting documentation to the DRA or DRB. The documentation must describe the dispute in individual discrete segments such that resolved and unresolved segments are differentiated. The party must include an estimate of the cost of the affected work and impacts to the work completion date.

A copy of all documents submitted to the DRA or DRB must be simultaneously submitted to the other party.

The Department furnishes the DRA or DRB with the Contract documents and provides meeting facilities at no cost to you.

Neither party may meet with or discuss Contract issues with the DRA or DRB members unless the other party is present.

If the dispute involves a subcontractor, the subcontractor's superintendent or project manager must attend the meeting.

Only the following persons are allowed to participate and present information at the meeting:

1. Engineer
2. Department's area construction engineer

3. Department's structure representative.
4. Your superintendent
5. Your project manager
6. Either party's employees that have direct knowledge of the dispute and direct involvement in the project
7. Consultants directly involved in the development of the estimate or construction
8. Subcontractor's superintendent or project manager if the dispute involves a subcontractor

The following persons are not allowed to attend the meeting:

1. Attorneys
2. Claim consultants
3. Outside technical services not employed by either party unless requested by the DRA or DRB

If the DRA or DRB needs outside technical services to help the DRA or DRB make a recommendation, the parties must agree to the services before they are provided. If the parties and the DRA or DRB agree, the technical services may be provided by technical staff who works for either party.

During a dispute meeting, each party presents its position, makes rebuttals, furnishes relevant documents, and responds to DRA or DRB questions and requests. The following is not allowed:

1. Testimony under oath
2. Cross-examination
3. Reporting of the procedures by a shorthand reporter or by electronic means

If either party fails to attend a dispute meeting, all documents submitted by the nonattending party is considered as the nonattending party's entire position, and the DRA or DRB and the attending party may proceed with the dispute process.

5-1.43E(1)(f) Informal Dispute Meetings

The parties may resolve small and uncomplicated disputes using an informal process. The parties may use this process only if the parties and the DRA or DRB agree its use is appropriate for resolving the dispute.

The informal dispute meeting process is independent from the traditional process. The Department does not grant time extensions for the traditional dispute process if the informal dispute process is used.

Each party furnishes the DRA or DRB a 1-page brief description of the dispute with supporting documentation and any additional information requested by the DRA or DRB.

In an informal dispute meeting, each party presents its position and receives the DRA's or DRB's recommendation orally on the same day the dispute is heard. The DRA or DRB furnishes a 1-page report confirming the recommendation within 5 business days.

Either party may ask for clarification of the DRA's or DRB's recommendation at the dispute meeting.

If the dispute remains unresolved, the parties must notify the DRA or DRB within 5 business days after receipt of the DRA's or DRB's written confirmation of the recommendation.

The DRA or DRB will not be bound by its informal recommendation if a dispute is later heard in a traditional dispute meeting.

If the dispute is not resolved using the informal dispute meeting process, the parties must comply with the traditional dispute meeting specifications.

5-1.43E(1)(g) Recommendations

Recommendations resulting from the ADR process are nonbinding.

If the parties resolve the dispute with the aid of the DRA's or DRB's recommendation, the parties must implement the resolution.

5-1.43E(1)(h) Completion of Alternative Dispute Resolution

All ADR activities must be completed before Contract acceptance. Accelerated timeframes may be used if the parties and the DRA or DRB agree.

If a dispute becomes an unresolved claim after Contract acceptance, comply with section 9-1.17D(2).

Neither party may call the DRA or DRB members who served on the Contract as a witness in arbitration or other proceedings that may arise from the Contract.

The parties must indemnify and hold harmless the DRA or DRB members from and against all claims, damages, losses, and expenses, including attorney's fees, arising out of and resulting from the findings and recommendations of the DRA or DRB.

5-1.43E(1)(i) Payment

Pay the DRA or each DRB member $2,000 per day for the DRA's or DRB's participation at each on-site meeting except if the DRA or a DRB member serves on more than 1 Department DRA or DRB, the $2,000 must be divided evenly among the contracts.

On-site meetings include:

1. Initial project meeting
2. Progress meetings
3. Dispute meetings

The payment includes full compensation for on-site time, travel expenses, transportation, lodging, travel time, and incidentals for each day or portion thereof the DRA or DRB member is at a DRA or DRB meeting.

Before a DRA or DRB member spends any time reviewing the plans or specifications, evaluating positions, preparing recommendations, completing forms, or performs any other off-site DRA- or DRB-related tasks, the parties must agree to pay for the tasks. Pay the DRA or DRB member $200 per hour for these tasks. This payment includes full compensation for incidentals such as expenses for telephone, fax, and computer services.

The Department reimburses you for 1/2 of the invoiced costs to the DRA or DRB and 1/2 of the costs of any outside technical services. Submit a change order bill and associated invoices with the original supporting documents in the form of a canceled check or bank statement to receive reimbursement. Do not add mark-ups to the change order bill.

The Department does not pay for (1) any DRA- or DRB-related work performed after Contract acceptance or (2) your cost of preparing for or attending ADR resolution meetings.

5-1.43E(2) Dispute Resolution Advisor

5-1.43E(2)(a) General

Section 5-1.43E(2) applies to a contract with a total bid from $3 million to $10 million.

5-1.43E(2)(b) DRA Selection

Within 30 days after Contract approval, the parties must select the DRA using the following procedure:

1. Each party nominates 3 DRA member candidates. Each candidate must be (1) on the Department's Dispute Resolution Advisor Candidates List at the Department's Division of Construction website or (2) must:
   - 1.1. Be knowledgeable in the type of construction and contract documents anticipated by the Contract
   - 1.2. Have completed training by the Dispute Resolution Board Foundation
   - 1.3. Have served on at least 3 dispute resolution boards on a Department contract as a member or at least 2 dispute resolution boards on a Department contract as the chairman
   - 1.4. Have no prior direct involvement on the Contract
   - 1.5. Have no financial interest in the Contract or with the parties, subcontractors, suppliers, consultants, or associated legal or business services within 6 months before award and during the Contract except for payments for Department DRA or DRB services or payments for

retirement or pensions from either party not tied to, dependent on, or affected by the net worth of the party

2. The parties must request a disclosure statement from each nominated DRA candidate and must furnish them to the other party. Each statement must include:
   - 2.1. Resume of the candidate's experience
   - 2.2. Declaration statement that describes past, present, anticipated, and planned professional or personal relationships with each of the following:
     - 2.2.1. Each party involved in the Contract
     - 2.2.2. Each parties' principals
     - 2.2.3. Each parties' counsel
     - 2.2.4. Associated subcontractors and suppliers
3. The parties must select 1 of the 6 candidates to be the DRA. If the parties cannot agree on 1 candidate, each party must select 1 of the 3 nominated by the other and the DRA is decided between the 2 candidates by a coin toss.

5-1.43E(2)(c) DRA Replacement

The services of the DRA may end at any time with a notice of at least 15 days if either of the following occurs:

1. DRA resigns.
2. Either party replaces the DRA for failing to comply with the required employment or financial disclosure conditions of the DRA as described in the Contract and the Dispute Resolution Advisor Agreement.

A DRA replacement is selected the same way as the original DRA. The selection of a replacement DRA must start upon determination of the need for a replacement and must be completed within 15 days. The Dispute Resolution Advisor Agreement must be amended to reflect the change of the DRA.

5-1.43E(2)(d) DRA Traditional Dispute Meeting

If you choose to pursue a potential claim, refer the dispute to the DRA within 5 business days after receiving the Engineer's response to your Supplemental Potential Claim Record. The dispute meeting must be held no later than 25 days after the DRA receives the referral unless the parties otherwise agree.

At least 10 days before the scheduled dispute meeting, each party must furnish the DRA documentation that supports its position and any additional information requested by the DRA.

If the DRA requests additional information within 5 business days after the dispute meeting, the party receiving the request must furnish this information within 5 business days after receiving the request.

The DRA furnishes a written recommendation within 10 days after the dispute meeting unless the parties agree to allow more time.

Within 5 business days after receiving the DRA's recommendation, either party may request clarification of any part of the recommendation. Only 1 request for clarification from each party is allowed per dispute.

Within 10 days after receiving the DRA's recommendation, each party must furnish a written response to the DRA indicating acceptance or rejection of the recommendation. If a party rejects the recommendation and has new information that supports its position, the party may request reconsideration. The reconsideration request must be made within 10 days after receiving the DRA’s recommendation. Only 1 reconsideration request from each party is allowed per dispute.

If the parties accept the DRA's recommendation but cannot agree on the time or payment adjustment within 30 days after accepting the recommendation, either party may request that the DRA recommend an adjustment.

5-1.43E(3) Dispute Resolution Board

5-1.43E(3)(a) General

Section 5-1.43E(3) applies to a contract with a total bid of over $10 million.

5-1.43E(3)(b) DRB Member Selection

Within 45 days after Contract approval, the parties must select DRB members and establish the DRB using the following procedure:

1. Each party nominates a DRB member candidate. Each candidate must be (1) on the Department's Dispute Resolution Candidates List at the Department's Division of Construction website or (2) must:
   1.1. Be knowledgeable in the type of construction and contract documents anticipated by the Contract
   1.2. Have completed training by the Dispute Resolution Board Foundation
   1.3. Have no prior direct involvement on the Contract
   1.4. Have no financial interest in the Contract or with the parties, subcontractors, suppliers, consultants, or associated legal or business services within 6 months before award and during the Contract except for payments for Department DRA or DRB services or payments for retirement or pensions from either party not tied to, dependent on, or affected by the net worth of the party
2. The parties must request a disclosure statement from each nominated DRB member candidate and must each furnish it to the other party. Each statement must include:
   2.1. Resume of the candidate's experience
   2.2. Declaration statement that describes past, present, anticipated, and planned professional or personal relationships with each of the following:
      2.2.1. Each party involved in the Contract
      2.2.2. Each parties' principals
      2.2.3. Each parties' counsel
      2.2.4. Associated subcontractors and suppliers
3. The parties are allowed:
   3.1. One-time objection to the other's candidate without stating a reason
   3.2. Objection to any of the other's subsequent candidates based on a specific breach of the candidate's responsibilities or qualifications under items 1 and 2 above
4. If either party objects to the other's candidate, the party whose candidate was objected to must nominate another DRB candidate within 15 days.
5. The 1st candidate from a party that receives no objection becomes that party's DRB member.
6. Each party furnishes written notification to the selected DRB member.
7. Within 15 days after their notifications, the selected DRB members recommend to the parties the 3rd DRB member candidate and furnish that candidate's disclosure statement.
8. Within 15 days after the recommendation, each party must notify the first 2 DRB members whether the party approves or disapproves of the recommended 3rd DRB member candidate.
9. If the 2 DRB members cannot agree on the 3rd DRB candidate, they will submit a list of candidates to the parties for the final selection and approval.
10. If (1) the 2 DRB members do not recommend a 3rd DRB candidate within 15 days of notification of their selections, (2) the parties do not agree on the 3rd DRB member candidate within 15 days after the recommendation, or (3) the parties do not agree on any of the candidates on the list furnished by the first 2 selected DRB members, each party must select 3 candidates from the current list of arbitrators certified by the Public Works Contract Arbitration Committee established by Pub Cont Code § 10245 et seq. who will be willing to serve as a DRB member. The first 2 selected DRB members must select the 3rd member in a blind draw of these 6 candidates.
11. The 3 DRB members then decide which of the 3 will act as the DRB chairman. If the parties do not agree with the selected chairman, the 3rd member will act as the DRB chairman.

5-1.43E(3)(c) DRB Member Replacement

The services of a DRB member may end at any time with a notice of at least 15 days if any of the following occurs:

1. A member resigns
2. The Department replaces its selected member
3. You replace your selected member
4. The Department's and your selected members replace the 3rd member
5. Either party replaces any member for failing to comply with the required employment or financial disclosure conditions of the DRB membership as described in the Contract and in the Dispute Resolution Board Agreement.

Replacing any DRB member must be accomplished by written notification to the DRB and the other party with substantiation for replacing the member.

A replacement DRB member is selected the same way as the original DRB member. The selection of a replacement DRB member must start upon determination of the need for a replacement and must be completed within 15 days. The Dispute Resolution Board Agreement must be amended to reflect the change to the DRB.

5-1.43E(3)(d) DRB Traditional Dispute Meeting

If you choose to pursue a potential claim, refer the dispute to the DRB within 21 days after receiving the Engineer's response to your Supplemental Potential Claim Record unless a facilitated dispute resolution is included in the signed original partnering charter, in which case, make the referral within 41 days after receiving the response. The dispute meeting must be held no sooner than 30 days and no later than 60 days after the DRB receives the referral unless the parties otherwise agree.

At least 15 days before the scheduled dispute meeting, each party must provide the DRB documentation that supports its position and any additional information requested by the DRB.

If the DRB requests additional information at the dispute meeting, the party receiving the request must provide this information within 10 days after receiving the request.

The DRB furnish a written recommendation report within 30 days after the dispute meeting unless the parties agree to allow more time.

Within 10 days after receiving the DRB's recommendation report, either party may request clarification of any part of the recommendation. Only 1 request for clarification from each party is allowed per dispute.

Within 30 days after receiving the DRB's recommendation, each party must furnish a written response to the DRB indicating acceptance or rejection of the recommendation. If a party rejects the recommendation, the party must include a list of specific reasons for the rejection. If a party has new information that supports its position, the party may request a reconsideration. The reconsideration request must be made within 30 days after receiving the DRB's recommendation. Only 1 request for reconsideration from each party is allowed per dispute.

If the parties accept the DRB's recommendation but cannot agree on the time or payment adjustment within 60 days after accepting the recommendation, either party may request that the DRB recommend an adjustment.

^^

6 CONTROL OF MATERIALS

07-21-17

Replace *METS website* in the last sentence in the last paragraph of section 6-2.01B with:

07-21-17

Authorized Facility Audit List website

Replace *METS website* in the last sentence in the last paragraph of section 6-2.01C with:

07-21-17

Authorized Material List website

Replace *METS website* in the last sentence in the last paragraph of section 6-2.01D with:

07-21-17

Authorized Material Source List website

^^

7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

04-20-18

Replace the paragraphs in section 7-1.02I(2) with:

05-06-16

Under 2 CA Code of Regs § 11105:

1. During the performance of this contract, the recipient, contractor, and its subcontractors shall not deny the contract's benefits to any person on the basis of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status, nor shall they discriminate unlawfully against any employee or applicant for employment because of race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status. Contractor shall insure that the evaluation and treatment of employees and applicants for employment are free of such discrimination.
2. Contractor shall comply with the provisions of the Fair Employment and Housing Act (Gov. Code, § 12900 et seq.), the regulations promulgated thereunder (Cal. Code Regs., tit. 2, § 11000 et seq.), the provisions of Article 9.5, Chapter 1, Part 1, Division 3, Title 2 of the Government Code (Gov. Code, §§ 11135-11139.5), and the regulations or standards adopted by the awarding state agency to implement such article.
3. Contractor or recipient shall permit access by representatives of the Department of Fair Employment and Housing and the awarding state agency upon reasonable notice at any time during the normal business hours, but in no case less than 24 hours' notice, to such of its books, records, accounts, and all other sources of information and its facilities as said Department or Agency shall require to ascertain compliance with this clause.
4. Recipient, contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.
5. The contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.

Under 2 CA Code of Regs § 11122:

STANDARD CALIFORNIA NONDISCRIMINATION CONSTRUCTION CONTRACT SPECIFICATIONS (GOV. CODE SECTION 12990)

These specifications are applicable to all state contractors and subcontractors having a construction contract or subcontract of $5,000 or more.

1. As used in the specifications:
   a. "Act" means the Fair Employment and Housing Act.
   b. "Administrator" means Administrator, Office of Compliance Programs, California Department of Fair Employment and Housing, or any person to whom the Administrator delegates authority;
2. Whenever the contractor or any subcontractor subcontracts a portion of the work, it shall include in each subcontract of $5,000 or more the nondiscrimination clause in this contract directly or through incorporation by reference. Any subcontract for work involving a construction trade shall also include the Standard California Construction Contract Specifications, either directly or through incorporation by reference.
3. The contractor shall implement the specific nondiscrimination standards provided in paragraphs 6(a) through (e) of these specifications.
4. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the contractor has a collective bargaining agreement, to refer members of any group protected by the Act shall excuse the contractor's obligations under these specifications, Government Code section 12990, or the regulations promulgated pursuant thereto.5. In order for the nonworking training hours of apprentices and trainees to be counted, such apprentices and trainees must be employed by the

contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor or the California Department of Industrial Relations.

5. In order for the nonworking training hours of apprentices and trainees to be counted, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor or the California Department of Industrial Relations.
6. The contractor shall take specific actions to implement its nondiscrimination program. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor must be able to demonstrate fully its efforts under steps a. through e. below:
   a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and at all facilities at which the contractor's employees are assigned to work. The contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the contractor's obligations to maintain such a working environment.
   b. Provide written notification within seven days to the director of the DFEH when the referral process of the union or unions with which the contractor has a collective bargaining agreement has impeded the contractor's efforts to meet its obligations.
   c. Disseminate the contractor's equal employment opportunity policy by providing notice of the policy to unions and training, recruitment and outreach programs and requesting their cooperation in assisting the contractor to meet its obligations; and by posting the company policy on bulletin boards accessible to all employees at each location where construction work is performed.
   d. Ensure all personnel making management and employment decisions regarding hiring, assignment, layoff, termination, conditions of work, training, rates of pay or other employment decisions, including all supervisory personnel, superintendents, general foremen, on-site foremen, etc., are aware of the contractor's equal employment opportunity policy and obligations, and discharge their responsibilities accordingly.
   e. Ensure that seniority practices, job classifications, work assignments, and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the equal employment opportunity policy and the contractor's obligations under these specifications are being carried out.
7. Contractors are encouraged to participate in voluntary associations that assist in fulfilling their equal employment opportunity obligations. The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on equal employment opportunity in the industry, ensures that the concrete benefits of the program are reflected in the contractor's workforce participation, and can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's.
8. The contractor is required to provide equal employment opportunity for all persons. Consequently, the contractor may be in violation of the Fair Employment and Housing Act (Government Code section 12990 et seq.) if a particular group is employed in a substantially disparate manner.
9. The contractor shall not use the nondiscrimination standards to discriminate against any person because race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, genetic information, marital status, sex, gender, gender identity, gender expression, age, sexual orientation, or military and veteran status.
10. The contractor shall not enter into any subcontract with any person or firm decertified from state contracts pursuant to Government Code section 12990.
11. The contractor shall carry out such sanctions and penalties for violation of these specifications and the nondiscrimination clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Government Code section 12990 and its implementing regulations by the awarding agency. Any contractor who fails to carry out such

sanctions and penalties shall be in violation of these specifications and Government Code section 12990.

12. The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company equal employment opportunity policy is being carried out, to submit reports relating to the provisions hereof as may be required by OCP and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, status, (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in any easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

Add to the end of the 2nd sentence in the 1st paragraph of section 7-1.02K(1):

04-22-16

, and hauling and delivery of ready-mixed concrete.

Add between the 4th and 5th paragraphs of section 7-1.02K(3):

04-22-16

Submitted certified payrolls for hauling and delivering ready-mixed concrete must be accompanied by a written time record. The time record must include:

1. Truck driver's full name and address
2. Name and address of the factory or batching plant
3. Time the concrete was loaded at the factory or batching plant
4. Time the truck returned to the factory or batching plant
5. Truck driver's signature certifying under penalty of perjury that the information contained in this written time record is true and correct

Add between the 1st and 2nd paragraphs of section 7-1.02K(6)(a)

04-20-18

You must contact the local public health service department for information concerning public health conditions within the area of the project.

Add to the end of section 7-1.02K(6)(a):

04-20-18

The Department is not responsible for the health and safety of:

1. Contractor's personnel
2. Subcontractor's personnel
3. Supplier's personnel
4. Any other persons present at the job site at the request of you or your subcontractors.

Replace item 3 in the list in the 3rd paragraph of section 7-1.02K(6)(j)(ii) with:

04-20-18

3. Sealed and signed by a CIH with knowledge of and experience complying with 8 CA Code of Regs

Add between the 9th and 10th paragraphs of section 7-1.03:

07-15-16

If a height differential of more than 0.04 foot is created by construction activities at a joint transverse to the direction of traffic on the traveled way or a shoulder subject to public traffic, construct a temporary taper at the joint with a slope complying with the requirements shown in the following table:

Temporary Tapers

Height differential (foot)	Slope (horizontal:vertical)	
	Taper use of 14 days or less	Taper use of more than 14 days
Greater than 0.08	100:1 or flatter	200:1 or flatter
0.04–0.08	70:1 or flatter	70:1 or flatter

For a taper on existing asphalt concrete or concrete pavement, construct the taper with minor HMA under section 39-2.07.

Grind existing surfaces to accommodate a minimum taper thickness of 0.10 foot under either of the following conditions:

1. HMA material such as rubberized HMA, polymer-modified bonded wearing course, or open-graded friction course is unsuitable for raking to a maximum 0.02 foot thickness at the edge
2. Taper will be in place for more than 14 days

For a taper on a bridge deck or approach slab, construct the taper with polyester concrete under section 60-3.04B.

The completed surface of the taper must be uniform and must not vary more than 0.02 foot from the lower edge of a 12-foot straightedge when placed on its surface parallel and perpendicular to traffic.

If authorized, you may use alternative materials or methods to construct the required taper.

Add to section 7-1.05:

04-20-18

7-1.05C Other

You are responsible to the fullest extent allowed by law, to defend and indemnify the State for any and all injury, illness, disease, or death arising out of or caused by an organism, including but not limited to animals, microscopic bacteria, fungi, plants and the like, to which persons, including but not limited to the public, any employees or agents of yours, the State, or any other contractors that are exposed in connection with the work on the project.

Replace *§ 337.15* in the 3rd item in the list in the paragraph of section 7-1.06B with:

05-06-16

§ 337.1

Add between the 1st and 2nd paragraphs of section 7-1.11A:

02-12-16

Comply with 46 CFR 381.7(a)–(b).

^^

8 PROSECUTION AND PROGRESS

01-20-17

Add between *establishment* and *are* in the introductory clause of the 3rd paragraph of section 8-1.10A:

01-20-17

or permanent erosion control establishment

Replace the table in the 3rd paragraph of section 8-1.10A with:

07-15-16

Liquidated Damages

Total bid		Liquidated damages per day
From over	To	
$0	$60,000	$1,400
$60,000	$200,000	$2,900
$200,000	$500,000	$3,200
$500,000	$1,000,000	$3,500
$1,000,000	$2,000,000	$4,000
$2,000,000	$5,000,000	$4,800
$5,000,000	$10,000,000	$6,800
$10,000,000	$20,000,000	$10,000
$20,000,000	$50,000,000	$13,500
$50,000,000	$100,000,000	$19,200
$100,000,000	$250,000,000	$25,300

Replace the 4th paragraph of section 8-1.10A with:

01-20-17

If all work except plant establishment or permanent erosion control establishment is complete and the total number of working days have expired, liquidated damages are $950 per day.

^^

9 PAYMENT

07-21-17

Replace the introductory clause in the 2nd paragraph of section 9-1.02B(3) with:

07-21-17

If imported topsoil, soil amendment, wood mulch, or compost is measured by volume:

Replace the 1st paragraph of section 9-1.11B with:

01-20-17

The TRO quantity does not include the number of working days to complete plant establishment or permanent erosion control establishment work.

Replace the 3rd and 4th paragraphs of section 9-1.11D with:

01-20-17

For a contract without plant establishment or permanent erosion control establishment work, the Department pays you the balance due for the TRO item total as specified in section 9-1.17B.

For a contract with plant establishment or permanent erosion control establishment work, the Department pays you the balance due for the TRO item total in the 1st progress payment after all non–plant establishment or non–permanent erosion control establishment work is completed.

Replace *may withhold* in the 1st paragraph of section 9-1.16E(4) with:

01-15-16

withholds

^^^

12 TEMPORARY TRAFFIC CONTROL

04-20-18

Replace the 4th paragraph of section 12-3.02B with:

01-20-17

Retroreflective cone sleeves must be permanently affixed, double-band, sleeves consisting of 2 white retroreflective bands. The top band must be 6 inches wide and placed a maximum of 4 inches from the top of the cone. The lower band must be 4 inches wide and placed 2 inches below the bottom of the top band. You may use traffic cones with double-band retroreflective cone sleeves during daylight hours.

Replace section 12-3.32 with:

04-15-16

12-3.32 PORTABLE CHANGEABLE MESSAGE SIGNS

12-3.32A General

12-3.32A(1) Summary

Section 12-3.32A includes specifications for placing portable changeable message signs.

12-3.32A(2) Definitions

Reserved

12-3.32A(3) Submittals

If requested, submit a certificate of compliance for each PCMS.

Submit your cell phone number before starting the first activity that requires a PCMS.

12-3.32A(4) Quality Assurance

Reserved

12-3.32B Materials

Each PCMS must have a message board, controller unit, power supply, and a structural support system. The unit must be assembled to form a complete self-contained PCMS that can be delivered to the job site and placed into immediate operation. The sign unit must be capable of operating at an ambient air temperature from -4 to 158 degrees F and must be unaffected by mobile radio transmissions other than those required to control the PCMS.

A PCMS must be permanently mounted on a trailer, truck bed, or truck cab under the manufacturer's instructions. The PCMS must be securely mounted on the support vehicle such that it remains attached during any impact to the vehicle. If it is mounted on a trailer, the trailer must be capable of being leveled and plumbed.

A minimum of 3 feet of retroreflective material must be permanently affixed on all 4 sides of the trailer. The retroreflective material need not be continuous but must be visible on the same plane.

The sign panel must be capable of displaying a 3-line message with at least 7 characters per line. The characters must be at least 18 inches in height where the useable shoulder area is at least 15 feet wide. To prevent encroachment onto the traveled way where the useable shoulder area is less than 15 feet wide, you may use a smaller message panel with at least 12-inch-high characters.

The message displayed on the sign must be visible from a distance of 1,500 feet and legible from a distance of 750 feet at noon on a cloudless day and during the night by persons with 20/20 vision or vision corrected to 20/20.

The characters on a sign panel may be 10 inches in height if:

1. PCMS is mounted on a service patrol truck or other incident response vehicle or used for traffic control operations on a highway facility where the posted speed limit is less than 40 mph
2. Message is legible from a distance of at least 650 feet at noon on a cloudless day and during the night by persons with 20/20 vision or vision corrected to 20/20

A matrix sign must provide a complete alphanumeric selection.

A PCMS must automatically adjust its brightness under varying light conditions to maintain the legibility of the message. The sign must be equipped with an automatic-dimming mode that automatically compensates for the influence of temporary light sources or abnormal lighting conditions. The sign must have 3 or more manual dimming modes of different intensities.

During the hours of darkness, a matrix sign not using lamps must be either internally or externally illuminated.

The controller must be an all solid-state unit containing the necessary circuitry for the storage of at least 5 preprogrammed messages. The controller must be installed at a location that allows the operator to perform all functions from a single position. The controller must have a keyboard entry system that allows the operator to generate an infinite number of additional messages in addition to the preprogrammed stored messages. The keyboard must be equipped with a security lockout feature to prevent unauthorized use of the controller.

The controller must have:

1. Nonvolatile memory that stores keyboard-created messages during periods when the power is not activated
2. Variable display rate that allows the operator to match the information display to the speed of approaching traffic
3. Screen upon which messages may be reviewed before being displayed on the sign

The flashing-off time must be adjustable from within the control cabinet.

12-3.32C Construction

Place a PCMS as far from the traveled way as practicable where it is legible to approaching traffic without encroaching on the traveled way. Where the vertical roadway curvature restricts the sight distance of approaching traffic, place the sign on or before the crest of the curvature where it is most visible to the approaching traffic. Where the horizontal roadway curvature restricts the sight distance of approaching traffic, place the sign at or before the curve where it is most visible to approaching traffic. Where practicable, place the sign behind guardrail or Type K temporary railing.

Make a taper consisting of 9 traffic cones placed 25 feet apart to delineate the location of a PCMS except where the sign is placed behind guardrail or Type K temporary railing.

When in full operation, the bottom of a sign must be at least 7 feet above the roadway in areas where pedestrians are anticipated and 5 feet above the roadway elsewhere, and the top of the sign must be not more than 14.5 feet above the roadway.

Operate the PCMS under the manufacturer's instructions.

Keep the PCMS clean to provide maximum visibility.

If multiple signs are needed, place each sign on the same side of the road at least 1,000 feet apart on freeways and expressways and at least 500 feet apart on other types of highways.

If more than one PCMS is simultaneously visible to traffic, only 1 sign may display a sequential message at any time. Do not use dynamic message displays, such as animation, rapid flashing, dissolving, exploding, scrolling, horizontal movement, or vertical movement of messages. The message must be centered within each line of the display.

You may use an additional PCMS if more than 2 phases are needed to display a message.

Display only messages shown or ordered.

Repeat the entire message continuously in not more than 2 phases of at least 3 seconds per phase. The sum of the display times for both of the phases must be a maximum of 8 seconds. If more than 2 phases are needed to display a message, use an additional PCMS.

You must be available by cell phone during activities that require a sign. Be prepared to immediately change the displayed message if ordered. You may operate the sign with a 24-hour timer control or remote control if authorized.

After the initial placement, move a sign from location to location as ordered.

When a PCMS is not in use, move it to an area at least 15 feet from the edge of the traveled way or remove it from the job site away from traffic.

12-3.32D Payment

Not Used

Add to section 12-4.02A(2):

07-21-17

Construction Zone Enhanced Enforcement Program (COZEEP): Program that provides California Highway Patrol officers to monitor the movement of traffic within the work zone.

Add between the 1st sentence and 2nd sentences in the 1st paragraph of section 12-4.02A(3)(a):

07-15-16

For a project in District 7, submit the request at least 15 days before the proposed closure date.

Add to the end of section 12-4.02A(3)(a):

07-21-17

Submit a traffic break request using LCS to show the location and time of the requested traffic break.

Replace *unauthorized closures or* in the last paragraph of section 12-4.02A(3)(b) with:

07-21-17

authorized and unauthorized closures and

Add to section 12-4.02A(3):

07-21-17

12-4.02A(3)(d) Traffic Break Schedule

Every Monday by noon, submit a traffic break request for the next week. Support for a traffic break is based on local California Highway Patrol staffing levels and may not be available for the date or time requested.

Traffic break requests are limited to the hours when a shoulder or lane closure is allowed.

Cancel a traffic break request using LCS at least 48 hours before the start time of the traffic break.

The Department notifies you through LCS of authorized and unauthorized traffic breaks.

The Department does not adjust time or payment if (1) a California Highway Patrol officer is unavailable for the requested date or time or (2) your request is not authorized.

Replace section 12-4.02C(2) with:

01-15-16

12-4.02C(2) Lane Closure System

12-4.02C(2)(a) General

The Department provides LCS training. Request the LCS training at least 30 days before submitting the 1st closure request. The Department provides the training within 15 days after your request.

LCS training is web-based or held at a time and location agreed upon by you and the Engineer. For web-based training, the Engineer provides you the website address to access the training.

With 5 business days after completion of the training, the Department provides LCS accounts and user IDs to your assigned, trained representatives.

Each representative must maintain a unique password and current user information in the LCS.

04-15-16

The project is not accessible in LCS after Contract acceptance.

01-20-17

12-4.02C(2)(b) Status Updates for Authorized Closures

Update the status of authorized closures using the LCS Mobile web page.

For a stationary closure on a traffic lane, use code:

1. 10-97 immediately before you place the 1st cone on the traffic lane
2. 10-98 immediately after you remove all of the cones from the traffic lane

For a stationary closure on the shoulder, use code:

1. 10-97 immediately before you place the 1st cone after the last advance warning sign
2. 10-98 immediately after you remove the last cone before the advance warning signs

For a moving closure, use code:

1. 10-97 immediately before the actual start time of the closure
2. 10-98 immediately after the actual end time of the closure

For closures not needed on the authorized date, use code 10-22 within 2 hours after the authorized start time.

If you are unable to access the LCS Mobile web page, immediately notify the Engineer of the closure's status.

Add to the end of section 12-4.02C(7):

07-21-17

12-4.02C(7)(d) Traffic Breaks

You may request a traffic break for special operations, such as:

1. Installation, removal, or replacement of an overhead power line or other utility cable across the highway
2. Falsework adjustment
3. Installation or removal of traffic control devices in areas without a standard-width shoulder
4. Transportation of large equipment across the highway
5. Access to median areas for workers or equipment

If the Department authorizes the traffic break, the Engineer notifies you and arranges the traffic break with the California Highway Patrol through COZEEP. The duration of a traffic break must not exceed 5 minutes or as authorized.

Two California Highway Patrol officers per vehicle are required for traffic breaks occurring any time from 2200 to 0600 hours.

A minimum of 2 California Highway Patrol vehicles will be assigned to conduct a traffic break.

Place a PCMS approximately 2,000 feet upstream of the work area or as agreed upon by the Engineer. The PCMS must comply with section 12-3.32 except the PCMS must not be trailer mounted. Monitor the traffic during the traffic break. If a queue develops, reposition the PCMS truck far enough upstream of the traffic break to provide real-time notification to motorists before they approach the traffic queue.

Add to the end of section 12-4.02D:

07-21-17

The Department does not pay for furnishing, placing, relocating, and removing PCMSs used for a traffic break.

The Department deducts the full cost of COZEEP support provided for the traffic break.

The hourly rate for each California Highway Patrol officer providing COZEEP support is $115. This rate includes full compensation for each hour or portion thereof that the officer provides the support. Markups are not added to any expenses associated with COZEEP support.

The minimum number of hours for an officer is 4 hours, except if a closure is already in place and the Engineer authorizes your request for an on-duty officer to conduct a traffic break, the minimum number of hours for an officer is 1 hour.

For a cancellation less than 48 hours before the scheduled start time of COZEEP support, except for a cancellation due to adverse weather or extenuating circumstances, the Department deducts:

1. Minimum of $50 per California Highway Patrol officer if the officer is notified before the start time
2. Maximum of 4 hours of pay per officer if the officer is not notified before the start time

Replace section 12-4.04 with:

04-20-18

12-4.04 TEMPORARY PEDESTRIAN ACCESS ROUTES

12-4.04A General

12-4.04A(1) Summary

Section 12-4.04 includes specifications for providing, maintaining, and removing temporary pedestrian access routes.

A temporary pedestrian access route includes temporary traffic control devices as shown except for Type K temporary railing and temporary crash cushions.

12-4.04A(2) Definitions

Reserved

12-4.04A(3) Submittals

If work activities require the closure of a pedestrian route and a temporary pedestrian access route is not shown, submit a work plan for a temporary pedestrian access route. The work plan must:

1. Describe the activities, processes, equipment, and materials that will be used to provide the temporary access route
2. Show the locations of the routes and the placement of traffic control devices for each stage of work
3. Include a time-scaled logic diagram displaying the sequence and duration of the planned activities for each stage of work
4. Be sealed and signed by an engineer who is registered as a civil engineer in the State

Submit “Temporary Pedestrian Access Route Contractor Compliance Report,” within 2 business days after construction of a temporary pedestrian access route,

Submit “Temporary Pedestrian Access Route Contractor Weekly Report,” within 2 business days of completing a weekly inspection.

12-4.04A(4) Quality Assurance

12-4.04A(4)(a) General

Reserved

12-4.04A(4)(b) Quality Control

Perform a review of the temporary pedestrian access route after it is constructed and document compliance on the “Temporary Pedestrian Access Route Contractor Compliance Report.”

The Department will conduct a verification inspection after receiving the compliance report.

For a temporary pedestrian access route in use perform a weekly review and document compliance on the “Temporary Pedestrian Access Route Contractor Weekly Report.”

12-4.04B Materials

The walkway surface must be slip resistant and surfaced with minor HMA or commercial-quality, bituminous material, commercial-quality concrete, or wood.

A handrail with a circular cross section must have an outer diameter from 1-1/4 to 2 inches. A handrail with a noncircular cross section must have a perimeter from 4 to 6-1/4 inches and a maximum cross-section dimension of 2-1/4 inches.

Fasteners must be rounded to prevent injury to a pedestrian's fingers, hands, and arms and to eliminate sharp edges that could catch on clothing.

A detectable warning surface must be on the Authorized Material List for detectable warning surfaces and match yellow color no. 33538 of FED-STD-595.

Temporary traffic control devices used to channelize pedestrians must:

1. Be free of sharp or rough edges
2. Have a continuous detectable edging at least 6 inches high and at no more than 2 inches above the walkway surface
3. Be at least 32 inches in height
4. Have smooth connection points between devices to allow for a handrail
5. Have a top and bottom surface in the same vertical plane

12-4.04C Construction

Notify the Engineer 5 business days before closing an existing pedestrian route. Do not close the route until authorized.

If work activities require the closure of a pedestrian route and a temporary pedestrian access route is not shown, provide a temporary pedestrian access route near the traveled way. You may route pedestrians using the existing sidewalk or by constructing a temporary access route.

If a bid item for a temporary pedestrian access route is not shown on the Bid Item List, then constructing a temporary pedestrian access route is change order work except, when the closure is a result of your means and methods.

Construct a temporary pedestrian access route such that:

1. Walkway surface is firm and stable and free of irregularities
2. Cross slope of the pedestrian route is at most 50:1 (horizontal:vertical)
3. Longitudinal slope of the pedestrian route is at most 20:1 (horizontal:vertical)
4. Walkway, landings, blended transitions, and curb ramps are at least 60 inches wide except where not feasible, the width must be at least 48 inches wide with a 60-by-60-inch passing space at least every 200 feet

5. Lateral joints or gaps between surfaces are less than 1/2 inch wide
6. Discontinuities in surface heights are less than 1/2 inch and beveled if greater than 1/4 inch with a slope no greater than 2:1 (horizontal:vertical)
7. Ramps have:
    7.1. Longitudinal slope of at most 12:1 (horizontal:vertical)
    7.2. Rise less than 30 inches
    7.3. Protective edging at least 2 inches high on each side and handrails at a height from 34 to 38 inches above the walkway surface if the rise is greater than 6 inches
8. Curb ramps have:
    8.1. Longitudinal slope of at most 12:1 (horizontal:vertical)
    8.2. Protective edging at least 2 inches high on each side if the curb ramp does not have flares and the rise is greater than 6 inches
9. Pedestrians are channelized when routed off existing pedestrian routes

Construct handrails such that they are continuous, smooth and free of sharp or rough edges.

Provide an overhead covering to protect pedestrians from falling objects and drippings from overhead structures.

If the temporary access route is next to traffic or work activities, place a temporary barrier to separate the route from vehicles and equipment.

Install a detectable warning surface at locations where a curb ramp, landing, or blended transition connects to a street. Install the warning surface such that it extends a minimum of 36 inches in the direction of travel and for the full width of the landing, blended transition, or curb ramp, excluding the flares.

Maintain the temporary pedestrian access route clear of obstructions. Do not allow traffic control devices, equipment, or construction materials to protrude into the walkway. Maintain a continuous unobstructed path connecting all pedestrian routes, parking lots, and bus stops located within the project limits.

Remove the temporary pedestrian access route when the Engineer determines it is no longer needed.

Provide a temporary pedestrian access route through falsework under section 16-2.02.

12-4.04D Payment

Not Used

Replace the last sentence in the 1st paragraph of section 12-6.03A with:

01-20-17

On multilane roadways, freeways, expressways, and 2-lane roadways with shoulders 4 feet or more in width, the temporary pavement delineation must also include edge line delineation for traveled ways open to traffic.

Replace the 1st sentence in the 3rd paragraph of section 12-6.03A with:

07-15-16

When the Engineer determines the temporary pavement delineation is no longer required for the direction of traffic, remove the temporary pavement delineation, including any underlying adhesive for temporary pavement markers, from the final layer of surfacing and from the pavement to remain in place.

Replace the introductory clause in the 1st paragraph of section 12-6.03C with:

01-20-17

On multilane roadways, freeways, expressways, and 2-lane roadways with shoulders 4 feet or more in width open to traffic where edge lines are obliterated and temporary pavement delineation to replace those edge lines is not shown, provide temporary pavement delineation for:

Replace *4-inch-wide* at each occurrence in section 12-6.03C with:

04-20-18

6-inch-wide

^^

13 WATER POLLUTION CONTROL

04-20-18

Replace *construction phase* and its definition in section 13-1.01B with:

01-20-17

construction phase: Phase that includes (1) the highway construction phase for building roads and structures, (2) the plant establishment, permanent erosion control establishment, and maintenance phase for placing vegetation for final stabilization, and (3) the suspension phase for suspension of work activities or a winter shutdown. The construction phase starts at the start of job site activities and ends at Contract acceptance.

Replace *General Industrial Permit* in the 2nd item in the list in the paragraph of section 13-1.01C(3) with:

05-06-16

Industrial General Permit

Add to the list in the paragraph of section 13-1.01C(3):

01-20-17

3. Copy of the plans for an offsite drying facility if you will be drying liquid residue from concrete grooving or grinding activities before disposal. The facility may include temporary lined ponds or other measures to prevent the liquid residue from infiltrating the soil. The plans must be sealed and signed by an engineer who is registered as a civil engineer in the State.

Replace section 13-1.01C(5) with:

01-20-17

13-1.01C(5) Disposal Documentation

At least 15 days before starting concrete grooving or grinding activities, submit a copy of one of the following documents from the disposal facility that will receive the grooving or grinding residue:

1. RWQCB permit allowing the facility to manage and dispose of the residue
2. Written approval from the RWQCB authorizing the facility to receive the residue
3. Local, state, or federal permits if the facility is located outside the State

Within 5 business days of completing concrete grooving or grinding activities, submit the disposal receipts and weight tickets as informational submittals.

Replace the 2nd paragraph of section 13-1.01D(2) with:

05-06-16

Discharges from manufacturing facilities, such as batch plants and crushing plants, must comply with the discharge requirements in the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities; Order No. 2014-0057-DWQ, CAS000001 (Industrial General Permit), issued by the SWRCB. For the Industrial General Permit, go to the SWRCB website.

Replace *General Industrial Permit* in the 3rd paragraph of section 13-1.01D(2) with:

05-06-16

Industrial General Permit

Add to the list in the 2nd paragraph of section 13-1.03B:

01-20-17

7. Offsite drying facilities for drying wastes before disposal

Replace item 7 in the list in the 2nd paragraph of section 13-2.01C with:

04-20-18

7. Include a copy of each permit obtained by the Department, such as the Department of Fish and Game permits, US Army Corps of Engineers permits, RWQCB 401 certifications, Docket No. ESPO-SMA 15/16-001 Soil Management Agreement for Aerially Deposited Lead-Contaminated Soils with the DTSC (ADL Agreement), ADL Agreement notification, and RWQCB waste discharge requirements for reuse of aerially deposited lead

Add between *Unit* and *the* in the 1st sentence in the 3rd paragraph of section 13-3.01A:

01-20-17

or on federal or tribal lands

Replace the paragraph in section 13-3.01C(1) with:

01-20-17

Submit the documents shown with an *X* in the following table:

Submittal Requirements

Document	Risk level 1	Risk level 2	Risk level 3	EPA	Lake Tahoe Hydrologic Unit
SWPPP	X	X	X	X	X
Construction Site Monitoring Program	X	X	X	X	X[a]
Job site monitoring reports	X	X	X	X	X
Sampling and analysis plan	X	X	X	X	X
Sampling and analysis plan for nonvisible pollutants	X	X	X	X	X
Sampling and analysis plan for pH and turbidity	--	X	X	--	X
NAL reports	--	X	X	--	X
Receiving water monitoring trigger reports	--	--	X	--	--
Rain Event Action Plan	--	X	X	--	X
Annual Certification	X	X	X	X	X
Stormwater Annual Report	X	X	X	X	X

[a]For a project in the Lake Tahoe Hydrologic Unit, this program is referred to as the Construction Site Monitoring and Reporting Program

Replace item 5 in the list in the 2nd paragraph of section 13-3.01C(2)(a) with:

04-20-18

5. Include a copy of each permit obtained by the Department, such as the Department of Fish and Game permits, US Army Corps of Engineers permits, RWQCB 401 certifications, Docket No. ESPO-SMA 15/16-001 Soil Management Agreement for Aerially Deposited Lead-Contaminated Soils with

the DTSC (ADL Agreement), ADL Agreement notification, and RWQCB waste discharge requirements for aerially deposited lead reuse

Add between *Unit* and *discharges* in the 1st paragraph of section 13-3.01D(2):

01-20-17

or on federal or tribal lands

Replace the 2nd paragraph of section 13-3.01D(2) with:

09-02-16

For a project in the Lake Tahoe Hydrologic Unit, discharges of stormwater from the project must comply with the NPDES General Permit for General Waste Discharge Requirements and National Pollutant Discharge Elimination System General Permit for Storm Water Discharges Associated with Construction Activity in the Lake Tahoe Hydrologic Unit, Counties of Alpine, El Dorado, and Placer, (Order No. R6T-2016-0010 and NPDES No. CAG616002). You may view the General Permit for the Lake Tahoe Hydrologic Unit at the Construction Storm Water Program page of the SWRCB website.

Add to the end of section 13-3.01D(2):

01-20-17

A project on federal or tribal lands must comply with the permit issued by the US EPA for National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities. This permit governs stormwater and nonstormwater discharges from work activities at the job site. This permit may be viewed at the US EPA website.

Add to the beginning of section 13-3.03:

01-20-17

Post a sign or other notice at a safe, publicly accessible location close to the job site. The notice must include the NPDES tracking number and a contact name and phone number for obtaining additional project information. Locate the sign or notice such that it is visible from the part of the highway nearest the work activities.

Replace the 2nd paragraph of section 13-4.03D(3) with:

01-20-17

Collect concrete waste simultaneously with the waste-producing activity. Concrete waste includes grout, dust, debris, residue, and slurry from demolition, saw cutting, coring, grooving, or grinding activities.

Add to the end of section 13-4.03D(3):

01-20-17

Dispose of liquid residue from concrete grooving or grinding activities at an appropriately permitted disposal facility.

If authorized, you may transport liquid grooving or grinding residue to a contractor-support facility for drying.

Replace section 13-5.02C with:

01-20-17

Section 13-5.02C Temporary Mulch

Temporary mulch must comply with the specifications for wood mulch in section 20.

Replace the 1st paragraph of section 13-5.03C with:

01-20-17

Spread temporary mulch as specified for spreading wood mulch in section 20.

Replace the 2nd paragraph of section 13-8.01D(2) with:

09-02-16

For a project within the Lake Tahoe Hydrologic Unit, the design, installation, operation, and monitoring of the temporary ATS and monitoring of the treated effluent must comply with Attachment E of the NPDES General Permit for General Waste Discharge Requirements and National Pollutant Discharge Elimination System General Permit for Storm Water Discharges Associated with Construction Activity in the Lake Tahoe Hydrologic Unit, Counties of Alpine, El Dorado, and Placer, (Order No. R6T-2016-0010 and NPDES No. CAG616002). You may view the General Permit for the Lake Tahoe Hydrologic Unit at the Construction Storm Water Program page of the SWRCB website.

Replace *high-visibility fence* at each occurrence in section 13-10.02 with:

01-20-17

temporary high-visibility fence

Replace sections 13-11–13-15 with:

04-20-18

13-11 RESERVED

13-12 TEMPORARY CREEK DIVERSION SYSTEMS

Reserved

13-13–13-15 RESERVED

^^

14 ENVIRONMENTAL STEWARDSHIP

04-20-18

Add to section 14-6.02:

07-21-17

biological resource incident: Take of a regulated species or violation of a biological resource PLAC.

invasive species: Species whose presence in the environment causes economic or environmental harm or harm to human health.

07-21-17

Delete *regulated fish* and its definition in section 14-6.02.

Replace *February 15 to September 1* in the 2nd paragraph of section 14-6.03B with:

07-21-17

February 1 to September 30

Replace the 1st paragraph of section 14-6.03C with:

07-21-17

Protect all life stages of regulated fish in streams and conduct work activities to allow free passage of migratory fish.

Replace *listed* in the 2nd paragraph of section 14-6.03C with:

07-21-17

regulated

Replace item 4 in the list in the 2nd paragraph of section 14-6.03D(1) with:

07-21-17

4. Immediately notify the Engineer of any take of regulated species or violation of a biological resource PLAC

Add to the list in the 3rd paragraph of section 14-6.03D(1):

07-21-17

10. Details of any take of regulated species or violation of a biological resource PLAC

Add between the 1st and 2nd sentences in the 4th paragraph of section 14-6.03D(1) with:

07-21-17

If required under PLACs, the Department sends the biologist's statement of qualifications to regulatory agencies for review and approval before hiring. Allow 30 days for the regulatory agencies' review.

07-21-17

Delete the 1st sentence of the 5th paragraph of section 14-6.03D(1).

Add between *is* and *authorized* in the last paragraph of section 14-6.03D(1):

07-21-17

approved by regulatory agencies

Add between the 2nd and 3rd sentences in the 3rd paragraph of section 14-10.01:

01-20-17

Do not perform solid waste management in the median area unless there is construction activity present. Perform solid waste management monthly during the plant establishment period.

Replace the 2nd paragraph of section 14-11.01 with:

04-20-18

If hazardous waste is or will be generated on the job site, the WPC manager must be knowledgeable of proper handling and emergency procedures for hazardous waste as demonstrated by submitting a training certificate which indicates completion of training required under 22 CA Code of Regs § 66265.16.

Replace the last paragraph of section 14-11.03 with:

01-20-17

Dispose of hazardous waste within 90 days of the start of generation. Use a hazardous waste manifest and a transporter registered with the DTSC to transport the waste to an appropriately permitted hazardous waste management facility. The transporter must have completed the California Highway Patrol's Basic Inspection of Terminals Program with a satisfactory rating.

Replace *13-mils-thick* in section 14-11.05A with:

04-20-18

12-mils-thick

Replace section 14-11.08 with:

04-20-18

14-11.08 REGULATED MATERIAL CONTAINING AERIALLY DEPOSITED LEAD

Reserved

Replace section 14-11.09 with:

04-20-18

14-11.09 MINIMAL DISTURBANCE OF REGULATED MATERIAL CONTAINING AERIALLY DEPOSITED LEAD

Reserved

Replace the 2nd paragraph of section 14-11.12E with:

04-20-18

The Engineer signs the manifests as the hazardous waste generator within 5 business days of 1) receiving and accepting the analytical test results and 2) receiving your request for the generator's EPA Identification Number.

Replace the 2nd paragraph of section 14-11.13A with:

04-20-18

Any work that disturbs the existing paint system produces debris containing heavy metals in amounts that exceed the established thresholds in 8 CA Code of Regs and exposes workers to health hazards which must be addressed in your lead compliance plan. Welding, cutting, or heating the surfaces coated by the existing paint system produces toxic fumes and must be done in compliance with 8 CA Code of Regs § 1537.

Any work that disturbs the existing paint system produces debris containing heavy metals in amounts that exceed the thresholds established in 22 CA Code of Regs. This debris is a Department-generated hazardous waste.

Replace the paragraph of section 14-11.13G(1) with:

04-20-18

For bidding purposes, assume the debris is a CA hazardous waste. Assume the debris is not regulated under the Federal Resource Conservation and Recovery Act, 42 USC § 6901 et seq. Disposal of hazardous waste debris identified by test results to be regulated under the Resource Conservation and Recovery Act is change order work.

Replace the 2nd paragraph of section 14-11.13G(2) with:

04-20-18

Use a hazardous waste manifest and a transporter whose vehicles have current DTSC registration certificates when transporting hazardous waste. The Engineer provides the generator's EPA Identification Number and signs the manifests as the hazardous waste generator within 5 business days of accepting the waste characterization test results and receiving your request for the generator's EPA Identification Number.

Replace the 2nd paragraph of section 14-11.13G(3) with:

01-20-17

You may dispose of nonhazardous debris at a facility equipped to recycle the debris if you make all arrangements with the recycling facility's operator and perform any facility-required testing of the debris.

Replace section 14-11.16 with:

07-21-17

14–11.16 ASBESTOS-CONTAINING CONSTRUCTION MATERIALS IN BRIDGES

Reserved

^^

16 TEMPORARY FACILITIES

04-20-18

Replace the heading of section 16-2.03 with:

01-20-17

TEMPORARY HIGH-VISIBILITY FENCES

Replace section 16-2.03A(1) with:

01-20-17

16-2.03A(1) Summary

Section 16-2.03 includes specifications for constructing temporary high-visibility fences.

Constructing a temporary high-visibility fence includes the installation of any signs specified in the special provisions.

Replace *1 by 1 inch to 2 by 4 inches* in the 3rd paragraph of section 16-2.03B with:

04-20-18

a minimum 1 by 1 inch to a maximum 2 by 4 inches

04-20-18

Delete the 5th paragraph of section 16-2.03B.

01-20-17

Delete the 2nd paragraph of section 16-2.04A(1)(a).

^^^^^^^^^^^^^^^^^^^

DIVISION III EARTHWORK AND LANDSCAPE

19 EARTHWORK

04-20-18

Add between the 2nd and 3rd paragraphs of section 19-1.01A:

07-21-17

If paleontological resources mitigation is specified in the special provisions under section 14-7.04, performing earthwork activities includes:

1. Paleontological resources training for your staff and subcontractors
2. Submittals of your schedule of subsurface-disturbing activities and updated schedules
3. Coordination and work with the Department's mitigation team

Replace *selected material* and its definition in section 19-2.01B with:

04-20-18

19-2.01B Definitions

selected material: Specific material excavated from a described location on the job site. Selected material includes topsoil.

Replace section 19-2.03D with:

04-20-18

19-2.03D Selected Material

19-2.03D(1) General

If selected material is not used for a specified layer, place the selected material in the roadway prism as embankment or structure backfill.

If selected material is used as a specified layer, spread and compact it under section 25.

If practicable and unless processing of material is required, haul selected material directly from the excavation to its final position in the roadway prism and compact it in place.

Selected material must remain in place until it can be placed in its final position unless stockpiling of selected material is ordered.

If stockpiling of selected material is ordered, excavate and stockpile the selected material until the stockpiled material is to be placed in its final position in the roadway prism. This work is change order work.

19-2.03D(2) Topsoil

Reserved

Replace the last paragraph of section 19-3.02E:

04-20-18

You may use slurry cement backfill as structure backfill only for pipe culverts.

Add to the list in the 6th paragraph of section 19-3.04:

04-20-18

3. Structure excavation more than 0.5 foot from the depth shown is a work-character change if you request an adjustment for an increased depth or the Engineer orders an adjustment for a decreased depth.

Replace section 19-4 with:

01-20-17

19-4 ROCK EXCAVATION

19-4.01 GENERAL

19-4.01A General

19-4.01A(1) Summary

Section 19-4 include general specifications for performing rock excavation.

19-4.01A(2) Definitions

flyrock: Rock that becomes airborne due to blasting.

near-field blasting: Blasting within 30 feet of a building, highway facility, or utilities.

19-4.01A(3) Submittals

Reserved

19-4.01A(4) Quality Assurance

Reserved

19-4.01B Materials

Not Used

19-4.01C Construction

Excavate rock by blasting, controlled blasting, using chemical expanders or hydraulic splitters, or another authorized method.

19-4.01D Payment

The payment quantity for any type of rock excavation is measured as specified for roadway excavation.

19-4.02 PRESPLITTING

19-4.02A General

19-4.02A(1) Summary

Section 19-4.02 includes specifications for presplitting rock to form rock excavation slopes in conjunction with blasting or controlled blasting.

19-4.02A(2) Definitions

presplitting: Establishing a free surface or shear plane in rock along the specified excavation slope by the controlled use of explosives and blasting accessories in appropriately aligned and spaced drilled holes.

19-4.02A(3) Submittals

Submit a copy of the explosive manufacturer's instructions as an informational submittal before using any column-type explosive for presplitting.

19-4.02A(4) Quality Assurance

Reserved

19-4.02B Materials

The maximum diameter of explosive used in a presplit hole must not be greater than 50 percent of the diameter of the presplit hole.

Standard cartridge explosives prepared and packaged by explosive manufacturing firms must be used in the presplit holes. The explosives must consist of one of the following:

1. Fractional portions of standard cartridges to be affixed to a detonating cord in the field
2. Solid column explosives joined and affixed to a detonating cord in the field

Stemming materials must be dry, free-running material complying with the gradation requirements shown in the following table when tested under California Test 202:

Sieve size	Percentage passing
3/8"	100
No. 8	10

19-4.02C Construction

Presplit the rock to form rock excavation slopes.

Before drilling the presplitting holes, remove overburden soil and weathered rock along the top of the excavation for a distance of at least 50 feet beyond the production hole drilling limits or to the end of the excavation. Expose fresh rock to an elevation equal to the bottom of the adjacent lift of the presplitting holes being drilled.

Drill slope holes for presplitting along the line of the planned slope. The drilled holes must be from 2-1/2 to 3 inches in diameter. Use the proper drilling equipment and techniques to ensure that no hole deviates (1) from the plane of the planned slope by more than 12 inches or (2) from parallel to an adjacent hole by more than 67 percent of the planned horizontal spacing between holes.

The Department does not pay for drilling more than 3 feet below finished grade unless additional drilling is ordered. The additional drilling is change order work.

The length of presplit holes for an individual lift must not exceed 20 feet, unless you can demonstrate to the Engineer that you can stay within the specified tolerances and produce a uniform slope. The length of holes may then be increased to a maximum of 60 feet if authorized.

Space the presplit holes a maximum of 3 feet on centers. Adjust the spacing to produce a uniform shear face between holes.

The Engineer may order you to drill auxiliary holes along the presplit line. These holes must not be loaded or stemmed. Except for spacing, the auxiliary drill holes must comply with the specifications for presplit holes. This work is change order work.

Place the adjacent line of production holes inside the presplit lines such that you avoid damage to the presplit face.

If necessary to reduce shatter and overbreak of the presplit surface, drill the 1st line of production holes parallel to the slope line at the top of the cut and at each bench level thereafter. Immediately stop blasting activities if the presplit surface is damaged.

Do not drill production holes within 8 feet of a presplit plane unless authorized. The bottom of the production holes must not be lower than the bottom of the presplit holes.

You may use a construction working bench offset by 24 inches from the bottom of each lift to drill the next lower presplitting pattern.

Adjust the drilling to compensate for any drift of previous levels and for the offset at the start of new levels to maintain the specified slope plane.

If the drilling and blasting methods do not produce a uniform slope and shear face without overbreak and within the specified tolerances, drill, blast, and excavate in short sections, up to 100 feet, until you achieve the desired results.

If you use a fractional portion of a standard explosive cartridge, firmly affix the cartridge to a length of detonating cord equal to the depth of the drill hole. Ensure the cartridge does not slip down the detonating cord or cock across the hole and bridge the flow of stemming material. Space the cartridges along the length of the detonating cord at a maximum of 30 inches on center. Adjust the spacing as needed to achieve the desired results.

If you use a solid column-type explosive, assemble and affix the column to the detonating cord under the explosive manufacturer's instructions.

The bottom charge of a presplit hole may be larger than the line charges but must not cause overbreak. Place the top charge of the presplitting hole far enough below the collar to avoid overbreaking the surface.

Before placing the charge, clear the hole of any obstructions for the hole's entire depth. Ensure that placing of the charge does not cause caving of material from the walls of the holes.

The Engineer may order the use of stemming materials as necessary to achieve a satisfactory presplit face. Stemmed presplit holes must be completely filled to the collar.

Simultaneously detonate charges in each presplitting pattern.

The tolerances specified in section 19-2.03G do not apply to presplit surfaces of excavation slopes where presplitting is required. The presplit face must not deviate more than 1 foot from the plane passing through adjacent drill holes, except where the character of the rock is such that irregularities are unavoidable. The average plane of the completed slopes must not deviate more than 1 foot from the plan slopes. These tolerances are measured perpendicular to the plane of the slope. No portion of the slope may encroach on the roadbed.

If equally satisfactory presplit slopes are obtained, you may either presplit the slope face before drilling for production blasting or presplit the slope face and production blast at the same time, provided that the presplitting drill holes are fired with zero delay. Detonation of the production holes must be delayed from the detonation of the presplit line and must start at the row of holes farthest from the new slope line and progressing in steps to the row of holes nearest the presplit line. Detonation of the production holes must result in a minimum 50 ms delay between detonation of the presplit holes and detonation of the row of production holes nearest the presplit line. The presplitting holes must extend either to the end of the excavation or for a distance of not less than 50 feet beyond the limits of the production holes to be detonated.

19-4.02D Payment

The payment quantity for drill hole (presplitting) is the theoretical slope length determined from the elevation taken before detonating each lift and a plane 3 feet below finished grade. For holes that comply with the specified slope and tolerances, except alignment within the plane of the slope, the payment quantity is 75 percent of the theoretical slope length.

The Department does not pay for holes that do not show a hole trace for approximately 50 percent of the drilled length.

19-4.03 BLASTING

19-4.03A General

19-4.03A(1) Summary

Section 19-4.03 includes specifications for excavating rock by blasting.

Blasting activities must comply with federal, State, and local blasting regulations, including 8 CA Code of Regs Ch 4, Subchapter 7, Group 18, "Explosive Materials."

19-4.03A(2) Definitions

Reserved

19-4.03A(3) Submittals

Submit 3 copies of your blasting safety plan. The plan must include:

1. References to applicable federal, State, and local codes and regulations
2. Copies of permits required for blasting activities
3. Business name, contractor license number, address, and telephone number of the blasting subcontractor
4. Proof of current liability insurance and bonding
5. Name, address, telephone number, copies of applicable licenses, and resume of:
   - 5.1. Blaster-in-charge
   - 5.2. Personnel responsible for blast design, loading, and conducting blasting operations
   - 5.3. Safety officer for the blasting subcontractor

6. Name, address, and telephone number of the local fire station and law enforcement agencies
7. Detailed description of:
    7.1. Location where explosives will be stored
    7.2. Security measures to protect and limit access to the explosives
    7.3. Means for transporting explosives
    7.4. List of personnel allowed to handle the explosives
8. Exclusion zone and limited-entry zone for nonblast-related operations and personnel surrounding loading and blasting operations
9. Details of warning signals used to alert employees on the job site of an impending blast and to indicate the blast is completed and the area is safe to enter
10. Procedures for conducting blasting operations
11. Measures to protect blasting operations and personnel from lightning
12. Emergency evacuation procedures for areas where explosives may be present
13. Methods for recognizing, handling, and resolving misfires, including:
    13.1. Who will be notified
    13.2. How the blast zone will be secured until the misfire is resolved
    13.3. Identification of equipment that may be needed to resolve misfires
14. Details of signs to be used around blasting zones, including:
    14.1. Timing of when signs will be posted for a specific blast
    14.2. Name and telephone number of the person responsible for placing the signs
    14.3. Roadway signs for compliance with the *California MUTCD*, Chapter 6H, Typical Application 2
15. Traffic control details for:
    15.1. Loading and blasting operations
    15.2. Misfire event or other blast-related phenomenon that causes a transportation corridor to remain closed to the public
16. Description of the possible generation of noxious gas and details of the safeguards to be used to protect employees, work zones adjacent to the shot, private property, and the public
17. Procedure to report and resolve complaints for blast-related accidents
18. Copies of each SDS and manufacturer data sheets of explosives, caps, primers, initiators, and other compounds

If the plan requires revisions, the Department provides comments. Submit a revised plan after receiving the comments. Submit 3 copies of the revised blasting safety plan after authorization.

19-4.03A(4) Quality Assurance

Reserved

19-4.03B Materials

Not Used

19-4.03C Construction

You may use hydraulic splitters, pneumatic hammers, blasting, or another authorized roadway excavation method to fracture rock and construct stable final rock cut faces.

19-4.03D Payment

Not Used

19-4.04 CONTROLLED BLASTING

19-4.04A General

19-4.04A(1) Summary

Section 19-4.04 includes specifications for excavating rock by controlled blasting.

Blasting activities must comply with federal, State, and local blasting regulations, including 8 CA Code of Regs Ch 4, Subchapter 7, Group 18, "Explosives and Pyrotechnics," and 22 CA Code of Regs, Division 4.5, Ch 33, "Best Management Practices for Perchlorate Materials."

19-4.04A(2) Definitions

controlled blasting: Using explosives and blasting accessories in predetermined spaced and aligned drilled holes.

19-4.04A(3) Submittals

19-4.04A(3)(a) General

Reserved

19-4.04A(3)(b) Blasting Safety Plan

Submit 3 copies of your blasting safety plan. The plan must include:

1. References to applicable federal, State, and local codes and regulations
2. Copies of permits required for blasting activities
3. Business name, contractor license number, address, and telephone number of the blasting subcontractor
4. Proof of current liability insurance and bonding
5. Name, address, telephone number, copies of applicable licenses, and resume of:
   - 5.1. Blaster-in-charge.
   - 5.2. Personnel responsible for blast design, loading, and conducting blasting operations.
   - 5.3. Safety officer for the blasting subcontractor.
   - 5.4 Blast monitoring consultant.
   - 5.5 Blasting consultant if the project involves near-field blasting activities. Include a list of controlled blasting projects worked on by the blasting consultant.
6. Name, address, and telephone number of the local fire station and law enforcement agencies
7. Detailed description of:
   - 7.1. Location where explosives will be stored
   - 7.2. Security measures to protect and limit access to the explosives
   - 7.3. Means for transporting explosives
   - 7.4. List of personnel allowed to handle the explosives
8. Exclusion zone and limited-entry zone for nonblast-related operations and personnel surrounding loading and blasting operations
9. Details of warning signals used to alert employees on the job site of an impending blast and to indicate the blast is completed and the area is safe to enter
10. Procedures for conducting blasting operations
11. Measures to protect blasting operations and personnel from lightning
12. Emergency evacuation procedures for areas where explosives may be present
13. Methods for recognizing, handling, and resolving misfires, including:
    - 13.1. Who will be notified
    - 13.2. How the blast zone will be secured until the misfire is resolved
    - 13.3. Identification of equipment that may be needed to resolve misfires
14. Details of signs to be used around blasting zones, including:
    - 14.1. Timing of when signs will be posted for a specific blast
    - 14.2. Name and telephone number of the person responsible for placing the signs
    - 14.3. Roadway signs for compliance with the *California MUTCD*, Chapter 6H, Typical Application 2
15. Traffic control details for:
    - 15.1. Loading and blasting operations
    - 15.2. Misfire event or other blast-related phenomenon that causes a transportation corridor to remain closed to the public
16. Description of the possible generation of noxious gas and details of the safeguards to be used to protect employees, work zones adjacent to the shot, private property, and the public
17. Procedure to report and resolve complaints for blast-related accidents
18. Copies of each SDS and manufacturer data sheets of explosives, caps, primers, initiators, and other compounds

If the blasting safety plan requires revisions, the Department provides comments. Submit a revised plan after receiving comments. Submit 3 copies of the revised plan after authorization.

19-4.04A(3)(c) Controlled Blasting Plan

Submit 3 copies of your controlled blasting plan for each blast. The plan must include details on how each blast will be controlled and the following:

1. Blast identification by numerical and chronological sequence
2. Location, referenced to stationing, offset distance, date, and time of the blast

3. Drawings showing drill hole pattern, spacing, burden, and initiation sequence
4. Typical cross-sections through the zone to be blasted
5. Groundwater level, if present, within the prism to be blasted
6. Initiation-sequence diagram showing the actual firing time of each delay
7. Type of material to be blasted
8. Number of drill holes
9. Diameter, depth, and spacing of holes
10. Height or length of stemming
11. Types and characteristics of explosives, including the explosive's density, relative strength, and date of manufacture
12. Type of caps and delay periods and their date of manufacture
13. Total amount of explosives to be used
14. Total amount of explosives detonating within any 8 ms period
15. Powder factor (pounds of explosive per cubic yard of material blasted)
16. Method of firing
17. Direction and distance to nearest building or structure
18. Type of instrumentation and method for monitoring vibration and noise from the blasting activities
19. Location and placement of the instrumentation
20. Measures to limit noise and flyrock
21. Measures to limit overbreak
22. Name of the blasting subcontractor
23. Name and signature of the blaster-in-charge
24. Drawings showing the spacing and proximity of shot guards relative to the blast location

If you revise the controlled blasting plan to adjust for site conditions or the Department provides comments, submit a revised plan before starting controlled blasting. Submit 3 copies of the revised plan after authorization.

19-4.04A(3)(d) Preblast and Postblast Surveys

Submit a preblast survey of all structures, including buildings, within 330 feet of controlled blasting locations at least 15 days before starting the blasting activities. Submit the preblast survey with the controlled blasting plan.

The preblast survey must include:

1. Written report, sketches, and photographs or video with the date and time displayed on the image
2. Name of the person who performed the survey
3. Names of the property owner and occupants
4. Property address
5. Date and time of the inspection
6. Description of the structure or other improvements, including culverts and bridges
7. Detailed description of the existing condition of the walls, ceiling, and floor of each interior room, including any attic or basement
8. Detailed description of the existing condition of the foundations, exterior walls, roofs, doors, windows, and porches
9. Detailed description of the existing condition of garages, outbuildings, sidewalks, driveways, and swimming pools
10. Detailed listing of highway sign posts, light fixtures, and overhead power lines
11. Survey of wells or other private water supplies, including the total depth and existing water surface levels
12. Identification of sites conducting procedures, processes, or operations that may be sensitive to blasting activities
13. Scaled map or aerial photo showing the location of the structures and properties surveyed and the location of all proposed blasting sites

If blasting activities are suspended for 45 days or more, perform another preblast survey and submit the survey at least 15 days before resuming blasting activities.

Submit a postblast survey of the same buildings and other structures as in the preblast survey within 15 days after completing blasting activities. The postblast survey must include all items included in the preblast survey.

19-4.04A(3)(e) Vibration and Noise Monitoring Report

Submit a vibration and noise monitoring report for each controlled blast shot. The report must include:

1. Identification of the blasting seismograph used to record each blast shot
2. Name of the blast monitoring consultant
3. Distance and direction of the recording stations from the blast area
4. Type of ground at the recording station and type of material on which the instrumentation sits
5. Maximum particle velocity in each component and the resultant peak particle velocity of each shot
6. Copy of the seismograph readings with the date and signature of the blast monitoring consultant
7. Noise levels recorded in dB (C-network or Linear network) units

19-4.04A(3)(f) Video Recording

Submit a video recording of each controlled blast on a DVD or other Engineer-authorized data-storage device. Identify each video or section of the video with an index to identify each blast.

19-4.04A(3)(g) Blasting Complaint Report

Submit a report for each blasting complaint, including:

1. Name and address of the complainant
2. Date, time, and nature of the complaint
3. Dated photo or videotape of the physical damage
4. Name of the person who received the complaint
5. Record of the complaint investigation
6. Resolution of the complaint

19-4.04A(3)(h) Postblast Report

Submit a postblast report within 48 hours of a controlled blast. The report must include all data required in the controlled blasting plan for that shot and the following information:

1. Description of site conditions, loading, and time of blast
2. Description of weather conditions at time of blast including wind direction and cloud cover
3. Drillers boring record
4. Copy of vibration and noise monitoring report
5. Copy of documented complaints arising from the blast

19-4.04A(4) Quality Assurance

19-4.04A(4)(a) General

Reserved

19-4.04A(4)(b) Blaster-In-Charge for Controlled Blasting

Assign a blaster-in-charge to supervise all controlled blasting activities. The blaster-in-charge must have at least 10 years of experience in performing or supervising similar blasting activities and must be a licensed blaster.

19-4.04A(4)(c) Blast Monitoring Consultant for Controlled Blasting

Assign a blast monitoring consultant to monitor blasting-generated vibrations and noise near buildings and other structures that may be subject to damage. The monitoring consultant must be responsible for collecting and interpreting the vibration and noise data. The blast monitoring consultant must:

1. Not be employed by the blasting contractor or other subcontractor on the project
2. Have a minimum 2-year associate's degree in science or engineering
3. Have at least 5 years of documented experience in collecting and interpreting ground vibrations and noise data

19-4.04A(4)(d) Blasting Consultant for Controlled Blasting

Assign a blasting consultant to oversee near-field blasting activities. The blasting consultant must:

1. Be an engineering geologist or civil engineer who is licensed in the State
2. Have at least 10 years of experience providing specialized blasting services in near-field blasting
3. Not be employed by the blasting contractor, explosive manufacturer, or explosive distributor

19-4.04B Materials

Each seismograph used to record controlled blasting activities must be capable of:

1. Recording particle velocities for 3 mutually perpendicular components of vibration and an instantaneous resultant peak vector sum in the range generally found for controlled blasting
2. Continuously measuring, recording, and reporting vibrations along 3 primary axes
3. Measuring and recording vibration frequencies ranging from 2 to 300 Hz
4. Providing a printed record of each event showing a plot of peak particle velocity versus vibration frequencies
5. Measuring and recording airblast noise levels

The seismograph's noise transducer must be detachable from the main unit to allow its placement at elevations with a clear line of sight between the transducer and the blast.

19-4.04C Construction

19-4.04C(1) General

At least 7 days before starting or resuming controlled blasting activities, provide written notification to the occupants of the buildings within 330 feet of the blasting. Notify the occupants of pending blasting activities on the day of blasting.

Do not perform blasts within 1,200 feet of concrete placed within the previous 72 hours.

Before firing any blast, confirm that the groundwater conditions are consistent with the shot design and explosive type to be used.

Before firing any blast in areas where flyrock may result in personal injury or damage to property or the work, cover the rock to be blasted with blasting mats, soil, or other equally serviceable material to prevent flyrock.

If blasting causes flyrock, suspend blasting activities. The blasting consultant must review the job site to determine the cause of the flyrock problem and submit a revised controlled blasting plan that prevents flyrock.

Do not use drill cuttings as stemming in controlled blasting activities.

Keep vibration levels below a peak particle velocity of 2 inches per second at the nearest building, highway facility, or utility.

Limit noise from airblast overpressure levels to below 128 dB (C-scale or linear network) at the nearest building.

Control ground vibrations and noise created from blasting by using properly designed delay sequencing and charge weights for shots.

Provide 3 seismographs to record controlled blasting activities. Record each blast shot using the seismographs. Video record each blast from a safe location with a clear view of the blast area, activities, and progression.

Notify the Engineer no later than the start of the next day's work shift of any blasting complaint received.

19-4.04D Payment

Not Used

19-4.05–19-4.08 RESERVED

Replace the 7th paragraph of section 19-10.03A with:

01-20-17

Do not stockpile material on the geosynthetic or place more geosynthetic than can be covered within 72 hours.

Do not operate equipment or vehicles directly on geosynthetic, except you may operate vehicles and equipment on geogrid if one of the following conditions is met:

1. Vehicles and equipment are:
   1.1. Equipped with rubber tires
   1.2 Operated under 10 mph
   1.3 Operated in a manner to avoid sudden braking and sharp turns
2. At least 0.35 feet of AB has been placed, spread, and compacted on the geogrid

Replace the 2nd heading of section 19-10.03 with:

01-20-17

19-10.03B Subgrade Enhancement Geotextile

^^

20 LANDSCAPE

04-20-18

Replace the 1st paragraph of section 20-1.01D(2) with:

01-20-17

The Engineer performs progress inspections:

1. After marking plant locations
2. Before cultivating work starts
3. Before pressure testing of irrigation pipe on the supply side of control valves
4. Before testing of low voltage control and neutral conductors
5. During irrigation system functional tests
6. Before planting the plants
7. Before completion of planting work
8. Before the start of plant establishment work
9. Once a month during the plant establishment period

07-21-17

Delete *oil or* in the 4th paragraph of section 20-1.02C.

Replace the 3rd paragraph of section 20-2.01B(7) with:

07-21-17

Valve box covers must be labeled. Labels must:

1. Be predrilled plate plastic consisting of 2 layers of contrasting color
2. Be at least 1/8 inch thick
3. Have mechanically engraved inscriptions at least 1 inch high

Covers for valve boxes that contain remote control valves must be labeled with the controller and station.

Covers for valve boxes that contain irrigation equipment must be labeled with the standard abbreviation for that equipment.

Replace section 20-2.01C(2) with:

07-21-17

20-2.01C(2) Trenching and Backfilling

For a project with multiple water service points, excavate and backfill the trenches 1 service point at a time.

Remove rocks and debris encountered during trenching activity. The removal of rocks and debris is change order work.

Backfill each trench with material that is excavated from the trench. Each trench must have a uniform bearing throughout the entire length and must be free of jagged rubble, rock, broken concrete, asphalt concrete and sharp objects greater than 2 inches in greatest dimension.

Compact the backfill in the trench to a minimum relative compaction of 90 percent. If the trench backfill settles, place additional material and compact until the backfill is level with the surrounding grade.

Ensure conduit, supply line, and joints are not moved or damaged by backfill activity.

If trenching requires the removal of:

1. Plants:
   - 1.1 Remove plants as necessary under section 20-1.03C.
   - 1.2 If plants are to remain, adjust the trench alignment to minimize damage.
   - 1.3 If the supply line location interferes with the excavation of plant holes, relocate the plant hole away from the supply line.
   - 1.4 Where authorized by the Engineer, prune trees and shrubs as necessary to complete the trenching work.
2. Turf:
   - 2.1 Do not remove a width of more than 12 inches.
   - 2.2 Replace with sod under section 20-3.02C(3)(e).
3. Groundcover:
   - 3.1 Do not remove a width of more than 6 feet.
   - 3.2 Replace groundcover with plants from flats and plant at 12 inches on center under section 20-3.02C.
   - 3.3 You may rototill existing *Carpobrotus* and *Delosperma.* Backfill for the trenches must not contain plants longer than 6 inches. No replacement of *Carpobrotus* and *Delosperma* is required if removed by rototilling.
4. Existing surface:
   - 4.1 Make a minimum 2-inch-deep saw cut along neat lines around the perimeter of the pavement to be removed at locations determined by the Engineer.
   - 4.2 Place a minimum of 2 inches of sand bedding under and on top of supply lines and conduits.
   - 4.3 Compact the backfill under the replacement surfacing to a minimum relative compaction of 95 percent.
   - 4.4 Replace the structural section to match the removed materials. The surface must have the same uniform smoothness, color, and texture as the adjacent surface.

If trenching in areas to receive new surfacing:

1. Place a minimum of 2 inches of sand bedding under and on top of supply lines and conduits.
2. Compact the backfill under the new surfacing to a minimum relative compaction of 95 percent.

Replace *86* in the 1st paragraph of section 20-2.01C(3) with:

04-15-16

87

Replace the paragraphs of section 20-2.03B with:

04-20-18

Each cam coupler assembly must consist of a cam coupler, dust cap, check valve, pipes, fittings, concrete thrust block, and valve box with woven wire cloth and gravel.

Cam couplers must be manufactured of brass or bronze and be able to withstand a working pressure of 150 psi.

04-20-18

Delete the 2nd paragraph of section 20-2.03C.

Replace section 20-2.04A(4) with:

04-15-16

Perform conductors test. The test must comply with the specifications in section 87.

Where the conductors are installed by trenching and backfilling, perform the test after a minimum of 6 inches of backfill material has been placed and compacted over the conductors.

Replace *5* in the 1st paragraph of section 20-2.04C(2) with:

07-21-17

10

Add between the 1st and 2nd paragraphs of section 20-2.04C(2):

07-21-17

Tie a 24-inch loop of wire at all changes of direction that are greater than 45 degrees. Untie the loops after all the connections are made.

Replace the 1st paragraph of section 20-2.04C(4) with:

04-15-16

Splice low voltage control and neutral conductors under section 87, except do not use Method B.

Replace the 3rd paragraph of section 20-2.05B with:

07-15-16

The impeller must be glass reinforced nylon on a tungsten carbide shaft.

Replace *86* in the 2nd paragraph of section 20-2.06C with:

04-15-16

87

Replace section 20-2.07B(5) with:

04-15-16

20-2.07B(5) PVC Pipe Conduit Sleeve

PVC pipe conduit sleeves must be schedule 40 complying with ASTM D1785.

Fittings must be schedule 80.

Replace the 9th paragraph of section 20-2.07C(1) with:

07-21-17

Place Type G pavement markers with retroreflective face facing away from the oncoming traffic under section 81-3 on paved shoulders or dikes at irrigation conduit locations where authorized.

07-21-17

Delete the 2nd paragraph of section 20-2.07C(2)(a).

Replace section 20-2.07C(3) with:

07-21-17

20-2.07C(3) PVC Pipe Conduit Sleeve

Where PVC pipe conduit sleeves 2 inches or less in outside diameter are installed under surfacing, you may install by directional boring under section 20-2.07C(2)(b).

Cap ends of conduit until used.

07-21-17

Delete the 4th and 5th paragraph of section 20-2.08C(4).

Replace sections 20-2.09B and 20-2.09C with:

07-15-16

20-2.09B Materials

20-2.09B(1) General

Swing joints must match the inlet connection size of the riser.

Where shown, a sprinkler assembly must include a check valve.

Threaded nipples for swing joints and risers must be schedule 80, PVC 1120 or PVC 1220 pipe, and comply with ASTM D1785. Risers for sprinkler assemblies must be UV resistant.

Fittings for sprinkler assemblies must be injection-molded PVC, schedule 40, and comply with ASTM D2466.

Flexible hose for sprinkler assemblies must be leak-free, non-rigid and comply with ASTM D2287, cell Type 6564500. The hose must comply with ASTM D2122 and have the thickness shown in the following table:

Nominal hose diameter (inch)	Minimum wall thickness (inch)
1/2	0.127
3/4	0.154
1	0.179

Solvent cement and fittings for flexible hose must comply with section 20-2.08B(5).

20-2.09B(2) Pop-Up Sprinkler Assemblies

Each pop-up sprinkler assembly must include a body, nozzle, swing joint, pressure reducing device, fittings, and sprinkler protector where shown.

20-2.09B(3) Riser Sprinkler Assemblies

Each riser sprinkler assembly must include a body, flexible hose, threaded nipple, nozzle, swing joint (except for a Type V riser), pressure reducing device, fittings, and riser support where shown.

20-2.09B(4) Tree Well Sprinkler Assemblies

Each tree well sprinkler assembly must include a threaded nipple, nozzle, swing joint, fittings, perforated drainpipe, and drain grate.

The perforated drainpipe must be commercial-grade, rigid PVC pipe with holes spaced not more than 6 inches on center on 1 side of the pipe.

The drain grate must be a commercially-available, 1-piece, injection-molded grate manufactured from structural foam polyolefins with UV light inhibitors. Drain grate must be black.

Gravel for filling the drainpipe must be graded such that 100 percent passes the 3/4-inch sieve and 100 percent is retained on the 1/2-inch sieve. The gravel must be clean, washed, dry, and free from clay or organic material.

20-2.09C Construction

Where shown, install a flow shut-off device under the manufacturer's instructions, unless you use equipment with a preinstalled flow shut-off device.

Where shown, install a pressure reducing device under the manufacturer's instructions, unless you use equipment with a preinstalled pressure reducing device.

Install pop-up and riser sprinkler assembly:

1. From 6-1/2 to 8 feet from curbs, dikes, and sidewalks
2. At least 10 feet from paved shoulders
3. At least 3 feet from fences and walls

If sprinkler assembly cannot be installed within these limits, the location will be determined by the Engineer.

Set sprinkler assembly riser on slopes perpendicular to the plane of the slope.

Replace the paragraph of section 20-2.10B(3) with:

07-15-16

Each check valve must be one of the following:

1. Schedule 80 PVC with a factory setting to withstand a minimum 7-foot head on risers
2. Class 200 PVC if used on a nonpressurized plastic irrigation supply line
3. Internal to the sprinkler body with a factory setting to withstand a minimum 7-foot head

07-21-17

Delete item 3 in the list in the paragraph of section 20-2.10B(4).

Replace the paragraph of section 20-2.10C(3) with:

07-15-16

Install check valves as necessary to prevent low-head drainage.

Replace the paragraph of section 20-3.01B(3) with:

04-20-18

20-3.01B(3)(a) General

Soil amendment must comply with the provisions in the Food & Agri Code and as specified in the special provisions.

Replace the paragraphs of section 20-3.01B(10) with:

07-15-16

Each plant stake for vines must be nominal 1 by 1 inch and 18 inches long.

Each plant stake for trees must be nominal 2 by 2 inches or nominal 2 inches in diameter and long enough to keep the tree in an upright position.

Replace the paragraph of section 20-3.01B(11) with:

07-15-16

Each plant tie for vines must be extruded vinyl-based tape, 1 inch wide and at least 8 mils thick.

Each plant tie for trees must be a (1) minimum 3/4-inch-wide, UV-resistant, flexible vinyl tie complying with ASTM D412 for tensile and elongation strength, or (2) lock-stitch, woven polypropylene with a minimum 900 lb tensile strength.

Add between the 7th and 8th paragraphs of section 20-3.02C(3)(b):

07-15-16

Spread the vine shoots and tie them with a plant tie to each stake above the crossing point.

Replace the 8th paragraph of section 20-3.02C(3)(b) with:

07-15-16

Tie trees to the stakes with 2 tree ties, 1 tie to each stake. Each tie must form a figure eight by crossing the tie between the tree and the stake. Install ties at the lowest position that will support the tree in an upright position. Install the ties such that they provide trunk flexibility but do not allow the trunk to rub against the stakes. Wrap each end of the tie 1-1/2 turns around the stake and securely tie or nail it to the stake.

Replace the 1st paragraph of section 20-5.02C(1) with:

07-15-16

Where edging is used to delineate the limits of inert ground cover or wood mulch areas, install the edging before installing the inert ground cover or wood mulch.

07-15-16

Delete *AND MULCHES* in the heading of section 20-5.03.

07-15-16

Delete *and mulches* in the paragraph of section 20-5.03A(1)(a).

Replace the paragraph of section 20-5.03A(3)(a) with:

07-15-16

Before installing inert ground cover, remove plants and weeds to the ground level.

Add to the beginning of section 20-5.03A(3)(b):

07-21-17

Excavate to the depth shown.

07-15-16

Delete *or mulch* at each occurrence in sections 20-5.03A(3)(c) and 20-5.03A(3)(d).

Add to the end of section 20-5.03B(2)(c):

07-21-17

You may use rock with superficial chipping or jagged edges if the rock is placed such that the chipped areas and jagged edges are submerged in the concrete.

04-20-18

Delete the 1st paragraph of section 20-5.03B(3).

Add to the 2nd paragraph of section 20-5.03B(3):

07-21-17

Rock that is exposed on the finished surface must be round, smooth, clean and without jagged edges or chipped areas showing.

Replace section 20-5.03E with:

04-20-18

20-5.03E Rock Mulch

Reserved

Replace section 20-5.04 with:

07-15-16

20-5.04 WOOD MULCH

20-5.04A General

20-5.04A(1) Summary

Section 20-5.04 includes specifications for placing wood mulch.

20-5.04A(2) Definitions

Reserved

20-5.04A(3) Submittals

Submit a certificate of compliance for wood mulch.

Submit a 2 cu ft mulch sample with the mulch source shown on the bag. Obtain authorization before delivering the mulch to the job site.

20-5.04A(4) Quality Assurance

Reserved

20-5.04B Materials

20-5.04B(1) General

Mulch must not contain more than 0.1 percent of deleterious materials such as rocks, glass, plastics, metals, clods, weeds, weed seeds, coarse objects, sticks larger than the specified particle size, salts, paint, petroleum products, pesticides or chemical residues harmful to plant or animal life.

20-5.04B(2) Tree Bark Mulch

Tree bark mulch must be derived from cedar, Douglas fir, or redwood species.

The mulch must be ground such that at least 95 percent of the material by volume is less than 2 inches long in any dimension and no more than 30 percent by volume is less than 1 inch long in any dimension.

20-5.04B(3) Wood Chip Mulch

Wood chip mulch must:

1. Be derived from clean wood
2. Not contain leaves or small twigs
3. Contain at least 95 percent by volume of wood chips with a width and thickness from 1/16 to 3/8 inch and a length from 1/2 to 3 inches

20-5.04B(4) Shredded Bark Mulch

Shredded bark mulch must:

1. Be derived from trees
2. Be a blend of loose, long, thin wood, or bark pieces
3. Contain at least 95 percent by volume of wood strands with a width and thickness from 1/8 to 1-1/2 inches and a length from 2 to 8 inches

20-5.04B(5) Tree Trimming Mulch

Tree trimming mulch must:

1. Be derived from chipped trees and may contain leaves and small twigs
2. Contain at least 95 percent by volume of material less than 3 inches long for any dimension and not more than 30 percent by volume of material less than 1 inch long for any dimension

20-5.04B(6)–20-5.04B(11) Reserved

20-5.04C Construction

Before placing wood mulch, remove plants and weeds to the ground level.

Maintain the planned flow lines, slope gradients, and contours of the job site. Grade the subgrade to a smooth and uniform surface.

Place mulch after the plants have been planted.

Place mulch in the plant basin at the rate described. Mulch must not come in contact with the plant crown and stem.

Place mulch as shown in areas outside of plant basins to a uniform thickness.

Spread mulch from the outside edge of the plant basin to the adjacent edges of shoulders, paving, retaining walls, dikes, edging, curbs, sidewalks, walls, fences, and existing plantings. If the plant is 12 feet or more from the adjacent edges of any of these elements, spread the mulch 6 feet beyond the outside edge of the plant basin.

Do not place mulch within 4 feet of:

1. Flow line of earthen drainage ditches
2. Edge of paved ditches
3. Drainage flow lines

20-5.04D Payment

The payment quantity for wood mulch is the volume measured in the vehicle at the point of delivery.

Add between *plants* and *if* in the 1st sentence of section 20-10.03C(2):

04-20-18

under section 20-3.01C(2)

Add between *prune* and *each* in the 1st paragraph of section 20-10.03C(3):

04-20-18

under section 20-3.01C(2)

^^

21 EROSION CONTROL

04-20-18

Replace the paragraph of section 21-1.01 with:

01-20-17

Section 21-1 includes general specifications for applying permanent erosion control measures.

Replace section 21-2.02C with:

04-20-18

21-2.02C Imported Topsoil

Imported topsoil must:

1. Consist of fertile, friable soil of loamy character that contains organic matter in quantities natural to the region and be capable of sustaining healthy plant life
2. Be free from deleterious substances such as litter, refuse, toxic waste, stones larger than 1 inch in size, coarse sand, heavy or stiff clay, brush, sticks, grasses, roots, noxious weed seed, weeds, and other substances detrimental to plant, animal, and human health

Replace the paragraphs in section 21-2.02K with:

04-20-18

Reserved

Replace the paragraphs in section 21-2.02Q with:

04-20-18

Reserved

07-21-17

Delete *and compost socks* in the 4th paragraph of section 21-2.02R.

Replace the 2nd sentence in the 1st paragraph of section 21-2.03B with:

07-21-17

Apply duff to the edge of the shoulder backing. When shoulder backing is absent, do not apply duff within 3 feet of the edge of pavement.

Replace section 21-2.03C with:

04-20-18

21-2.03C Imported Topsoil

Place imported topsoil after all other earthwork in an area is complete.

Spread imported topsoil to a uniform thickness.

Trackwalk imported topsoil with tracked equipment run perpendicular to slope contours. Water may be used to assist the process but must not cause erosion.

Replace item 3 in the list in the 2nd paragraph of section 21-2.03F with:

07-21-17

Apply seed to the edge of the shoulder backing. When shoulder backing is absent, do not apply seed within 3 feet of the edge of pavement.

Add to the end of the paragraph of section 21-2.03I:

07-21-17

Apply compost to the edge of the shoulder backing. When shoulder backing is absent, do not apply compost within 3 feet of the edge of pavement.

Replace items 2 and 3 in the list in the 2rd paragraph of section 21-2.03Q with:

07-21-17

2. Fasten compost sock to soil surface.
3. Remove sock and stakes if ordered. Cut sock and empty contents in place. This work is change order work.

Add between the 2nd and 3rd paragraphs of section 21-2.04:

07-21-17

The payment quantity for bid items paid for by volume is the volume measured in the vehicle at the point of delivery.

04-20-18

Delete the 4th paragraph of section 21-2.04.

07-21-17

Delete the 5th paragraph of section 21-2.04.

Replace section 21-3 with:

01-20-17

21-3 PERMANENT EROSION CONTROL ESTABLISHMENT WORK

Reserved

^^^

DIVISION IV SUBASES AND BASES

23 GENERAL

01-20-17

Replace the headings and paragraphs in section 23 with:

07-15-16

23-1 GENERAL

23-1.01 GENERAL

23-1.01A Summary

Section 23 includes general specifications for constructing subbases and bases.

23-1.01B Definitions

Reserved

23-1.01C Submittals

Submit a QC plan for the types of subbases or bases where described.

23-1.01D Quality Assurance

23-1.01D(1) General

23-1.01D(1)(a) General

Take samples under California Test 125.

23-1.01D(1)(b) Test Result Disputes

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer within 5 business days of receiving the test result if you dispute the test result.

01-20-17

If you or the Engineer dispute each other's test results, submit your test results and copies of paperwork including worksheets used to determine the disputed test results. An independent third party performs referee testing. Before the independent third party participates in a dispute resolution, it must be qualified under AASHTO re:source program and the Department's Independent Assurance Program. The independent third party must have no prior direct involvement with this Contract. By mutual agreement, the independent third party is chosen from:

1. Department laboratory in a district or region not in the district or region the project is located
2. Transportation Laboratory
3. Laboratory not currently employed by you or your material producer

07-15-16

If split acceptance samples are not available, the independent third party uses any available material representing the disputed material for evaluation.

If the independent third party determines the Department's test results are valid, the Engineer deducts the independent third party testing costs from payments. If the independent third party determines your test results are valid, the Department pays the independent third party testing costs.

23-1.01D(2) Quality Control

23-1.01D(2)(a) General

Provide a QC manager when the quantity of subbase or base is as shown in the following table:

QC Manager Requirements

Subbase or base	Requirement
Stabilized soil (sq yd)	≥ 20,000
Aggregate subbases (cu yd)	≥ 20,000
Aggregate bases (cu yd)	≥ 20,000
CTB (cu yd)	≥ 10,000
Lean concrete base (cu yd)	≥ 2,000
Rapid strength concrete base (cu yd)	≥ 1,000
Lean concrete base rapid setting (cu yd)	≥ 1,000
Concrete base (cu yd)	≥ 1,000
Treated permeable bases (cu yd)	≥ 2,000
Reclaimed pavements (sq yd)	≥ 10,000

Provide a testing laboratory to perform quality control tests. Maintain sampling and testing equipment in proper working condition.

You are not entitled to compensation for the suspension of work resulting from noncompliance with quality control requirements, including those identified within the QC plan.

23-1.01D(2)(b) Quality Control Plan

The QC plan must describe the organization and procedures used to:

1. Control the production process
2. Determine if a change to the production process is needed
3. Implement a change

The QC plan must include action and suspension limits and details of corrective action to be taken if any process is outside of those limits. Suspension limits must not exceed specified acceptance criteria.

The QC plan must describe how test results will be submitted including times for sampling and testing for each quality characteristic.

23-1.01D(2)(c) Qualifications

Testing laboratories and testing equipment must comply with the Department's Independent Assurance Program.

Personnel performing sampling and testing must be qualified under the Department's Independent Assurance Program for the sampling and testing performed.

23-1.01D(3) Department Acceptance

Reserved

23-1.02 MATERIALS

Not Used

23-1.03 CONSTRUCTION

Not Used

23-1.04 PAYMENT

Not Used

23-2–23-7 RESERVED

^^

24 STABILIZED SOILS

07-21-17

Add to section 24-1.01C(1):

07-15-16

Submit a stabilized soil quality control plan.

Add to section 24-1.01D(1):

07-15-16

Construct test pads for compaction tests by scraping away material to the depth ordered. If a compaction test fails, corrective action must include the layers of material already placed above the test pad elevation.

Replace section 24-1.01D(2) with:

07-15-16

24-1.01D(2) Quality Control

24-1.01D(2)(a) General

Reserved

24-1.01D(2)(b) Quality Control Plan

Reserved

24-1.01D(2)(c) Qualifications

Reserved

24-1.01D(2)(d) Preparing Basement Material

After preparing an area for soil stabilization, verify the surface grades.

24-1.01D(2)(e) Mixing

Except for clods larger than 1 inch, randomly test the adequacy of the mixing with a phenolphthalein pH indicator solution.

Add to the end of footnote *a* in the table in section 24-1.01D(3):

07-21-17

For cement stabilized soil, see section 24-3.03D.

Replace the 1st paragraph of section 24-1.03C with:

07-15-16

The Engineer orders the application rate as pounds of stabilizing agent per square yard of basement material to be stabilized.

07-15-16

Delete section 24-2.01D(1)(c)

Replace *250* in the 2nd sentence in the 2nd paragraph of section 24-2.01D(2)(c) with:

07-15-16

500

Add to section 24-2.01D(2):

07-15-16

24-2.01D(2)(d) Quality Control Testing

Lime stabilized soil quality control must include testing the quality characteristics at the frequencies shown in the following table:

QC Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum frequency
Ground surface temperature before adding lime and full depth ground temperature during mixing operations	--	Each temperature location	1 test per 20,000 sq ft, minimum 1 per day
Lime application rate	Calibrated tray or equal	Roadway	1 test per 40,000 sq ft, minimum 2 per day
Gradation on mixed material	California Test 202	Roadway	1 per 500 cu yd, minimum 1 per day
Moisture content	California Test 226	Roadway	1 per 500 cu yd on each layer, each day during mixing and mellowing periods, minimum 1 per day
Relative compaction	California Test 231	Roadway	1 per 500 cu yd on each layer, minimum 1 per day

Replace section 24-3 with:

07-21-17

24-3 CEMENT STABILIZED SOIL

24-3.01 GENERAL

24-3.01A Summary

Section 24-3 includes specifications for constructing CSS by mixing basement material with cement and water.

24-3.01B Definitions

Reserved

24-3.01C Submittals

Submit cement samples under California Test 125. Include the mill analysis.

Submit a certificate of compliance under section 90-1.01C(3).

24-3.01D Quality Assurance

24-3.01D(1) General

24-3.01D(1)(a) General

Stop CSS activities and immediately notify the Engineer if either of the following occurs:

1. Any quality control test result does not comply with the specifications
2. Visual inspection shows noncompliant CSS

If CSS activities are stopped, before resuming activities:

1. Notify the Engineer of the adjustments you will make
2. Reprocess, remedy, or replace the noncompliant CSS until it complies with specifications
3. Construct a 1,000 square yard test strip of CSS demonstrating ability to comply with the specifications
4. Obtain the Engineer's authorization

24-3.01D(1)(b) Preparing Basement Material

For every 1,000 sq yd of basement material to be cement stabilized:

1. Test the relative compaction under California Test 231
2. Test the moisture content under California Test 226

24-3.01D(1)(c) Applying Cement

The Engineer determines the final application rate based on ASTM D1633, Method A, except:

1. Test specimens must be compacted under ASTM D1557, Method A or B.
2. Test specimens must be cured by sealing each specimen with 2 layers of plastic at least 4 mil thick. The plastic must be tight around the specimen. Seal all seams with duct tape to prevent moisture loss. Sealed specimens must be placed in an oven for 7 days at 100 ± 5 degree F. At the end of the curing period, specimens must be removed from the oven and air-cooled. Duct tape and plastic wrap must be removed before capping. Specimens must not be soaked before testing.

The application rate is ordered as pounds of cement per square yard of basement material to be stabilized.

Before applying cement, measure and record the air temperature and in situ moisture content of the basement material to be stabilized.

The Engineer verifies the application rate using a calibrated tray or equal once per 40,000 sq ft of stabilized basement material, or twice per day, whichever is greater.

24-3.01D(2) Quality Control

24-3.01D(2)(a) General

Reserved

24-3.01D(2)(b) Mixing

During mixing operations, measure and record the air temperature for the basement material to be stabilized.

For each day of mixing, test the in-place moisture content under California Test 231, Part 1, Section E and verify moisture content under California Test 226. Sample immediately after mixing.

After mixing, maintain the in-place moisture of the basement material to be stabilized within a range of 1 percent below to 2 percent above the optimum moisture determined under California Test 216. Determine in-place moisture content under California Test 231. During compaction and finish grading, add water to the surface to prevent drying until the next layer of mixed material is placed, or until you apply curing treatment.

24-3.01D(2)(c) Compaction

After compaction, determine in-place wet density under California Test 231 and moisture content under California Test 226, at the same locations. Perform one test per 1,000 sq yd of CSS. Test in 0.50-foot depth intervals from the bottom of the CSS layer regardless of the layer thickness. Convert wet density to dry density and calculate relative compaction under California Test 216 on a dry density basis.

24-3.01D(2)(d) Quality Control Testing

Cement stabilized soil quality control must include testing the quality characteristics at the frequencies shown in the following table:

QC Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum frequency
Air temperature before adding cement to basement material	--	Each temperature location	1 test per 20,000 sq ft, minimum 1 per day
Moisture content of basement material before adding cement	California Test 226	Roadway	1 per 1000 sq yd per layer, minimum 1 per day
Cement application rate	Calibrated tray or equal	Roadway	1 test per 20,000 sq ft, minimum 2 per day
Gradation on mixed material	California Test 202	Roadway	1 per 1000 sq yd per layer, minimum 1 per day
Moisture content of mixed material	California Test 226	Roadway	1 per 1000 sq yd per layer, minimum 1 per day
Moisture content of compacted material at time of relative compaction testing	California Test 231	Roadway	1 per 1000 sq yd per layer, minimum 1 per day
Relative compaction	California Test 231	Roadway	1 per 1000 sq yd per layer, minimum 1 per day

24-3.02 MATERIALS

Cement must comply with section 90-2.01A, Type II or Type V portland cement.

24-3.03 CONSTRUCTION

24-3.03A General

Remove standing water from the basement material.

Apply cement at air temperatures above 40 degrees F and rising. Do not apply cement to frozen basement material.

During compaction and finish grading, add water to the surface to prevent drying until the next layer of mixed material is placed, or until you apply curing treatment.

Do not scarify surfaces of intermediate or final layers of CSS.

24-3.03B Applying Cement

Apply cement uniformly over the area to be stabilized using a vane spreader.

Do not apply dry cement in windy conditions that will result in dust outside the treatment area.

24-3.03C Mixing

You may mix cement and the basement material off the job site.

Complete initial mixing work within 30 minutes of the application of cement.

After mixing, maintain the in-place moisture of the basement material to be stabilized within a range of 1 percent below to 2 percent above the optimum moisture.

Before compaction, the CSS, except rock, must within the percentage passing limits for the sieve sizes shown in the following table:

Cement Stabilized Soil Gradation

Sieve sizes	Percentage passing
2"	100
3/4"	98-100
No. 4	55-100

24-3.03D Compaction

Complete initial compaction of a layer within 2 hours of initial mixing of cement.

Complete all compaction of a layer within 4 hours of mixing of cement.

Compact the CSS to at least 97 percent relative compaction.

24-3.03E Finish Grading

Maintain the moisture content of the CSS to within a range of 1 percent below and 2 percent above the optimum moisture content through the entire finish grading operation.

Finish rolling of trimmed surfaces must be performed within 2 hours of completion of compacting.

The finished surface of the CSS must not vary more than 0.05 foot above or below the grade established by the Engineer unless the CSS is to be covered by material paid for by the cubic yard, in which case the finished surface may not vary above the grade established by the Engineer.

Fill areas of finished CSS that are lower than the grade established by the Engineer with material specified for the subsequent layer.

24-3.03F Curing

24-3.03F(1) General

Choose the method of curing and apply the chosen cure method on the same day as completing compaction and any trimming and finish grading.

Do not trim CSS after curing.

24-3.03F(2) Subsequent Pavement Layer

For CSS you may cure by placing a subsequent pavement layer over the finished CSS.

You may place subsequent pavement layers any time after finish grading if the CSS is sufficiently stable to support the required construction equipment without marring or permanently distorting the surface.

24-3.04 PAYMENT

The Department does not adjust the unit price for an increase or decrease in cement quantity.

The Department does not pay for subsequent layer material used to fill low areas of cement stabilized soil.

^^

25 AGGREGATE SUBBASES

07-21-17

Add to the beginning of section 25:

07-21-17

25-1 GENERAL

Replace *Reserved* in section 25-1.01C with:

07-15-16

Submit an aggregate subbase QC plan.

Replace *Reserved* in section 25-1.01D(2) with:

07-15-16

25-1.01D(2)(a) General

Reserved

25-1.01D(2)(b) Quality Control Plan

Reserved

25-1.01D(2)(c) Qualifications

Reserved

25-1.01D(2)(d) Quality Control Testing

AS quality control must include testing the quality characteristics at the frequencies shown in the following table:

QC Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum frequency
R-value	California Test 301	Stockpiles, transportation units, windrows, or roadways	1 test before beginning work and every 2000 cu yd thereafter[a]
Aggregate gradation	California Test 202	Stockpiles, transportation units, windrows, or roadways	1 per 500 cu yd but at least one per day of placement
Sand equivalent	California Test 217	Stockpiles, transportation units, windrows, or roadways	
Relative compaction	California Test 231	Roadway	1 per 500 sq yd on each layer

[a]Additional R-value frequency testing will not be required when the average of 4 consecutive sand equivalent tests is 4 or more above the specified operating range value.

Add between the 2nd and 3rd paragraphs of section 25-1.01D(3):

07-15-16

The Engineer takes aggregate subbase samples for R-value, aggregate gradation, and sand equivalent from any of the following locations:

1. Windrow
2. Roadway

07-15-16

Delete *for each noncompliant test result* in the 4th paragraph of section 25-1.01D(3).

07-15-16

Delete *a* in the 5th paragraph of section 25-1.01D(3).

Add to the end of section 25:

07-21-17

25-2–25-10 RESERVED

^^

26 AGGREGATE BASES

07-21-17

Add to the beginning of section 26:

07-21-17

26-1 GENERAL

Replace *Reserved* in section 26-1.01C with:

07-15-16

Submit an aggregate base QC plan.

Replace *Reserved* in section 26-1.01D(1) with:

07-15-16

Aggregate samples must not be treated with lime, cement, or chemicals before testing for durability index. Aggregate from untreated reclaimed processed AC, PCC, LCB, or CTB is not considered treated.

Replace *Reserved* in section 26-1.01D(2) with:

07-15-16

26-1.01D(2)(a) General

Reserved

26-1.01D(2)(b) Quality Control Plan

Reserved

26-1.01D(2)(c) Qualifications

Reserved

26-1.01D(2)(d) Quality Control Testing

AB quality control must include testing the quality characteristics at the frequencies shown in the following table:

QC Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum frequency
R-value	California Test 301	Stockpiles, transportation units, windrows, or roadways	1 test before starting work and every 2,000 cu yd thereafter[a]
Aggregate gradation	California Test 202	Stockpiles, transportation units, windrows, or roadways	1 per 500 cu yd but at least one per day of placement
Sand equivalent	California Test 217	Stockpiles, transportation units, windrows, or roadways	
Durability index[b]	California Test 229	Stockpiles, transportation units, windrows, or roadways	1 per project
Relative compaction	California Test 231	Roadway	1 per 500 sq yd on each layer

[a]Additional R-value frequency testing will not be required when the average of 4 consecutive sand equivalent tests is 29 or greater for Class 2 AB or 25 or greater for Class 3 AB.
[b]Applies if section 26-1.02 contains an applicable requirement for durability index

Add between *requirements,* and *and* in the 1st paragraph of section 26-1.01D(3):

07-15-16

durability,

Add between the 2nd and 3rd paragraphs of section 26-1.01D(3):

07-15-16

The Engineer takes aggregate base samples for R-value, aggregate gradation, sand equivalent, and durability index from any of the following locations:

1. Windrow
2. Roadway

07-15-16

Delete the 3rd paragraph of section 26-1.01D(3).

Add to the end of section 26:

07-21-17

26-2–26-10 RESERVED

^^

27 CEMENT TREATED BASES

07-21-17

Add to the beginning of section 27:

07-21-17

27-1 GENERAL

Add to section 27-1.01C:

07-15-16

Submit cement treated base QC plan.

Replace the headings and paragraphs in section 27-1.01D with:

07-15-16

27-1.01D Quality Assurance

27-1.01D(1) General

After the CTB has been spread on the subgrade and before initial compaction, the cement content of the completed mixture of CTB must not vary from the specified cement content by more than 0.6 percent of the weight of the dry aggregate when tested under California Test 338.

For Class A CTB, compaction is tested under California Test 312 or 231.

The relative compaction of CTB must be at least 95 percent. Each layer of CTB may be tested for compaction, or all layers may be tested together at the option the Engineer. If all layers are tested together, you are not relieved of the responsibility to achieve the required compaction in each layer placed.

27-1.01D(1)(a) Aggregate

When tested under California Test 301, aggregate for Class B CTB must have (1) an R-value of at least 60 before mixing with cement and (2) an R-value of at least 80 when aggregate is mixed with an amount of cement that does not exceed 2.5 percent by weight of the dry aggregate.

Before sand equivalent testing, aggregate samples must not be treated with lime, cement, or chemicals.

If the aggregate gradation test results, the sand equivalent test results, or both comply with contract compliance requirements but not operating range requirements, you may continue placing CTB for the remainder of the work day. Do not place additional CTB until you demonstrate to the Engineer that the CTB to be placed complies with the operating range requirements.

If the aggregate gradation test results, sand equivalent test results, or both do not comply with contract compliance requirements, remove the CTB or request a payment deduction. If your request is authorized, $2.50/cu yd is deducted. If CTB is paid for by weight, the Engineer converts tons to cubic yards for the purpose of reducing payment for noncompliant CTB left in place. An aggregate gradation and a sand equivalent test represents up to (1) 500 cu yd or (2) 1 day's production if less than 500 cu yd.

27-1.01D(1)(b) Road-Mixed Cement Treated Base Moisture Content

Just before initial compaction the moisture content of the completed mixture must be at least the optimum moisture content less 1 percent. The moisture content is determined under California Test 226 and optimum moisture content is determined under California Test 312.

27-1.01D(1)(c) Plant-Mixed Cement Treated Base Moisture Content

At the point of delivery to the work, the moisture content of the completed mixture must be at least the optimum moisture content less 1 percent. The moisture content is determined under California Test 226 and optimum moisture content under California Test 312.

27-1.01D(2) Quality Control

27-1.01D(2)(a) General

Reserved

27-1.01D(2)(b) Quality Control Plan

Reserved

27-1.01D(2)(c) Qualifications

Reserved

27-1.01D(2)(d) Quality Control Testing

CTB quality control must include testing the quality characteristics at the frequencies shown in the following table:

QC Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum frequency
Aggregate gradation	California Test 202 modified	Stockpiles, plant, transportation units, windrow, or roadway	1 per 500 cu yd but at least one per day of placement
Sand equivalent	California Test 217	Stockpiles, plant, transportation units, windrow, or roadway	
R-value[a]	California Test 301	Stockpiles, plant, transportation units, windrows, or roadway	1 test before starting work and every 2000 cu yd thereafter[b]
Optimum moisture content	California Test 312	Plant, transportation units, windrow, or roadway	1 per day of placement
Moisture content	California Test 226	Roadway	1 per 500 cu yd but at least one per day of placement
Cement content	California Test 338	Windrows or roadway	1 per 1000 cu yd but at least one per day of placement
Relative compaction	California Test 312 or 231	Roadway	1 per 2000 sq yd but at least one per day of placement
Compressive strength[c]	California Test 312	Windrow or roadways	1 per day of placement

[a]R-value is required for Class B CTB only
[b]Additional R-value frequency testing will not be required while the average of 4 consecutive sand equivalent tests is 4 or more above the specified operating range value.
[c]Compressive strength is required for Class A CTB only when specified

27-1.01D(3) Department Acceptance

The Department's acceptance testing includes testing the CTB quality characteristics shown in the following table:

CTB Requirements for Acceptance

Quality characteristic	Test method
Aggregate gradation	California Test 202 modified
Sand equivalent	California Test 217
R-value[a]	California Test 301
Optimum moisture content	California Test 312
Moisture content	California Test 226
Cement content	California Test 338
Relative compaction	California Test 312 or 231
Compressive strength[b]	California Test 312

[a]R-value is required for Class B CTB only
[b]Compressive strength is required for Class A CTB only when specified

The Engineer takes samples for aggregate gradation and sand equivalent from any of the following locations:

1. Plant
2. Truck
3. Windrow, for road-mixed only
4. Roadbed, for road-mixed only

Add to section 27-1.02:

07-15-16

Water must comply with section 90-1.02D.

Add to section 27-1.03F:

07-15-16

The relative compaction of CTB must be at least 95 percent.

Add to the end of section 27:

07-21-17

27-2–27-10 RESERVED

^^

28 CONCRETE BASES

07-15-16

Replace the headings and paragraphs in section 28-1.01D with:

07-15-16

28-1.01D Quality Assurance

28-1.01D(1) General

Aggregate samples must not be treated with lime, cement, or chemicals before testing for sand equivalent.

Stop concrete base activities and immediately notify the Engineer whenever:

1. Any QC or QA test result does not comply with the specifications
2. Visual inspection shows a noncompliant concrete base

If concrete base activities are stopped, before resuming activities:

1. Notify the Engineer of the adjustments you will make
2. Remedy or replace the noncompliant concrete base
3. Field qualify or construct a new test strip as specified for the concrete base involved to demonstrate compliance with the specifications
4. Obtain authorization

28-1.01D(2) Quality Control

28-1.01D(2)(a) General

Reserved

28-1.01D(2)(b) Quality Control Plan

Reserved

28-1.01D(2)(c) Qualifications

Reserved

28-1.01D(3) Department Acceptance

Reserved

Add to section 28-2.01C(1):

07-15-16

Submit a lean concrete base QC plan.

Replace the headings and paragraphs in section 28-2.01D with:

07-15-16

28-2.01D Quality Assurance

28-2.01D(1) General

28-2.01D(1)(a) General

The molds for compressive strength testing under ASTM C31 or ASTM C192 must be 6 by 12 inches.

If the aggregate gradation test results, sand equivalent test results or both comply with the contract compliance requirements but not the operating range requirements, you may continue placing LCB for the remainder of the work day. Do not place additional LCB until you demonstrate the LCB to be placed complies with the operating range requirements.

28-2.01D(1)(b) Qualifications

Field qualification tests and calculations must be performed by an ACI certified "Concrete Laboratory Technician, Grade I.

28-2.01D(1)(c) Aggregate Qualification Testing

Qualify the aggregate for each proposed aggregate source and gradation. The qualification tests include (1) a sand equivalent and (2) an average 7-day compressive strength under ASTM C39 of 3 cylinders manufactured under ASTM C192 except cure cylinders in molds without lids after initial curing.

For the compressive strength test, the cement content for each cylinder must be 300 lb/cu yd. The 7-day average compressive strength must be at least 610 psi. The cement must be Type II portland cement.

LCB must have from 3 to 4 percent air content during aggregate qualification testing.

28-2.01D(1)(d) Field Qualification Testing

Before placing LCB, you must perform field qualification testing and obtain authorization for each mix design. Retest and obtain authorization for changes to the authorized mix designs.

Notify the Engineer at least 5 business days before field qualification. Perform the field qualification at the job site or an authorized location.

Field qualification testing includes tests for compressive strength, air content, and penetration or slump.

For compressive strength field qualification testing:

1. Prepare 12 cylinders under ASTM C31 except final cure cylinders in molds without lids from a single batch.
2. Perform 3 tests; each test consists of determining the average compressive strength of 2 cylinders at 7 days under ASTM C39. The average compressive strength for each test must be at least 530 psi

If you submitted a notice to produce LCB qualifying for a transverse contraction joint waiver, manufacture additional specimens and test the LCB for compressive strength at 3 days. Prepare the compressive strength cylinders under ASTM C31 except final cure cylinders in molds without lids at the same time using the same material and procedures as the 7-day compressive strength cylinders except do not submit 6 additional test cylinders. The average 3-day compressive strength for each test must be not more than 500 psi.

28-2.01D(2) Quality Control

28-2.01D(2)(a) General

Reserved

28-2.01D(2)(b) Quality Control Manager

Reserved

28-2.01D(2)(c) Quality Control Testing

Test the LCB under the test methods and at the locations and frequencies shown in the following table:

LCB Sampling Location and Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum sampling and testing frequency
Sand equivalent	ASTM D2419	Source	1 per 500 cubic yards but at least 1 per day of production
Aggregate gradation	ASTM C136		
Air content	ASTM C231	Job site	
Penetration[a]	ASTM C360		
Slump[a]	ASTM C143		
Compressive strength	ASTM C39 [b]		

[a]Test for either penetration or slump

[b]Prepare cylinders under ASTM C31 except final cure cylinders in molds without lids.

28-2.01D(3) Department Acceptance

The Department accepts LCB based on compliance with the requirements shown in the following table:

LCB Requirements for Acceptance

Quality characteristic	Test method	Requirement
Compressive strength (min, psi at 7 days)	ASTM C39 [a]	530 [b]

[a] Cylinders prepared under ASTM C31 except final cure cylinders in molds without lids.

[b] A compressive strength test represents up to (1) 1,000 cu yd or (2) 1 day's production if less than 1,000 cu yd.

Replace *section 28-2.01D(4)* in item 3 of the 5th paragraph in section 28-2.03D with:

07-15-16

section 28-2.01D(1)(c)

Replace the 1st paragraph in section 28-2.03F with:

07-15-16

After finishing LCB, cure LCB with pigmented curing compound under section 90-1.03B(3) and 40-1.03I. Apply curing compound:

1. In 2 separate applications
2. Before the atmospheric temperature falls below 40 degrees F
3. At a rate of 1 gal/150 sq ft for the first application
4. At a rate of 1 gal/200 sq ft for the second application

Replace *Reserved* in section 28-3.01C(3) with:

07-15-16

Submit a rapid strength concrete base QC plan.

Replace the headings and paragraphs in section 28-3.01D with:

07-15-16

28-3.01D Quality Assurance

28-3.01D(1) General

28-3.01D(1)(a) General

At the preconstruction meeting be prepared to discuss the project specifications and methods of performing each item of work. Items discussed must include the processes for:

1. Production
2. Transportation
3. Placement
4. QC plan, if specified in the special provisions
5. Contingency plan
6. QC sampling and testing
7. Acceptance criteria

Beams for modulus of rupture testing must be fabricated and tested under California Test 524. The beams may be fabricated using an internal vibrator under ASTM C31. For each test, 3 beam must be fabricated and the test results averaged. No single test represents more than that day's production or 130 cu yd, whichever is less.

For early age testing, beams must be cured so the monitored temperatures in the beams and the test strip are always within 5 degrees F. The internal temperatures of the RSC base and early age beams must be monitored and recorded at intervals of at least 5 minutes. Thermocouples or thermistors connected to strip-chart recorders or digital data loggers must be installed to monitor the temperatures. Temperature recording devices must be accurate to within ±2 degrees F. Until early age testing is completed, internal temperatures must be measured at 1 inch from the top, 1 inch from the bottom, and no closer than 3 inches from any edge.

For other age testing, beams must be cured under California Test 524 except beams must be placed into sand at a time that is the earlier of either from 5 to 10 times the final set time, or 24 hours.

RSC base must have an opening age modulus of rupture of not less than 400 psi and a 7-day modulus of rupture of not less than 600 psi.

28-3.01D(1)(b) Preconstruction Meeting

Reserved

28-3.01D(1)(c) Test Strip

Reserved

28-3.01D(2) Quality Control

28-3.01D(2)(a) General

Reserved

28-3.01D(2)(b) Quality Control Manager

Reserved

28-3.01D(2)(c) Quality Control Testing

Test the rapid strength concrete base under the test methods and at the locations and frequencies shown in the following table:

Rapid Strength Concrete Base Sampling Location and Testing Frequencies

Quality characteristic	Test method	Sample Location	Minimum testing frequency[a]
Cleanness value	California Test 227	Source	1 per 500 cubic yards but at least 1 per shift
Sand equivalent	California Test 217		
Aggregate gradation	California Test 202		
Air content	California Test 504	Job site	1 per 130 cu yd but at least 1 per shift
Yield	California Test 518		1 per shift
Slump or penetration	ASTM C143 or California Test 533		1 per 2 hours of placement
Density	California Test 518		1 per shift
Aggregate moisture meter calibration[b]	California Test 223 or California Test 226		1 per shift
Modulus of rupture	California Test 524		1 per 130 cu yd but at least 1 per shift

[a]Test at the most frequent interval.
[b]Check calibration of the plant moisture meter by comparing moisture meter readings with California Test 223 or California Test 226 test results.

Notify the Engineer at least 2 business days before any sampling and testing. Submit testing results within 15 minutes of testing completion. Record inspection, sampling, and testing on the forms accepted with the QC plan and submit them within 48 hours of completion of each day of production and within 24 hours of 7-day modulus of rupture tests.

During the placement of RSC base, fabricate beams and test for the modulus of rupture:

1. At opening age
2. At 7 days after placing the first 30 cu yd
3. At least once every 130 cu yd
4. Within the final truckload

Opening age tests must be performed in the presence of the Engineer.

28-3.01D(3) Department Acceptance

The Department accepts RSC base based on compliance with the requirements shown in the following table:

RSC Base Requirements for Acceptance

Quality characteristic	Test method	Requirement
Modulus of rupture (min, psi at 7 days)	California Test 524	600

The Engineer adjust payment for RSC base for the 7-day modulus of rupture as follows:

1. Payment for a base with a modulus of rupture of 600 psi or greater is not adjusted.
2. Payment for a base with a modulus of rupture of less than 600 and greater than or equal to 550 psi is reduced by 5 percent.
3. Payment for a base with a modulus of rupture of less than 550 and greater than or equal to 500 psi is reduced by 10 percent.
4. Payment for a base with a modulus of rupture of less than 500 psi is not adjusted and no payment is made. Remove and replace this base.

Add to section 28-4.01C(1):

07-15-16

Submit a lean concrete base rapid setting QC plan.

Replace the headings and paragraphs in section 28-4.01D with:

07-15-16

28-4.01D Quality Assurance

28-4.01D(1) General

28-4.01D(1)(a) General

For compressive strength testing, prepare 6 cylinders under California Test 540. Test cylinders must be 6 by 12 inches. As an alternative to rodding, a vibrator may be used under California Test 524. Test cylinders under California Test 521 and perform 3 tests with each test consisting of 2 cylinders. The test result is the average from the 2 cylinders.

28-4.01D(1)(b) Field Qualification

Before placing lean concrete base rapid setting, you must perform field qualification testing and obtain authorization for each mix design. Retest and obtain authorization for changes to authorized mixed designs.

Proposed mix designs must be field qualified before you place the base represented by those mix designs. The technician performing the field test must hold current ACI certification as a Concrete Field Testing Technician-Grade I.

Notify the Engineer at least 5 days before field qualification. Perform field qualification within the job site or a location authorized.

Field qualification testing includes compressive strength, air content, and penetration or slump in compliance with the table titled "Lean Concrete Base Rapid Setting Requirements."

Field qualification must comply with the following:

1. Test for compressive strength at opening age and 7 days of age
2. At opening age, the compressive strength for each test must be at least 180 psi and the average strength for the 3 tests must be at least 200 psi
3. At 7 days age, the compressive strength for each test must be at least 600 psi and the average strength for the 3 tests must be at least 725 psi

28-4.01D(2) Quality Control

28-4.01D(2)(a) General

Reserved

28-4.01D(2)(b) Quality Control Manager

Reserved

28-4.01D(2)(c) Quality Control Testing

Test the base under the test methods and at the locations and frequencies shown in the following table:

LCB Rapid Setting Sampling Location and Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum sampling and testing frequency
Sand equivalent	ASTM D2419	Source	1 per 500 cu yd, minimum 1 per day of production
Aggregate gradation	ASTM C136		
Air content	ASTM C231	Job site	1 per 4 hours of placement work, plus one in the last hour of placement work
Penetration[a]	ASTM C360		
Slump[a]	ASTM C143		
Compressive strength	California Test 521		

[a]Test either penetration or slump

During placement of lean concrete base rapid setting, fabricate cylinders and test compressive strength for opening age and 7 days. Opening age tests must be performed in the presence of the Engineer.

28-4.01D(3) Department Acceptance

The Department accepts LCB rapid setting based on compliance with the requirement shown in the following table:

LCB Rapid Setting Requirements for Acceptance

Quality characteristic	Test method	Requirement
Compressive strength (min, psi at 7 days)	California Test 521[a]	725

[a]Cylinders made under California Test 540

Replace the 2nd and 3rd paragraphs in section 28-4.03A with:

07-15-16

Concrete paving operations with equipment not supported by the base may start before opening age. Do not open pavement for traffic before opening age of the LCB rapid setting.

Any other paving operations must start after the final set time of the base. The base must have a compressive strength of at least 450 psi under California Test 521 before:

1. Placing HMA
2. Placing other base material
3. Operating equipment on the base

Replace *Reserved* in section 28-5.01C with:

07-15-16

Submit a concrete base QC plan.

Replace the headings and paragraphs in section 28-5.01D(2) with:

07-15-16

28-5.01D(2) Quality Control

28-5.01D(2)(a) General

Reserved

28-5.01D(2)(b) Quality Control Manager

Reserved

28-5.01D(2)(c) Quality Control Testing

Test the concrete base under the test methods and at the locations and frequencies shown in the following table:

Concrete Base Sampling Location and Testing Frequencies

Quality characteristic	Test method	Sample location	Minimum testing frequency[a]
Cleanness value	California Test 227	Source	1 per 500 cubic yards but at least 1 per shift
Sand equivalent	California Test 217		
Aggregate gradation	California Test 202		
Air content	California Test 504	Job site	1 per 500 cu yd but at least 1 per shift
Yield	California Test 518		1 per shift
Slump or penetration	ASTM C143 or California Test 533		1 per 2 hours of placement
Density	California Test 518		1 per shift
Aggregate moisture meter calibration[b]	California Test 223 or California Test 226		1 per shift
Modulus of rupture	California Test 524		1 per 500 cu yd but at least 1 per shift

[a]Test at the most frequent interval.
[b]Check calibration of the plant moisture meter by comparing moisture meter readings with California Test 223 or California Test 226 test results.

28-5.01D(3) Department Acceptance

The Department accepts a concrete base based on compliance with the requirements shown in the following table:

Concrete Base Requirements for Acceptance

Quality characteristic	Test method	Requirement
Modulus of rupture (min, psi at 28 days)	California Test 523	570

Acceptance for the modulus of rupture is on a lot basis. The Department provides the molds and machines for the modulus of rupture acceptance testing. Provide any material and labor the Engineer may require for the testing.

^^

29 TREATED PERMEABLE BASES

07-15-16

Replace the headings and paragraphs in section 29-1.01 with:

07-15-16

29-1.01 GENERAL

29-1.01A Summary

Section 29-1 includes general specifications for constructing treated permeable bases.

29-1.01B Definitions

Reserved

29-1.01C Submittals

Submit a treated permeable base quality control plan.

29-1.01D Quality Assurance

29-1.01D(1) General

Reserved

29-1.01D(2) Quality Control

29-1.01D(2)(a) General

Reserved

29-1.01D(2)(b) Quality Control Plan

Reserved

29-1.01D(2)(c) Qualifications

Reserved

29-1.01D(3) Department Acceptance

Reserved

Replace the headings and paragraphs in section 29-2.01D with:

07-15-16

29-2.01D Quality Assurance

29-2.01D(1) General

The Engineer determines the asphalt content of the asphalt mixture under California Test 382. The bitumen ratio, pounds of asphalt per 100 lb of dry aggregate, must not vary more than 0.5 lb of asphalt above or below the quantity designated by the Engineer. Samples used to determine the bitumen ratio are obtained from trucks at the plant or from the mat behind the paver before rolling. If the sample is taken from the mat behind the paver, the bitumen ratio must not be less than the quantity designated by the Engineer, less 0.7 lb of asphalt per 100 lb of dry aggregate.

29-2.01D(2) Quality Control

29-2.01D(2)(a) General

Reserved

29-2.01D(2)(b) Quality Control Testing

ATPB quality control must include testing the quality characteristics at the frequencies shown in the following table:

QC Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum frequency
Gradation	California Test 202	Stockpiles or plant	1 for every 4 hours of production but at least one per day of placement
Cleanness value	California Test 227	Stockpiles or plant	1 for every 4 hours of production but at least one per day
Percentage of crushed particles	California Test 205	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter
Los Angeles rattler loss at 500 rev	California Test 211	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter
Film stripping	California Test 302	Plant	1 test before production and one every 5000 cu yd thereafter
Asphalt content of the asphalt mixture	California Test 382	Plant, transportation units, windrows, or roadway	1 for every 4 hours of production but at least one per day

29-2.01D(3) Department Acceptance

The Department accepts ATPB based on aggregate gradation, cleanness value, percent of crushed particles, Los Angeles rattler, film stripping and asphalt content requirements specified in section 29-2.02 and section 29-2.01D(1).

The Engineer takes samples for aggregate gradation, cleanness value, percent of crushed particles, Los Angeles rattler, and film stripping from the plant.

The Engineer takes samples for asphalt content of the asphalt mixture from any of the following locations:

1. Plant
2. Truck
3. Windrow
4. Roadbed

Replace the headings and paragraphs in section 29-3.01 with:

07-15-16

29-3.01 GENERAL

29-3.01A Summary

Section 29-3 includes specifications for constructing cement treated permeable bases.

29-3.01B Definitions

Reserved

29-3.01C Submittals

Reserved

29-3.01D Quality Assurance

29-3.01D(1) General

Reserved

29-3.01D(2) Quality Control

29-3.01D(2)(a) General

Reserved

29-3.01D(2)(b) Quality Control Testing

CTPB quality control must include testing the quality characteristics at the frequencies shown in the following table:

QC Testing Frequencies

Quality characteristic	Test method	Sampling location	Minimum frequency
Gradation	California Test 202	Stockpiles or plant	1 for every 4 hours of production but at least one per day of placement
Cleanness value	California Test 227	Stockpiles or plant	1 for every 4 hours of production but at least one per day
Los Angeles rattler loss at 500 rev	California Test 211	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter
Soundness	California Test 214	Stockpiles or plant	1 test before production and one every 5,000 cu yd thereafter

29-3.01D(3) Department Acceptance

The Department accepts CTPB based on aggregate gradation, cleanness value, Los Angeles rattler and soundness requirements in section 29-3.02.

The Engineer takes samples for aggregate gradation, cleanness value, Los Angeles rattler and soundness from the plant.

Add to section 29-3.02A:

07-15-16

Water must comply with section 90-1.02D.

Replace *3rd* in the 2nd paragraph in section 29-3.03 with:

07-15-16

4th

^^

30 RECLAIMED PAVEMENT

07-15-16

Replace *section 30-1.01C(2)(c)* in the 1st paragraph of section 30-3.01C(2)(c) with:

07-15-16

section 30-1.01C(3)(c)

Replace the table in section 30-3.02A with:

07-15-16

FDR—Foamed Asphalt Quality Characteristic Requirements

Quality characteristic	Test method	Requirement
Moisture content before HMA paving	California Test 226	< 50% of OMC
Asphalt binder expansion ratio (min, %)	Note a	10
Asphalt binder half-life (seconds, min)		12
Gradation (%, passing) Sieve Size: 3 inch 2 inch 1-1/2 inch	California Test 202	 100 95–100 85–100
Moisture content Maximum Minimum	California Test 226	 OMC OMC - 2%
In-place wet density (lb/cu ft)	California Test 216	Report only
Relative compaction (min, %)	California Test 231	98
Indirect dry tensile strength (psi)[b]	California Test 371	90% of mix design value
Indirect wet tensile strength (psi)[b]	California Test 371	90% of mix design value
Tensile strength ratio (%)	California Test 371	90% of mix design value

[a]Test at the foaming temperature and percentage of foaming water by dry weight of FDR—foamed asphalt material designated in the mix design. To test asphalt binder expansion ratio and half-life, use a pail of known volume and a dipstick calibrated for the pail. From the inspection nozzle on the asphalt binder spray bar, inject foamed asphalt into the pail without exceeding the pail's capacity. With the dipstick, immediately measure and record the level of foamed asphalt in the pail. Record the half-life in seconds from the time the injection of foamed asphalt in the pail is turned off to half the dip stick reading after peak. Calculate the expansion ratio as the volume of the foamed asphalt upon injection divided by the volume of the unfoamed asphalt binder.

[b]From material passing the 1-inch sieve, compact 6 specimens under California Test 304, Part 2. Cure the specimens at 100 °F for 72 hours and allow the specimens to cool to room temperature. Test 3 specimens for dry tensile strength under California Test 371. Test 3 specimens for wet tensile strength under California Test 371 after moisture conditioning.

Replace *section 30-4.01D(3)* in the 2nd paragraph of section 30-4.01D(1) with:

07-15-16

section 30-4.01D(4)

Replace *section 30-4.01D(1)(a)* in the table in section 30-4.02A with:

07-15-16

section 30-4.01D(2)

^^^

DIVISION V SURFACINGS AND PAVEMENTS

36 GENERAL

04-20-18

Replace section 36-3 with:

07-21-17

36-3 PAVEMENT SMOOTHNESS

36-3.01 GENERAL

36-3.01A Summary

Section 36-3 includes specifications for measuring the smoothness of pavement surfaces.

36-3.01B Definitions

area of localized roughness: Moving average of the International Roughness Index values for each wheel path using a 25-foot continuous interval and a 250-mm filter.

Mean Roughness Index: Average of the International Roughness Index values for the left and right wheel paths for the same traffic lane using a fixed interval and a 250-mm filter.

wheel paths: Pair of lines 3 feet from and parallel to the edges of a traffic lane. Left and right wheel paths are based on the direction of travel.

36-3.01C Submittals

36-3.01C(1) General

Reserved

36-3.01C(2) Inertial Profiler Certification

At least 5 business days before starting initial profiling or changing the inertial profiler or operator, submit:

1. Inertial profiler certification issued by the Department
2. Operator certification for the inertial profiler issued by the Department
3. Manufacturer's instructions and test procedures for calibration and verification of the inertial profiler

Within 2 business days after cross-correlation testing, submit a ProVAL profiler certification analysis report for the test results to the Engineer and to the electronic mailbox address smoothness@dot.ca.gov.

36-3.01C(3) Inertial Profiler Data

36-3.01C(3)(a) General

04-20-18

At least 15 days before inertial profiling, you must register with the Department's secure file sharing system. To obtain information on the registration process, send an e-mail with your contact information to smoothness@dot.ca.gov.

Within 2 business days after each day of profiling, submit the profile information to the Engineer and to the Department's secure file sharing system. After submitting the profile information to the Department’s file sharing system, send a notification of your electronic submittal to the Engineer and to the above electronic mailbox address with the names of the files submitted.

For each surface with inertial profile smoothness requirements, the profiling information must include:

1. Raw profile data for each lane
2. ProVAL ride quality analysis report for the Mean Roughness Index of each lane in a PDF file. Report the following:
   - 2.1. Listing of Mean Roughness Index values for 0.1-mile segments or portions thereof
   - 2.2. Inputs, including the specified Mean Roughness Index threshold and fixed segment length
   - 2.3. Raw profile data name selections
   - 2.4. Areas exempt from inertial profile smoothness
3. ProVAL ride quality analysis report for the International Roughness Index of the left and right wheel paths of each lane in a PDF file. Report the following:
   - 3.1. Listing of areas of localized roughness

3.2. Inputs, including the specified area of the localized roughness threshold and continuous segment length
3.3. Raw profile data name selections
3.4. Areas exempt from inertial profile smoothness

4. GPS data file for each lane. Submit the data file in GPS eXchange file format.
5. Manufacturer's recommended calibration and verification test results for the inertial profiler.
6. Inertial profiler's calibration and verification test results, including results for bounce, block, and the distance measurement instrument.
7. Completed Pavement Smoothness Inertial Profiler Submittal Record.

Submit Asphalt Concrete Pavement Smoothness Corrections Information or Concrete Pavement Smoothness Corrections Information with your final profiling information submittal.

Submit the raw profile data in an unfiltered electronic pavement profile file format. Use the following file-naming convention:

YYYYMMDD_TTCCCRRR_EA_D_L_W_B_E_X_PT.PPF

where:

YYYY = year

MM = month, leading zero

DD = day of month, leading zero

TT = district, leading zero

CCC = county, 2- or 3-letter abbreviation as shown in section 1-1.08

RRR = route number with no leading zeros

EA = Contract number, excluding the district identification number, expressed as 6 characters

D = traffic direction, *NB*, *SB*, *WB*, or *EB*

L = lane number from left to right in the direction of travel

W = wheel path, *L* for left, *R* for right, or *B* for both

B = beginning station to the nearest foot, such as 10+20, or beginning post mile to the nearest hundredth, such as 25.06 with no leading zero

E = ending station to the nearest foot, such as 14+20, or ending post mile to the nearest hundredth, such as 28.06 with no leading zero

X = profile operation, *EXIST* for existing pavement, *INTER* for after prepaving smoothness correction, *MILL* for after milling, *PAVE* for after paving, and *CORR* for after final surface pavement correction, and FINAL for completed pavement documentation of compliance.

PT = type of pavement surface profiled, such as Type A HMA, RHMA-G, OGFC, JPCP, or CRCP

If you are submitting multiple inertial profiler data files, compress the files into a .ZIP file format and submit them using the file-naming convention TT_EA_X_YYYYMMDD.zip.

07-21-17

36-3.01C(3)(b) Smoothness Corrective Grinding Plan

At least 2 business days before performing corrective grinding for areas of localized roughness or areas exceeding the specified thresholds for the Mean Roughness Index, submit a corrective grinding plan as an informational submittal.

The corrective grinding plan must include:

1. Grinder manufacturer make and model

2. Grinder wheelbase in feet, measured from the front centerline to the back centerline of the single wheel or tandem wheel spread
3. Grinder head position in feet, measured relative to the centerline of the front single wheel or the front tandem wheel spread
4. Tandem wheel spreads in feet, for rear and front wheels as applicable
5. Tabular listing of the planned corrective grinding, including:
   5.1. Start and stop locations in stationing to the nearest foot
   5.2. Width of grind, such as left half lane, right half lane, or full width lane
   5.3. Corresponding grinder head depths to the nearest 0.01 inch
   5.4. Direction of grind, up to 2 passes per grind location, such as forward, reverse, forward-forward, reverse-reverse, forward-reverse, reverse-forward
   5.5. Distance from start or stop locations to the nearest semipermanent reference point
6. Forecasted improvement in terms of the Mean Roughness Index and area of localized roughness values

36-3.01C(4) Straightedge Measurements

Within 2 business days of measuring smoothness with a straightedge, submit a list of the areas requiring smoothness correction or a report stating there are no areas requiring smoothness correction. Identify the areas requiring smoothness correction by:

1. Location number
2. District-County-Route
3. Beginning station or post mile to the nearest 0.01 mile
4. For correction areas within a traffic lane:
   4.1. Lane direction, *NB, SB, EB*, or *WB*
   4.2. Lane number from left to right in the direction of travel
   4.3. Wheel path, *L* for left, *R* for right, or *B* for both
5. For correction areas not within a traffic lane:
   5.1. Identify the pavement area, such as shoulder, weigh station, or turnout
   5.2. Direction and distance from the centerline, *L* for left or *R* for right
6. Estimated size of correction area

36-3.01D Quality Assurance

36-3.01D(1) General

Reserved

36-3.01D(2) Certifications

The inertial profiler must display a current certification decal showing the expiration date.

The operator must be certified for each model of inertial profiler operated.

The certifications issued by the Department for the inertial profiler and operator must not be more than 12 months old.

36-3.01D(3) Quality Control

36-3.01D(3)(a) General

Reserved

36-3.01D(3)(b) Smoothness

36-3.01D(3)(b)(i) General

Test pavement smoothness using an inertial profiler except use a 12-foot straightedge for the pavement at:

1. Traffic lanes less than 1,000 feet in length, including ramps, turn lanes, and acceleration and deceleration lanes
2. Horizontal curves with a centerline radius less than the following and within the superelevation transition of such curves:
   2.1. 150 feet for asphalt concrete pavements
   2.2. 300 feet for Portland cement concrete pavements

3. Areas within 12.5 feet of manholes
4. Shoulders
5. Weigh-in-motion areas
6. Miscellaneous areas such as medians, gore areas, turnouts, and maintenance pullouts

Where inertial profiler testing is required:

1. Determine the pavement smoothness for each traffic lane by obtaining the International Roughness Index for the left and right wheel paths in an individual lane
2. Determine the Mean Roughness Index and areas of localized roughness using FHWA's engineering software ProVAL

Where OGFC is required, test the pavement smoothness of the final HMA or concrete pavement surface before placing OGFC and after placing OGFC.

36-3.01D(3)(b)(ii) Inertial Profiler Calibration and Verification Tests

Notify the Engineer at least 2 business days before performing calibration and verification testing of the inertial profiler.

Conduct the following calibration and verification tests in the Engineer's presence each day before profiling:

1. Block test to verify the accuracy of the height sensor under California Test 387
2. Bounce test to verify the combined accuracy of the height sensor and accelerometer under California Test 387
3. Distance measurement instrument test to verify the accuracy of the distance measuring instrument under California Test 387
4. Manufacturer's recommended tests

Conduct a cross-correlation verification test of the inertial profiler in the Engineer's presence before performing the initial profiling. A verification test must be performed at least annually. Conduct 5 repeat runs of the inertial profiler on an authorized test section. The test section must be a 0.1-mile segment of existing concrete pavement if you are measuring new concrete pavement or existing asphalt concrete pavement if you are measuring new asphalt concrete pavement. Where micro-milled asphalt concrete surfaces are to be measured, the cross-correlation verification test may be performed on the initial 0.1-mile section of milled asphalt concrete surface. Calculate a cross-correlation to determine the repeatability of your device under California Test 387 using a ProVAL profiler certification analysis with a 3-foot maximum offset. The cross-correlation must be a minimum of 0.92.

36-3.01D(3)(b)(iii) Performing, Analyzing, and Collecting Data

Operate the inertial profiler under the manufacturer's instructions and AASHTO R 57 at 1-inch recording intervals using a minimum 4-inch line laser sensor.

Establish semipermanent reference points for aligning inertial profiler runs and locating potential corrective grinding. Place semipermanent reference points at a frequency of 0.5 mile or less along the edge of the traffic lane or roadway. Maintain semipermanent reference points until Department acceptance testing is completed.

Collect profiling data under AASHTO R 57 and analyze it using 250 mm and International Roughness Index filters.

While collecting the profile data to determine the International Roughness Index values, record semipermanent reference points and the beginning and end of the following locations in the raw profile data:

1. Bridge approach slabs
2. Bridges
3. Culverts visible on the roadway surface
4. Railroad crossings
5. At-grade intersections
6. Project limits

7. Change in pavement type

Profile the left and right wheel paths of each lane.

Determine the Mean Roughness Index for 0.1-mile fixed sections using the ProVAL ride quality analysis with a 250 mm filter. Calculate the Mean Roughness Index of each lane. A partial section equal or less than 0.05-mile length is to be included with the previous or the subsequent segment forming up to a 0.15-mile length. A partial section greater than 0.05 mile, but less than 0.10 mile, is a separate segment. Sections must comply with the Mean Roughness Index specifications for a full section. A weighted average calculation will be used for those partial sections that have been combined with previous or subsequent segments.

Determine the areas of localized roughness using ProVAL with the average International Roughness Index values for each wheel path using a 25-foot continuous interval and a 250 mm filter.

36-3.01D(4) Department Acceptance

The Department accepts pavement surfaces for smoothness based on compliance with the smoothness specifications for the type of pavement surface specified.

For areas that require pavement smoothness determined using a 12-foot straightedge, the pavement surface must not vary from the lower edge of the straightedge by more than:

1. 0.01 foot when the straightedge is laid parallel with the centerline
2. 0.02 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. 0.02 foot when the straightedge is laid within 24 feet of a pavement conform

Pavement located within 12.5 feet of the ends of bridges, approach slabs, culverts visible on the roadway surface, railroad crossings, at-grade intersections, and transverse surface joints with existing pavement must comply with Mean Roughness Index and 12-foot straightedge requirements. The requirements for areas of localized roughness do not apply to these areas.

For each 0.1-mile section, your International Roughness Index values must be within 10 percent of the Department's International Roughness Index values. The Engineer may order you to recalibrate your inertial profiler equipment and reprofile. If your results are inaccurate due to operator error, the Engineer may disqualify your inertial profiler operator.

36-3.02 MATERIALS

Not Used

36-3.03 CONSTRUCTION

Notify the Engineer of the start location by station and start time at least 2 business days before each day of profiling.

Before profiling, remove foreign objects from the pavement surface and mark the beginning and ending station on the pavement shoulder. The stationing must be the same when profiling more than one surface.

36-3.04 PAYMENT

Not Used

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37 BITUMINOUS SEALS

01-20-17

Replace section 37 with:

07-15-16

37 SEAL COATS

37-1 GENERAL

37-1.01 GENERAL

37-1.01A Summary

Section 37-1 includes general specifications for applying seal coats.

37-1.01B Definitions

Reserved

37-1.01C Submittals

At least 10 days before the preconstruction meeting submit a list of participants in the preconstruction meeting. Provide each participant's name, employer, title, and role in the production and placement of the seal coats.

At least 10 days before starting seal coat activities, submit the names of the authorized laboratories for quality control testing.

For each delivery of asphalt binder or asphaltic emulsion to the job site, submit a certificate of compliance and a copy of the specified test results.

For a seal coat that uses crumb rubber modifier, submit a Crumb Rubber Usage Report form monthly and at the end of project.

37-1.01D Quality Assurance

37-1.01D(1) General

For aggregate testing, quality control laboratories must be in compliance with the Department's Independent Assurance Program to be an authorized laboratory. Quality control personnel must be qualified under the Department's Independent Assurance Program.

01-20-17

For emulsion testing, quality control laboratories must participate in the AASHTO re:source proficiency sample program.

07-15-16

37-1.01D(2) Preconstruction Meeting

Hold a preconstruction meeting within 5 days before start of seal coat work at a mutually agreed time and place with the Engineer and your:

1. Project superintendent
2. Project foreman
3. Traffic control foreman

Make arrangements for the conference facility. Preconstruction meeting participants must sign an attendance sheet provided by the Engineer. Be prepared to discuss:

1. Quality control testing
2. Acceptance testing
3. Seal coat placement
4. Proposed application rates for asphaltic emulsion or asphalt binder and aggregate.
5. Training on placement methods
6. Checklist of items for proper placement
7. Unique issues specific to the project, including:
   - 7.1. Weather
   - 7.2. Alignment and geometrics
   - 7.3. Traffic control requirements

7.4. Haul distances
7.5. Presence and absence of shaded areas
7.6. Any other local conditions

8. Contingency plan for material deliveries, equipment breakdowns, and traffic handling
9. Who in the field has authority to adjust application rates and how adjustments will be documented
10. Schedule of sweepings

37-1.02 MATERIALS

Not Used

37-1.03 CONSTRUCTION

37-1.03A General

If seal coat activities affect access to public parking, residential property, or commercial property, post signs at 100-foot intervals on the affected streets. Signs must display *No Parking – Tow Away*. Signs must state the dates and hours parking or access will be restricted. Notify residents, businesses, and local agencies at least 24 hours before starting activities. The notice must:

1. Describe the work to be performed
2. Detail streets and limits of activities
3. Indicate dates and work hours
4. Be authorized

Asphaltic emulsion or asphalt binder for seal coats may be reheated if necessary. After loading the asphaltic emulsion or asphalt binder into a truck for transport to the job site, do not heat asphaltic emulsion above 160 degrees F and asphalt rubber binder above 425 degrees F. During reheating, circulate or agitate the asphaltic emulsion or asphalt binder to prevent localized overheating.

Except for fog seals, apply quick setting Grade 1 asphaltic emulsions at a temperature from 75 to 130 degrees F and apply quick setting Grade 2 asphaltic emulsions at a temperature from 110 to 185 degrees F.

You determine the application rates for asphaltic emulsion or asphalt binder and aggregate and the Engineer authorizes the application rates.

37-1.03B Equipment

A self-propelled distributor truck for applying asphaltic emulsion or asphalt binder must be equipped with:

1. Pressure-type system with insulated tanks with circulating unit
2. Spray bars:
   2.1. With minimum length of 9 feet and full-circulating type
   2.2. With full-circulating-type extensions if needed to cover a greater width
   2.3. Adjustable to allow positioning at various heights above the surface to be treated
   2.4. Operated by levers such that 1 or all valves may be quickly opened or closed in one operation
3. Devices and charts to provide for accurate and rapid determination and control of asphaltic emulsion or asphalt binder quantities being applied. Include an auxiliary wheel type meter that registers:
   3.1. Speed in ft/min
   3.2. Trip by count
   3.3. Total distance in feet
4. Distribution system:
   4.1. Capable of producing a uniform application of asphaltic emulsion or asphalt binder in controlled quantities ranging from 0.02 to 1 gal/sq yd of surface and at a pressure ranging from 25 to 75 psi
   4.2. Pumps that spray asphaltic emulsion or asphalt binder within 0.02 gal/sq yd of the set rate
   4.3. With a hose and nozzle for application of asphaltic emulsion to areas inaccessible to the spray bar
   4.4. With pressure gauges and a thermometer for determining temperatures of the asphaltic emulsion or asphalt binder

You may use cab-controlled valves for the application of asphaltic emulsion or asphalt binder. The valves controlling the flow from nozzles must act positively to provide a uniform unbroken application of asphaltic emulsion or asphalt binder.

Maintain distributor and storage tanks at all times to prevent dripping.

37-1.04 PAYMENT

Not Used

37-2 CHIP SEALS

37-2.01 GENERAL

37-2.01A General

37-2.01A(1) Summary

Section 37-2.01 includes general specifications for applying chip seals.

37-2.01A(2) Definitions

Reserved

37-2.01A(3) Submittals

At least 15 days before starting placement of chip seal, submit:

1. Samples for:
   1.1. Asphaltic emulsion chip seal, two 1-quart wide mouth plastic containers with screw top lid of asphaltic emulsion
   1.2. Polymer modified asphaltic emulsion chip seal, two 1-quart wide mouth plastic containers with screw top lid of polymer modified asphaltic emulsion
   1.3. Asphalt rubber binder chip seal, two 1-quart cans of base asphalt binder
   1.4. Asphalt rubber binder chip seal, five 1-quart cans of asphalt rubber binder
2. Asphaltic emulsion, polymer modified asphaltic emulsion, asphalt binder or asphalt rubber binder data as follows:
   2.1. Supplier and Type/Grade of asphaltic emulsion or asphalt binder
   2.2. Type of modifier used including polymer or crumb rubber or both
   2.3. Percent of crumb rubber, if used as modifier
   2.4. Copy of the specified test results for asphaltic emulsion or asphalt binder
3. 50 lb of uncoated aggregate
4. Aggregate test results for the following:
   4.1. Gradation
   4.2. Los Angeles Rattler
   4.3. Percent of crushed particles
   4.4. Flat and elongated particles
   4.5. Film stripping
   4.6. Cleanness value
   4.7. Durability
5. Vialit test results

Submit quality control test results for the quality characteristics within the reporting times allowance after sampling shown in the following table:

Quality Control Test Result Reporting

Quality characteristic	Maximum reporting time allowance
Los Angeles Rattler loss (max, %)	48 hours
Percent of crushed particles (min, %)	48 hours
Flat and elongated particles (max by weight at 3:1, %)	48 hours
Film stripping (max, %)	48 hours
Durability (min)	48 hours
Gradation (percentage passing)	24 hours
Cleanness value (min)	24 hours
Asphaltic emulsion spread rate (gal/sq yd)	24 hours

Within 3 days after taking asphaltic emulsion or asphalt binder quality control samples, submit the authorized laboratory's test results.

37-2.01A(4) Quality Assurance

37-2.01A(4)(a) General

Reserved

37-2.01A(4)(b) Quality Control

37-2.01A(4)(b)(i) General

Reserved

37-2.01A(4)(b)(ii) Aggregate

All tests must be performed on uncoated aggregate except for film stripping which must be performed on precoated aggregate.

For aggregate, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

Aggregate Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Los Angeles Rattler loss (max, %) At 100 revolutions At 500 revolutions	California Test 211	1st day of production	See California Test 125
Percent of crushed particles Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve) One fractured face	AASHTO T 335	1st day of production	See California Test 125
Flat and elongated particles (max by weight at 3:1, %)	ASTM D4791	1st day of production	See California Test 125
Film stripping (max, %)	California Test 302	1st day of production	See California Test 125
Durability (min)	California Test 229	1st day of production	See California Test 125
Gradation (% passing)	California Test 202	2 per day	See California Test 125
Cleanness value (min)	California Test 227	2 per day	See California Test 125

37-2.01A(4)(b)(iii) Chip Seals

For a chip seal, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

Chip Seal Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Asphaltic emulsion binder spread rate (gal/sq yd)	California Test 339	1 per day per distributor truck	Pavement surface

37-2.01A(4)(c) Department Acceptance

Department Acceptance shall not apply to identified areas where the existing surfacing before application of chip seal, contains defective areas as determined by the Engineer and Contractor. At least 7 days

before starting placement of the chip seal, the Contractor shall submit a written list of existing defective areas, identifying the lane direction, lane number, starting and ending highway post mile locations, and defect type. The Engineer must agree on which of the identified areas are defective.

Defective areas are defined as one of the following:

1. Areas with wheel path rutting in excess of 3/8 inch when measured by placing a straightedge 12 feet long on the finished surface perpendicular to the center line and measuring the vertical distance between the finished surface and the lower edge of the straightedge
2. Areas exhibiting flushing

For a chip seal, acceptance is based on visual inspection for the following:

1. Uniform surface texture
2. Raveling, which consists of the separation of the aggregate from the asphaltic emulsion or asphalt binder
3. Flushing, which consists of the occurrence of a film of asphaltic material on the surface of the chip seal.
4. Streaking, which consists of alternating longitudinal bands of asphaltic emulsion or asphalt binder without uniform aggregate retention, approximately parallel with the lane line.

Areas of raveling, flushing or streaking that are greater than 0.5 sq ft shall be considered defective and must be repaired.

Raveling and streaking must be repaired by placing an additional layer of chip seal over the defective area.

For asphaltic emulsion or asphalt binder, acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristics specified.

For aggregate, acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Chip Seal Aggregate Acceptance Criteria

Quality characteristic	Test method	Requirements
Los Angeles Rattler loss (max, %) At 100 revolutions At 500 revolutions	California Test 211	 10 40
Percent of crushed particles: Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve) One fractured face	AASHTO T 335	 95 90 70
Flat and elongated particles (max by weight at 3:1, %)	ASTM D4791	10
Film stripping (max, %)	California Test 302	25
Durability (min)	California Test 229	52
Gradation (% passing by weight)	California Test 202	Aggregate Gradation table shown under Materials for the chip seal type specified.
Cleanness value (min)	California Test 227	80

If test results for the aggregate gradation do not comply with specifications, you may remove the chip seal represented by these tests or request that it remain in place with a payment deduction. The deduction is $1.75 per ton for the aggregate represented by the test results.

If test results for aggregate cleanness value do not comply with the specifications, you may remove the chip seal represented by these tests or you may request that the chip seal remain in place with a pay deduction corresponding to the cleanness value shown in the following table:

Chip Seal Cleanness Value Deductions

Cleanness value	Deduction
80 or over	None
79	$2.00 /ton
77–78	$4.00 /ton
75–76	$6.00 /ton

If the aggregate cleanness value is less than 75, remove the chip seal.

37-2.01B Materials

37-2.01B(1) General

Reserved

37-2.01B(2) Asphaltic Emulsions and Asphalt Binders

Reserved

37-2.01B(3) Aggregate

37-2.01B(3)(a) General

Aggregate must be broken stone, crushed gravel, or both.

Aggregate must comply with the requirements shown in the following table:

Chip Seal Aggregate Requirements

Quality characteristic	Test method	Requirements
Los Angeles Rattler loss (max, %) At 100 revolutions At 500 revolutions	California Test 211	 10 40
Percent of crushed particles Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve) One fractured face	AASHTO T 335	 95 90 70
Flat and elongated particles (max by weight at 3:1, %)	ASTM D4791	10
Film stripping (max, %)	California Test 302	25
Durability (min)	California Test 229	52
Gradation (% passing by weight)	California Test 202	Aggregate Gradation table shown under Materials for the chip seal type specified.
Cleanness value (min)	California Test 227	80

The authorized laboratory must conduct the Vialit test using the proposed asphaltic emulsion or asphalt binder and aggregate for compliance with the requirements shown in the following table:

Chip Retention Requirements

Quality characteristic	Test method	Requirement
Chip retention (%)	Vialit test method for aggregate in chip seals, French chip (Modified)[a]	95

[a]The asphaltic emulsion or asphalt binder must be within the field placement temperature range and application rate during specimen preparation. For asphalt binder cure the specimen for first 2 hours at 100 °F.

37-2.01B(3)(b) Precoated Aggregate

Precoating of aggregate must be performed at a central mixing plant. The plant must be authorized under the Department's *MPQP*.

When precoating aggregate, do not recombine fine materials collected in dust control systems.

Precoated aggregate must be preheated from 260 to 325 degrees F. Coat with any of the asphalts specified in the table titled "Performance Graded Asphalt Binder" in section 92. The asphalt must be from 0.5 to 1.0 percent by weight of dry aggregate. You determine the exact asphalt rate for precoating of aggregate.

Do not stockpile precoated aggregate.

37-2.01C Construction

37-2.01C(1) General

For chip seals on 2-lane, 2-way roadways, place a W8-7 (LOOSE GRAVEL) sign and a W13-1 (35) plaque at 2,000-foot maximum intervals along each side of the traveled way where aggregate is spread on a traffic lane and at public roads or streets entering the chip seal area. Place the 1st W8-7 sign in each direction where traffic first encounters the loose aggregate, regardless of which lane the aggregate is spread on. A W13-1 (35) plaque is not required where the posted speed limit is less than 40 mph.

For chip seals on freeways, expressways, and multilane conventional highways, place a W8-7, (LOOSE GRAVEL) sign and a W13-1 (35) plaque at 2,000-foot maximum intervals along the outside edge of the traveled way nearest to the lane worked on, at on ramps, and at public roads or streets entering the chip seal area. Place the 1st W8-7 sign where the aggregate starts with respect to the direction of travel on that lane. A W13-1 (35) plaque is not required where the posted speed limit is less than 40 mph.

Pilot cars must have cellular or radio contact with other pilot cars and personnel in the work zone. The maximum speed of the pilot cars convoying or controlling traffic through the traffic control zone must be 15 mph on 2-lane, two-way highways and 25 mph on multilane divided and undivided highways. Pilot cars must only use traffic lanes open to traffic.

On the days that closures are not allowed, you may use a moving closure to maintain the seal coat surface. The moving closure is only allowed during daylight hours when traffic will be the least inconvenienced and delayed. The Engineer determines the hours for the moving closure.

Maintain signs in place at each location until the final sweeping of the chip seal surface for that location is complete. Signs may be set on temporary portable supports with the W13-1 sign below the W8-7 sign or on barricades with the W13-1 sign alternating with the W8-7 sign.

Schedule chip seal activities so that the chip seals are placed on both lanes of the traveled way each work shift.

If traffic is routed over a surface where a chip seal application is intended, the chip seal must not be applied to more than half the width of the traveled way at a time, and the remaining width must be kept free of obstructions and open to traffic until the previously applied width is ready for traffic use.

Wherever maintenance sweeping of the chip seal surface is complete, place permanent traffic stripes and pavement markings within 10 days.

If you fail to place the permanent traffic stripes and pavement markings within the specified time, the Department withholds 50 percent of the estimated value of the chip seal work completed that has not received permanent traffic stripes and pavement markings.

37-2.01C(2) Equipment

Equipment for chip seals must include and comply with the following:

1. Aggregate haul trucks must have:
   1.1. Tailgate that discharge aggregate
   1.2. Device to lock onto the rear aggregate spreader hitch
   1.3. Dump bed that will not push down on the spreader when fully raised
   1.4. Dump bed that will not spill aggregate on the roadway when transferred to the spreader hopper
   1.5. Tarpaulin to cover precoated aggregate when haul distance exceeds 30 minutes or ambient temperature is less than 65 degrees F
2. Self-propelled aggregate spreaders must have:
   2.1. Aggregate hopper in the rear
   2.2. Belt conveyor that carries the aggregate to the front
   2.3. Spreading hopper capable of providing a uniform aggregate spread rate over the entire width of the traffic lane in 1 application.
3. Self-propelled power brooms must:
   3.1. Not be steel-tined brooms on emulsion chip seals
   3.2. Be capable of removing loose aggregate adjacent to barriers that prevent aggregate from being swept off the roadway, including curbs, gutters, dikes, berms, and railings
4. Pneumatic or foam filled rubber tired rollers must:
   4.1. Be an oscillating type at least 4 feet wide
   4.2. Be self-propelled and reversible
   4.3. Have tires of equal size, diameter, type, and ply
   4.4. Carry at least 3,000 lbs of load on each wheel
   4.5 Have tires with an air pressure of 100 ± 5 psi or be foam filled

37-2.01C(3) Surface Preparation

Before applying chip seals, cover manholes, valve and monument covers, grates, or other exposed facilities located within the area of application, using a plastic or oil resistant construction paper secured by tape or adhesive to the facility being covered. Reference the covered facilities with enough control points to relocate the facilities after the application of the chip seal.

Immediately before applying chip seals, clean the surface to receive a chip seal by removing any extraneous material affecting adhesion of the chip seal with the existing surface and drying. Use self-propelled power brooms to clean the existing pavement.

37-2.01C(4) Placement

37-2.01C(4)(a) General

Schedule the operations so that chip seals are placed on both lanes of the traveled way each work shift. At the end of the work shift, the end of the chip seals on both lanes must generally match.

37-2.01C(4)(b) Applying Asphaltic Emulsions or Asphalt Binders

Prevent spraying on existing pavement not intended for chip seals or on previously applied chip seals using a material such as building paper. Remove the material after use.

Align longitudinal joints between chip seal applications with designated traffic lanes.

For asphaltic emulsion or asphalt binder, overlap longitudinal joints by not more than 4 inches. You may overlap longitudinal joints up to 8 inches if authorized.

For areas not accessible to a truck distributor bar apply:

1. Asphaltic emulsions by hand spraying
2. Asphalt binders with a squeegee or other authorized means

You may overlap the asphaltic emulsion or asphalt binder applications before the application of aggregate at longitudinal joints.

Do not apply the asphaltic emulsion or asphalt binder unless there is sufficient aggregate at the job site to cover the asphaltic emulsion or asphalt binder.

Discontinue application of asphaltic emulsion or asphalt binder early enough to comply with lane closure requirements. Apply to 1 lane at a time and cover the lane width entirely in 1 operation.

37-2.01C(4)(c) Spreading Aggregates

37-2.01C(4)(c)(i) General

Prevent vehicles from driving on asphaltic emulsion or asphalt binder before spreading aggregate.

Spread aggregate within 10 percent of your determined rate.

Spread aggregate at a uniform rate over the full lane width in 1 application. Apply to 1 lane at a time.

Sweep excess aggregate at joints before spreading adjacent aggregate.

Operate the spreader at speeds slow enough to prevent aggregate from rolling over after dropping.

If the spreader is not moving, aggregate must not drop. If you stop spreading and aggregate drops, remove the excess aggregate before resuming activities.

37-2.01C(4)(c)(ii) Precoated Aggregate Application

During transit, cover precoated aggregate with tarpaulins if the ambient air temperature is below 65 degrees F or the haul time exceeds 30 minutes.

When applied, precoated aggregate must be from 225 to 325 degrees F.

37-2.01C(4)(d) Finishing

37-2.01C(4)(d)(i) General

Remove piles, ridges, or unevenly distributed aggregate. Repair permanent ridges, bumps, streaks or depressions in the finished surface. Spread additional aggregate and roll if aggregate is picked up by rollers or vehicles.

Chip seal joints between adjacent applications of a chip seal must be smooth, straight, uniform, and completely covered.

A coverage is 1 roller movement over the entire width of lane. A pass is 1 roller movement parallel to the chip seal application in either direction. Overlapping passes are part of the coverage being made and are not part of a subsequent coverage. Do not start a new coverage until completing the previous coverage.

Before opening to traffic, finish the chip seals in the following sequence:

1. Perform initial rolling consisting of 1 coverage with a pneumatic-tired roller
2. Perform final rolling consisting of 2 coverages with a pneumatic-tired roller
3. Sweep excess aggregate from the roadway and adjacent abutting areas
4. Apply a flush coat if specified
5. Remove covers from the facilities

37-2.01C(4)(d)(ii) Traffic Control With Pilot Car

For 2-lane 2-way roadways under 1-way traffic control, upon completion of final rolling, traffic must be controlled with pilot cars and routed over the new chip seal for a period of 2 to 4 hours before opening the lane to traffic not controlled with pilot cars.

For multilane roadways, when traffic is controlled with pilot cars, a maximum of 1 lane in the direction of travel must be open to traffic. Traffic must be controlled with pilot cars and be routed on the new chip seal surface of the lane for a minimum of 2 hours after completion of the initial sweeping and before opening the lane to traffic not controlled with pilot cars. Once traffic controlled with pilot cars is routed over the chip seal at a particular location, continuous control must be maintained at that location until the chip seal placement and sweeping on adjacent lanes to receive a chip seal is completed.

37-2.01C(4)(d)(iii) Sweeping

Sweeping must be performed after the chip seal has set and there is no damage or dislodging of aggregate from the chip seal surface. As a minimum, sweeping is required at the following times:

1. On 2-lane 2-way roadways, from 2 to 4 hours after traffic, controlled with pilot cars, has been routed on the chip seal
2. On multilane roadways, from 2 to 4 hours after aggregate have been placed
3. In addition to previous sweeping, perform final sweeping immediately before opening any lane to public traffic, not controlled with pilot cars

37-2.01C(4)(d)(iv) Excess Aggregate

Dispose of excess aggregate. If ordered, salvaging and stockpiling of excess aggregate is change order work.

37-2.01C(4)(e) Chip Seal Maintenance

Perform sweeping on the morning following the application of aggregate on any lane that has been open to traffic not controlled with pilot cars and before starting any other activities.

Chip seal surfaces must be maintained for 4 consecutive days from the day aggregate is applied. Maintenance must include sweeping to maintain a surface free of loose aggregate and to prevent formation of corrugations. Sweeping must not dislodge aggregate set in asphaltic emulsion or asphalt binder.

After 4 consecutive days, excess aggregate must be removed from the paved areas.

37-2.01D Payment

If there is no bid item for traffic control system, furnishing and using a pilot car is included in the various items of the work involved in applying the chip seal.

The payment quantity for precoated aggregate is the weight measured after the aggregate is preheated and precoated with asphalt binder.

If recorded batch weights are printed automatically, the payment quantity for aggregate is the weight determined from the printed batch weights if:

1. Total weight for the precoated aggregate per batch is printed
2. Total asphalt binder weight per batch is printed
3. Zero tolerance weight is printed before weighing the first batch and after weighing the last batch for each truckload
4. Time, date, mix number, load number, and truck identification are correlated with a load slip
5. Copy of the recorded batch weights is certified by a licensed weighmaster

37-2.02 ASPHALTIC EMULSION CHIP SEALS

37-2.02A General

37-2.02A(1) Summary

Section 37-2.02 includes specifications for applying asphaltic emulsion chip seals. An asphaltic emulsion chip seal includes applying an asphaltic emulsion, followed by aggregate, and then a flush coat.

A double asphaltic emulsion chip seal is the application of an asphaltic emulsion followed by aggregate, applied twice in sequence and then a flush coat.

37-2.02A(2) Definitions

Reserved

37-2.02A(3) Submittals

Immediately after sampling, submit two 1-quart plastic containers of asphaltic emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping container.

37-2.02A(4) Quality Assurance

37-2.02A(4)(a) General

Reserved

37-2.02A(4)(b) Quality Control

37-2.02A(4)(b)(i) General

Reserved

37-2.02A(4)(b)(ii) Asphaltic Emulsions

Circulate asphaltic emulsion in the distributor truck before sampling. Take samples from the distributor truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take two 1-quart samples in a plastic container with lined sealed lid for acceptance testing.

For asphaltic emulsion, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

Asphaltic Emulsion

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge[a]			
Tests on Residue from Distillation Test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Ductility	AASHTO T 51		
Solubility in trichloroethylene	AASHTO T 44		

[a]If the result of the particle charge is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

37-2.02A(4)(c) Department Acceptance

Aggregate acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Aggregate Gradation Acceptance Criteria

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight) Sieve size:	California Test 202	3/8"	5/16"	1/4"
3/4"		--	--	--
1/2"		100	--	--
3/8"		85–100	100	100
No. 4		0–15	0–50	60–85
No. 8		0–5	0–15	0–25
No. 16		--	0–5	0–5
No. 30		--	0–3	0–3
No. 200		0–2	0–2	0–2

37-2.02B Materials

37-2.02B(1) General

Reserved

37-2.02B(2) Asphaltic Emulsions

Reserved

37-2.02B(3) Aggregate

Aggregate gradation for an asphaltic emulsion chip seal must comply with the requirements shown in the following table:

Asphaltic Emulsion Chip Seal Aggregate Gradation

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight) Sieve size:	California Test 202	3/8"	5/16"	1/4"
3/4"		--	--	--
1/2"		100	--	--
3/8"		85–100	100	100
No. 4		0–15	0–50	60–85
No. 8		0–5	0–15	0–25
No. 16		--	0–5	0–5
No. 30		--	0–3	0–3
No. 200		0–2	0–2	0–2

37-2.02C Construction

37-2.02C(1) General

Reserved

37-2.02C(2) Asphaltic Emulsions

Asphaltic emulsions must be applied within the application rate ranges shown in the following table:

Asphaltic Emulsion Application Rates

Aggregate gradation	Application rate range (gal/sq yd)
3/8"	0.30–0.45
5/16"	0.25–0.35
1/4"	0.20–0.30

For double asphaltic emulsion chip seals, the asphaltic emulsions must be applied within the application rates shown in the following table:

Asphaltic Emulsion Application Rates

Double chip seals	Application rate range (gal/sq yd)
1st application	0.30–0.45
2nd application	0.20–0.30

When applied, the temperature of the asphaltic emulsions must be from 130 to 180 degrees F.

Apply asphaltic emulsions when the ambient air temperature is from 65 to 110 degrees F and the pavement surface temperature is at least 80 degrees F.

Do not apply asphaltic emulsions when weather forecasts predict the ambient air temperature will fall below 39 degrees F within 24 hours after application.

37-2.02C(3) Spreading Aggregates

Aggregate must be spread within the spread rate ranges shown in the following table:

Aggregate Spread Rates

Aggregate gradation	Spread rate range (lb/sq yd)
3/8"	20–30
5/16"	16–25
1/4"	12–20

For double asphaltic emulsion chip seals, aggregate must be spread within the spread rate ranges shown in the following table:

Aggregate Spread Rates

Double chip seal	Spread rate range (lb/sq yd)
1st application	23–30
2nd application	12–20

Remove excess aggregate on the 1st application before the 2nd application of asphaltic emulsion.

You may stockpile aggregate for asphaltic emulsion chip seals if you prevent contamination. Aggregate must have a damp surface at spreading. If water visibly separates from the aggregate, do not spread. You may re-dampen aggregate in the delivery vehicle.

Spread aggregate before an asphaltic emulsion sets or breaks.

Do not spread aggregate more than 2,500 feet ahead of the completed initial rolling.

37-2.02D Payment

Not Used

37-2.03 POLYMER MODIFIED ASPHALTIC EMULSION CHIP SEALS

37-2.03A General

37-2.03A(1) Summary

Section 37-2.03 includes specifications for applying polymer modified asphaltic emulsion chip seals. A polymer modified asphaltic emulsion chip seal includes applying a polymer modified asphaltic emulsion, followed by aggregate, and then a flush coat.

A double polymer modified asphaltic emulsion chip seal is the application of a polymer modified asphaltic emulsion followed by aggregate, applied twice in sequence and then a flush coat.

37-2.03A(2) Definitions

Reserved

37-2.03A(3) Submittals

Immediately after sampling, submit two 1-quart cans of polymer modified asphaltic emulsion taken in the presence of the Engineer. A sample must be submitted in an insulated shipping container.

37-2.03A(4) Quality Assurance

37-2.03A(4)(a) General

Reserved

37-2.03A(4)(b) Quality Control

37-2.03A(4)(b)(i) General

Reserved

37-2.03A(4)(b)(ii) Polymer Modified Asphaltic Emulsions

Circulate polymer modified asphaltic emulsions in the distributor truck before sampling. Take samples from the distributor truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take two 1-quart samples for acceptance testing.

For polymer modified asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

Polymer Modified Asphaltic Emulsion

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 50 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Settlement, 5 days (max, %)			
Storage stability test, 1 day (max, %)			
Sieve test (max, %)			
Demulsibility (min, %)			
Particle charge			
Ash content (max, %)	ASTM D3723		
Residue by evaporation (min, %)	California Test 331		
Tests on residue from evaporation test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Penetration, 4 °C, 200g for 60 seconds	AASHTO T 49		
Ductility, 25 °C (min, mm)	AASHTO T 51		
Torsional recovery (min, %)	California Test 332		
Ring and Ball Softening Point (min, °F)	AASHTO T 53		

37-2.03A(4)(c) Department Acceptance

Aggregate acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Aggregate Gradation Acceptance Criteria

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight) Sieve size:	California Test 202	3/8"	5/16"	1/4"
3/4"		--	--	--
1/2"		100	--	--
3/8"		85–100	100	100
No. 4		0–15	0–50	60–85
No. 8		0–5	0–15	0–25
No. 16		--	0–5	0–5
No. 30		--	0–3	0–3
No. 200		0–2	0–2	0–2

37-2.03B Materials

37-2.03B(1) General

Reserved

37-2.03B(2) Polymer Modified Asphaltic Emulsions

A polymer modified asphaltic emulsion must include elastomeric polymer.

A polymer modified asphaltic emulsion must be Grade PMRS2, PMRS2h, PMCRS2, or PMCRS2h. Polymer content in percent by weight does not apply.

A polymer modified asphaltic emulsion must comply with section 94 and the quality characteristic requirements in the following table:

Polymeric Asphaltic Emulsion

Quality characteristic	Test method	Requirement
Penetration, 4 °C, 200g for 60 seconds (min)	AASHTO T 49	6
Ring and Ball Softening Point (min, °F)	AASHTO T 53	135

37-2.03B(3) Aggregate

The aggregate gradation for a polymer modified asphaltic emulsion chip seal must comply with the requirements shown in the following table:

Asphaltic Emulsion Chip Seal Aggregate Gradation

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight) Sieve Size	California Test 202	3/8"	5/16"	1/4"
3/4"		--	--	--
1/2"		100	--	--
3/8"		85–100	100	100
No. 4		0–15	0–50	60–85
No. 8		0–5	0–15	0–25
No. 16		--	0–5	0–5
No. 30		--	0–3	0–3
No. 200		0–2	0–2	0–2

37-2.03C Construction

Polymer modified asphaltic emulsions must be applied within the application rate ranges shown in the following table:

Polymer Modified Asphaltic Emulsion Application Rates

Aggregate gradation	Application rate range (gal/sq yd)
3/8"	0.30–0.45
5/16"	0.25–0.35
1/4"	0.20–0.30

For double polymer modified asphaltic emulsion chip seals, polymer modified asphaltic emulsions must be applied within the application rates shown in the following table:

Polymer Modified Asphaltic Emulsion Application Rates

Double application	Application rate range (gal/sq yd)
1st application	0.30–0.45
2nd application	0.20–0.30

Apply polymer modified asphaltic emulsions when the ambient air temperature is from 60 to 105 degrees F and the pavement surface temperature is at least 80 degrees F.

Do not apply polymer modified asphaltic emulsions when weather forecasts predict the ambient air temperature will fall below 39 degrees F within 24 hours after application.

Aggregate must be spread within the spread rate ranges shown in the following table:

Aggregate Spread Rates

Chip seal type	Spread rate range (lb/sq yd)
3/8"	20–30
5/16"	16–25
1/4"	12–20

For double chip seals, aggregate must be spread within spread rate ranges shown in the following table:

Aggregate Spread Rates

Double application	Spread rate range (lb/sq yd)
1st application	23–30
2nd application	12–20

Remove excess aggregate on the 1st application before the 2nd application of asphaltic emulsion.

You may stockpile aggregate for the polymer modified asphaltic emulsion chip seals if you prevent contamination. Aggregate must have damp surfaces at spreading. If water visibly separates from the aggregate, do not spread. You may redampen aggregate in the delivery vehicle.

Spread aggregate before the polymer modified asphaltic emulsion sets or breaks.

Do not spread aggregate more than 2,500 feet ahead of the completed initial rolling.

37-2.03D Payment

Not Used

37-2.04 ASPHALT RUBBER BINDER CHIP SEALS

37-2.04A General

37-2.04A(1) Summary

Section 37-2.04 includes specifications for applying asphalt rubber binder chip seals.

An asphalt rubber binder chip seal consists of applying asphalt rubber binder followed by heated aggregate precoated with asphalt binder followed by a flush coat.

37-2.04A(2) Definitions

crumb rubber modifier: Combination of ground or granulated high natural scrap tire crumb rubber and scrap tire crumb rubber derived from waste tires described in Pub Res Code § 42703.

descending viscosity reading: Subsequent viscosity reading at least 5 percent lower than the previous viscosity reading.

high natural scrap tire crumb rubber: Material containing 40 to 48 percent natural rubber.

scrap tire crumb rubber: Any combination of vehicle tires or tire buffing.

37-2.04A(3) Submittals

At least 5 business days before use, submit the permit issued by the local air district for asphalt rubber binder field blending equipment and application equipment. If an air quality permit is not required by the local air district for producing asphalt rubber binder, submit verification from the local air district that an air quality permit is not required.

For each delivery of asphalt rubber binder ingredients to the job site, submit a certificate of compliance with a copy of the specified test results.

Submit a certified volume or weight slip for each delivery of asphalt rubber binder ingredients and asphalt rubber binder.

Submit a SDS for each asphalt rubber binder ingredient and the asphalt rubber binder.

At least 15 days before use, submit:

1. Samples of each asphalt rubber binder ingredient:
   1.1. 2 lbs of scrap tire crumb rubber
   1.2. 2 lbs of high natural scrap tire crumb rubber
   1.3. Two 1-quart cans of base asphalt binder
   1.4. Two 1-quart cans of asphalt modifier
2. Asphalt rubber binder formulation and data as follows:
   2.1. For asphalt modifier, include:
      2.1.1. Source of asphalt modifier
      2.1.2. Type of asphalt modifier
      2.1.3. Percentage of asphalt modifier by weight of asphalt binder
      2.1.4. Percentage of combined asphalt binder and asphalt modifier by weight of asphalt rubber binder
      2.1.5. Test results for the specified quality characteristics
   2.2. For crumb rubber modifier, include:
      2.2.1. Each source and type of scrap tire crumb rubber and high natural scrap tire crumb rubber
      2.2.2. Percentage of scrap tire crumb rubber and high natural scrap tire crumb rubber by total weight of asphalt rubber binder
      2.2.3. Test results for the specified quality characteristics
   2.3. For asphalt rubber binder, include minimum reaction time and temperature

Immediately after sampling, submit five 1-quart cans of asphalt rubber binder taken in the presence of the Engineer. Sample must be submitted in insulated shipping containers.

Submit notification 15 minutes before each viscosity test or submit a schedule of testing times.

Submit the log of asphalt rubber binder descending viscosity test results within 1 business day after sampling.

Submit asphalt rubber binder quality control viscosity test results within 1 business day after sampling.

37-2.04A(4) Quality Assurance

37-2.04A(4)(a) General

The equipment used in producing asphalt rubber binder and the equipment used in spreading asphalt rubber binder must be permitted for use or exempted by the local air district.

37-2.04A(4)(b) Quality Control

37-2.04A(4)(b)(i) General

Reserved

37-2.04A(4)(b)(ii) Asphalt Modifiers

For asphalt modifiers, the authorized laboratory must perform quality control sampling and testing at the specified frequency for the following quality characteristics:

Asphalt Modifier for Asphalt Rubber Binder

Quality characteristic	Test method	Frequency
Viscosity	ASTM D445	1 per shipment
Flash point	ASTM D92	
Molecular Analysis:		
Asphaltenes	ASTM D2007	1 per shipment
Aromatics	ASTM D2007	

37-2.04A(4)(b)(iii) Crumb Rubber Modifiers

Sample and test scrap tire crumb rubber and high natural scrap tire crumb rubber separately.

Perform quality control sampling and testing at the specified frequency for the following quality characteristics:

Crumb Rubber Modifier

Quality characteristic	Test method	Frequency
Scrap tire crumb rubber gradation	California Test 385	1 per 10,000
High natural scrap tire crumb rubber gradation	California Test 385	1 per 3,400 lb
Wire in CRM	California Test 385	1 per 10,000 lb
Fabric in CRM	California Test 385	
CRM particle length	--	
CRM specific gravity	California Test 208	
Natural rubber content in high natural scrap tire crumb rubber	ASTM D297	1 per 3,400 lb

37-2.04A(4)(b)(iv) Asphalt Rubber Binders

For asphalt rubber binders, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

Asphalt Rubber Binder Quality Control Requirements

Quality characteristic	Test method	Sampling location	Frequency
Descending viscosity[a] at 375 °F (Pa•s x 10^{-3})	ASTM D7741	Reaction vessel	1 per lot[b]
Viscosity at 375 °F (Pa•s x 10^{-3})	ASTM D7741	Distribution truck	15 minutes before use per lot[b]
Cone penetration at 25 °C (0.10 mm)	ASTM D217	Distribution truck	1 per lot[b]
Resilience at 25 °C (% rebound)	ASTM D5329		
Softening point (°C)	ASTM D36		

[a]Start taking viscosity readings at least 45 minutes after adding crumb rubber modifier and continue taking viscosity readings every 30 minutes until 2 consecutive descending viscosity readings have been obtained and the final viscosity complies with the specification requirement.
[b]A lot is defined in the *MPQP*.

Retain samples from each lot. Test samples for cone penetration, resilience, and softening point for the first 3 lots and if all 3 lots pass, the testing frequency may be reduced to once for every 3 lots.

If QC test results indicate that the asphalt rubber binder does not comply with the specifications, take corrective action and notify the Engineer.

37-2.04A(4)(c) Department Acceptance

37-2.04A(4)(c)(i) General

Reserved

37-2.04A(4)(c)(ii) Asphalt Modifiers

The Department accepts asphalt modifier based on compliance with the requirements shown in the following table:

Asphalt Modifier for Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Viscosity at 100 °C (m^2/s x 10^{-6})	ASTM D445	X ± 3[a]
Flash point (min, °C)	ASTM D92	207
Molecular Analysis:		
Asphaltenes (max, % by mass)	ASTM D2007	0.1
Aromatics (min, % by mass)	ASTM D2007	55

[a]The symbol "X" is the asphalt modifier viscosity.

37-2.04A(4)(c)(iii) Crumb Rubber Modifiers

Scrap tire CRM and high natural CRM are sampled and tested separately.

The Department accepts scrap tire CRM and high natural CRM based on compliance with the requirements shown in the following table:

Crumb Rubber Modifier for Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Wire in CRM (max, %)	California Test 385	0.01
Fabric in CRM (max, %)	California Test 385	0.05
CRM particle length (max, in)	--	3/16
CRM specific gravity	California Test 208	1.1–1.2
Natural rubber content in high natural CRM (%)	ASTM D297	40.0–48.0

The Department accepts CRM gradation based on the requirements shown in the following table:

Crumb Rubber Modifier Gradation Requirements

Quality characteristic	Test method	Requirement			
Gradation (% passing by weight) Sieve size:	California Test 385	Scrap tire crumb rubber		High natural scrap tire crumb rubber	
		Operating range	Contract compliance	Operating range	Contract compliance
No. 8		100	100	--	--
No. 10		95–100	90–100	100	100
No. 16		35–85	32–88	92–100	85–100
No. 30		2–25	1–30	25–95	20–98
No. 50		0–10	0–15	6–35	2–40
No. 100		0–5	0–10	0–7	0–10
No. 200		0–2	0–5	0–3	0–5

If a test result for CRM gradation does not comply with the specifications, the Department deducts the corresponding amount for each gradation test as shown in the following table:

Material	Gradation test result[a]	Deduction
Scrap tire crumb rubber	Operating range < TR < Contract compliance	$250
Scrap tire crumb rubber	TR > Contract compliance	$1,100
High natural scrap tire crumb rubber	Operating range < TR < Contract compliance	$250
High natural scrap tire crumb rubber	TR > Contract compliance	$600

[a]Test Result = TR

Each gradation test for scrap tire crumb rubber represents 10,000 lb or the quantity used in that day's production, whichever is less.

Each gradation test for high natural scrap tire crumb rubber represents 3,400 lb or the quantity used in that day's production, whichever is less.

37-2.04A(4)(c)(iv) Asphalt Rubber Binders

For Department acceptance testing, take a sample of asphalt rubber binder in the Engineer's presence every 5 lots or once a day, whichever is greater. Each sample must be in five 1-quart cans with an open top and friction lid.

For an asphalt rubber binder, acceptance is based on the Department’s sampling and testing for compliance with the requirements shown in the following table:

Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Cone penetration at 25 °C (0.10 mm)	ASTM D217	25–60
Resilience at 25 °C (% rebound)	ASTM D5329	18–50
Softening point (°C)	ASTM D36	55–88
Viscosity at 375 °F (Pa•s x 10^{-3})[a]	ASTM D7741	1,500–2,500

[a]Prepare sample for viscosity test under California Test 388.

37-2.04A(4)(c)(v) Precoated Aggregate

The Department accepts precoated aggregate based on compliance with the requirements shown in the following table:

Precoated Aggregate Gradation Acceptance Criteria

Quality Characteristic	Test method	Requirement
1/2" gradation (% passing by weight)	California Test 202	
Sieve size:		
3/4"		100
1/2"		85–90
3/8"		0–30
No. 4		0–5
No. 8		--
No. 200		0–1
3/8" gradation (% passing by weight)	California Test 202	
Sieve size:		
3/4"		100
1/2"		95–100
3/8"		70–85
No. 4		0–15
No. 8		0–5
No. 200		0–1

37-2.04B Materials

37-2.04B(1) General

Reserved

37-2.04B(2) Asphalt Binders

Asphalt binder used as the base binder for asphalt rubber binder must comply with the specifications for asphalt binder. Do not modify asphalt binder with polymer.

37-2.04B(3) Asphalt Modifiers

An asphalt modifier must be a resinous, high flash point, and aromatic hydrocarbon. An asphalt modifier must comply with the requirements shown in the following table:

Asphalt Modifier for Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Viscosity at 100 °C (m^2/s x 10^{-6})	ASTM D445	X ± 3[a]
Flash point (min, CL.O.C., °C)	ASTM D92	207
Molecular analysis:		
Asphaltenes by mass (max, %)	ASTM D2007	0.1
Aromatics by mass (min, %)	ASTM D2007	55

[a]*X* denotes the proposed asphalt modifier viscosity from 19 to 36. A change in *X* requires a new asphalt rubber binder submittal.

37-2.04B(4) Crumb Rubber Modifiers

The CRM to be used must be on the Authorized Materials List for crumb rubber modifier.

The CRM must be ground or granulated at ambient temperature.

Scrap tire crumb rubber and high natural scrap tire crumb rubber must be delivered to the asphalt rubber binder production site in separate bags.

Steel and fiber must be separated. If steel and fiber are cryogenically separated, it must occur before grinding and granulating. Cryogenically-produced CRM particles must be large enough to be ground or granulated.

The CRM must be dry, free-flowing particles that do not stick together. A maximum of 3 percent calcium carbonate or talc by weight of CRM may be added. The CRM must not cause foaming when combined with the asphalt binder and asphalt modifier.

The CRM must comply with the requirements shown in the following table:

Crumb Rubber Modifier for Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Wire in CRM (max, %)	California Test 385	0.01
Fabric in CRM (max, %)	California Test 385	0.05
CRM particle length (max, in)	--	3/16
CRM specific gravity	California Test 208	1.1–1.2

The CRM must comply with the requirements shown in the following table:

Crumb Rubber Modifier Requirements

Quality characteristic	Test method	Requirement	
		Scrap tire crumb rubber	High natural scrap tire crumb rubber
Acetone extract (%)	ASTM D297	6.0–16.0	4.0–16.0
Rubber hydrocarbon (min, %)		42.0–65.0	50.0
Natural rubber content (%)		22.0–39.0	40.0–48.0
Carbon black content (%)		28.0–38.0	--
Ash content (max, %)		8.0	--

Scrap tire crumb rubber gradation must comply with the gradation requirements shown in the following table:

Scrap Tire Crumb Rubber Gradation

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight) Sieve size:	California Test 385	Gradation limit	Operating range	Contract compliance
No. 8		100	100	100
No. 10		98–100	95–100	90–100
No. 16		45–75	35–85	32–88
No. 30		2–20	2–25	1–30
No. 50		0–6	0–10	0–15
No. 100		0–2	0–5	0–10
No. 200		0	0–2	0–5

High natural scrap tire crumb rubber gradation must comply with the gradation requirements shown in the following table:

High Natural Scrap Tire Crumb Rubber Gradation

Quality characteristic	Test method	Requirement		
Gradation (% passing by weight) Sieve size:	California Test 385	Gradation limit	Operating range	Contract compliance
No. 10		100	100	100
No. 16		95–100	92–100	85–100
No. 30		35–85	25–95	20–98
No. 50		10–30	6–35	2–40
No. 100		0–4	0–7	0–10
No. 200		0–1	0–3	0–5

37-2.04B(5) Asphalt Rubber Binders

An asphalt rubber binder must be a combination of:

1. Asphalt binder
2. Asphalt modifier
3. Crumb rubber modifier

Asphalt rubber binder blending equipment must be authorized under the Department's *MPQP*.

The blending equipment must allow the determination of weight percentages of each asphalt rubber binder ingredient.

An asphalt rubber binder must be 79 ± 1 percent by weight asphalt binder and 21 ± 1 percent by weight of CRM. The minimum percentage of CRM must be 20.0 percent and lower values must not be rounded up.

The CRM must be 75 ± 2 percent by weight scrap tire crumb rubber and 25 ± 2 percent by weight high natural scrap tire crumb rubber.

An asphalt modifier and asphalt binder must be blended at the production site. An asphalt modifier must be from 2.5 to 6.0 percent by weight of the asphalt binder in the asphalt rubber binder. The asphalt rubber binder supplier determines the exact percentage.

If blended before adding CRM, the asphalt binder must be from 375 to 440 degrees F when an asphalt modifier is added and the mixture must circulate for at least 20 minutes. An asphalt binder, asphalt modifier, and CRM may be proportioned and combined simultaneously.

The blend of an asphalt binder and an asphalt modifier must be combined with the CRM at the asphalt rubber binder production site. The asphalt binder and asphalt modifier blend must be from 375 to 440 degrees F when the CRM is added. Combined ingredients must be allowed to react at least 45 minutes at temperatures from 375 to 425 degrees F except the temperature must be at least 10 degrees F below the flash point of the asphalt rubber binder.

After reacting, the asphalt rubber binder must comply with the requirements shown in the following table:

Asphalt Rubber Binder

Quality characteristic	Test method	Requirement
Cone penetration at 25 °C (0.10 mm)	ASTM D217	25–60
Resilience at 25 °C (% rebound)	ASTM D5329	18–50
Softening point (°C)	ASTM D36	55–88
Viscosity at 375 °F (Pa•s x 10^{-3})[a]	ASTM D7741	1,500–2,500

[a]Prepare sample for viscosity test under California Test 388.

Maintain asphalt rubber binder at a temperature from 375 to 415 degrees F.

Stop heating unused asphalt rubber binder 4 hours after the 45-minute reaction period. Reheating asphalt rubber binder that cools below 375 degrees F is a reheat cycle. Do not exceed 2 reheat cycles. If reheating, the asphalt rubber binder must be from 375 to 415 degrees F before use.

During reheating, you may add CRM. The CRM must not exceed 10 percent by weight of the asphalt rubber binder. Allow added CRM to react for at least 45 minutes. Reheated asphalt rubber binder must comply with the specifications for asphalt rubber binder.

37-2.04B(6) Precoated Aggregate

Before precoating with asphalt binder, aggregate for an asphalt rubber binder chip seal must comply with the gradation requirements shown in the following table:

Asphalt Rubber Binder Chip Seal Aggregate Gradation

Quality characteristic	Test method	Requirement	
Gradation (% passing by weight) Sieve size:	California Test 202	1/2"	3/8"
3/4"		100	100
1/2"		85–90	95–100
3/8"		0–30	70–85
No. 4		0–5	0–15
No. 8		--	0–5
No. 200		0–1	0–1

37-2.04C Construction

37-2.04C(1) General

Reserved

37-2.04C(2) Equipment

Distributor trucks must be equipped with:

1. Mixing and heating unit
2. Observation platform on the rear of the truck for an observer on the platform to see the nozzles and unplug them if needed

37-2.04C(3) Asphalt Rubber Binder Application

Apply the asphalt rubber binder when the ambient temperature is from 60 to 105 degrees F and the pavement surface temperature is at least 55 degrees F.

Do not apply the asphalt rubber binder unless enough aggregate is available at the job site to cover the asphalt rubber binder within 2 minutes. Intersections, turn lanes, gore points, and irregular areas must be covered within 15 minutes.

Do not apply asphalt rubber binder when pavement is damp or during high wind conditions. If authorized, you may adjust the distributor bar height and distribution speed and use shielding equipment during high wind conditions.

When applied, the temperature of the asphalt rubber binder must be from 385 to 415 degrees F.

Apply the asphalt rubber binder at a rate from 0.55 to 0.65 gal/sq yd. You may reduce the application rate by 0.050 gal/sq yd in the wheel paths.

37-2.04C(4) Precoated Aggregate Spreading

Spread aggregate at a rate from 28 to 40 lb/sq yd. Do not spread aggregate more than 200 feet ahead of the completed initial rolling.

37-2.04C(5) Rolling and Sweeping

Perform initial rolling within 90 seconds of spreading aggregate. If authorized for final rolling, you may use a steel-wheeled roller weighing from 8 to 10 tons in static mode only.

Perform a final sweeping before Contract acceptance. The final sweeping must not dislodge aggregate.

37-2.04D Payment

Asphalt rubber binder is measured as specified for asphalt binder.

37-2.05 STRESS ABSORBING MEMBRANE INTERLAYERS

37-2.05A General

Section 37-2.05 includes specifications for placing stress absorbing membrane interlayers (SAMI).

Comply with section 37-2.04 except a flush coat is not required.

Traffic must not be allowed on a SAMI.

37-2.05B Materials

For a SAMI, aggregate must comply with the 3/8-inch gradation.

37-2.05C Construction

If a SAMI is overlaid in the same work shift, section 37-2.01C(4)(e) does not apply.

Final sweeping is not required for a SAMI.

37-2.05D Payment

Not Used

37-2.06 MODIFIED ASPHALT BINDER CHIP SEALS

Reserved

37-2.07 SCRUB SEALS

Reserved

37-3 SLURRY SEALS AND MICRO-SURFACINGS

37-3.01 GENERAL

37-3.01A General

37-3.01A(1) Summary

Section 37-3.01 includes general specifications for applying slurry seals and micro-surfacings.

37-3.01A(2) Definitions

Reserved

37-3.01A(3) Submittals

At least 15 days before starting placement of a slurry seal or micro-surfacing, submit:

1. Samples for:
   - 1.1. Asphaltic emulsion slurry seal, two 1-quart wide mouth plastic containers with screw top lid of asphaltic emulsion
   - 1.2 Polymer modified asphaltic emulsion slurry seal, two 1-quart wide mouth plastic containers with screw top lid of polymer modified asphaltic emulsion
   - 1.3. Micro-surfacing, two 1-quart wide mouth plastic containers with screw top lid of micro-surfacing emulsion
2. Asphaltic emulsion, polymer modified asphaltic emulsion, or micro-surfacing emulsion data as follows:
   - 2.1. Supplier and Type/Grade of asphaltic emulsion
   - 2.2. Type of modifier polymer for polymer modified asphaltic emulsion or micro-surfacing emulsion
   - 2.3. Copy of the specified test results for asphaltic emulsion, polymer modified asphaltic emulsion, or micro-surfacing emulsion
3. 50 lb of aggregate
4. Aggregate test results for the followings:
   - 4.1. Gradation
   - 4.2. Los Angeles Rattler
   - 4.3. Percent of crushed particles

4.4 Sand equivalent
4.5 Durability

At least 10 days before starting placement of a slurry seal or micro-surfacing, submit a laboratory report of test results and the proposed mix design from an authorized laboratory. The authorized laboratory must sign the laboratory report and mix design.

The report must include:

1. Test results used in the mix design compared with specification requirements
2. Proportions based on the dry weight of aggregate, including ranges, for:
   2.1. Aggregate
   2.2. Water
   2.3. Additives
   2.4. Mineral filler
   2.5. Slurry seal emulsion or micro-surfacing emulsion residual asphalt content
3. Recommended changes to the proportions based on heating the mixture to 100 degrees F and mixing for 60 seconds, if atmospheric temperatures during application will be 90 degrees F or above, for:
   3.1. Water
   3.2. Additives
   3.3. Mineral filler
4. Quantitative moisture effects on the aggregate's unit weight determined under ASTM C29M

If the mix design consists of the same materials covered by a previous laboratory report, you may submit the previous laboratory report that must include material testing data performed within the previous 12 months for authorization.

If you change any of the materials in the mix design, submit a new mix design and laboratory report at least 10 days before starting slurry seal or micro-surfacing work.

Submit a certificate of compliance as specified for asphaltic emulsion in section 94-1.01C with each shipment of asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion.

Submit quality control test results for the quality characteristics within the reporting times allowance after sampling shown in the following table:

Quality Control Test Reporting Requirements

Quality characteristic	Maximum reporting time allowance
Los Angeles Rattler loss (max, %)	2 business days
Percent of crushed particles (min, %)	2 business days
Durability (min)	2 business days
Resistance of fine aggregate to degradation by abrasion in the Micro-Deval Apparatus (% loss by weight)	2 business days
Gradation (% passing by weight)	48 hours
Sand equivalent (min)	48 hours
Moisture content (%)	48 hours

Within 3 days after taking asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion quality control samples, submit the authorized laboratory's test results.

37-3.01A(4) Quality Assurance

37-3.01A(4)(a) General

Your authorized laboratory must be able to perform International Slurry Surfacing Association tests and mix design.

37-3.01A(4)(b) Quality Control

37-3.01A(4)(b)(i) General

Reserved

37-3.01A(4)(b)(ii) Aggregate

For aggregate, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

Aggregate Quality Control

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211	1st day of production	See California Test 125
Percent of crushed particles (min, %)	AASHTO T 335	1st day of production	See California Test 125
Sand equivalent (min)	California Test 217	1 per working stockpile per day	See California Test 125
Resistance of fine aggregate to degradation by abrasion in the Micro-Deval Apparatus (% loss by weight)	ASTM D7428	1 per working stockpile per day	See California Test 125
Gradation (% passing by weight)	California Test 202	1 per working stockpile per day	See California Test 125
Moisture content, from field stockpile (%)	AASHTO T 255[a]	1 per working stockpile per day	See California Test 125

[a]Test aggregate moisture at field stockpile every 2 hours if you are unable to maintain the moisture content to within a maximum daily variation of ±0.5 percent.

37-3.01A(4)(b)(iii) Slurry Seals and Micro-surfacings

Reserved

37-3.01A(4)(c) Department Acceptance

Slurry Seal and micro-surfacing acceptance is based on:

1. Visual inspection for the following:
   - 1.1. Uniform surface texture throughout the work limits.
   - 1.2. Marks in the surface:
     - 1.2.1. Up to 4 marks in the completed slurry seal or micro-surfacing surface that are up to 1 inch wide and up to 6 inches long per 1000 square feet of slurry seal or micro-surfacing placed.
     - 1.2.2. No marks in the completed slurry seal or micro-surfacing surface that are over 1 inch wide or 6 inches long.
   - 1.3. Excessive raveling consisting of the separation of the aggregate from the asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion.
   - 1.4. Bleeding consists of the occurrence of a film of asphaltic material on the surface of the slurry seal or micro-surfacing.
   - 1.5. Delaminating of slurry seal or micro-surfacing from the existing pavement.
   - 1.6. Rutting or wash-boarding.
2. Department's sampling and testing for compliance with the requirements for aggregate shown in the following table:

Aggregate Gradation Acceptance Criteria

Quality characteristic	Test method	Requirements		
Gradation (% passing by weight) Sieve Size:	California Test 202	Type I	Type II	Type III
3/8"		--	100	100
No. 4		100	94–100	70–90
No. 8		90–100	65–90	45–70
No. 16		60–90	40–70	28–50
No. 30		40–65	25–50	19–34
No. 200		10–20	5–15	5–15

An aggregate gradation test represents 300 tons or 1 day's production, whichever is less.

If test results for aggregate gradation do not comply with the specifications, you may remove the slurry seal or micro-surfacing represented by the test results or request it remain in place with a payment deduction. If your request is authorized, the Department deducts:

1. $1.75 per ton of slurry seal for each noncompliant aggregate gradation
2. $2.00 per ton of micro-surfacing for each noncompliant aggregate gradation

37-3.01B Materials

37-3.01B(1) General

Additional water must not cause separation of the asphaltic emulsion, polymer modified asphaltic emulsion or micro-surfacing emulsion from the aggregate before placement.

You may use an additive that does not adversely affect the slurry seal or micro-surfacing.

37-3.01B(2) Aggregate

Aggregate must be rock dust. Aggregate must be free from vegetable matter, deleterious substances, caked or clay lumps, and oversized particles.

Aggregate for a slurry seal and micro-surfacing must comply with the gradations shown in the following table:

Aggregate Gradation

Quality characteristic	Test method	Requirements		
Gradation (% passing by weight) Sieve size:	California Test 202	Type I	Type II	Type III
3/8"		--	100	100
No. 4		100	94–100	70–90
No. 8		90–100	65–90	45–70
No. 16		60–90	40–70	28–50
No. 30		40–65	25–50	19–34
No. 200		10–20	5–15	5–15

37-3.01C Construction

37-3.01C(1) General

Before applying slurry seals or micro-surfacings, cover manholes, valve and monument covers, grates, and other exposed facilities located within the area of application using plastic or oil resistant construction paper secured by tape or adhesive to the facility being covered. Reference the covered facilities with enough control points to relocate the facilities after application of the slurry seals or micro-surfacings.

37-3.01C(2) Proportioning

Proportion slurry seal and micro-surfacing ingredients in compliance with the authorized mix design.

37-3.01C(3) Mixing and Spreading Equipment

37-3.01C(3)(a) General

Mixing and spreading equipment for slurry seals and micro-surfacings must proportion the asphaltic emulsions, water, aggregate, and any additives by volume and mix them in continuous pug mill mixers.

Introduce emulsions into the mixer with a positive displacement pump. If you use a variable-rate pump, the adjusting unit must be sealed in its calibrated position.

Introduce water into the mixer through a meter that measures gallons.

Choose a truck mounted mixer-spreader or continuous self-loading mixer spreader.

37-3.01C(3)(b) Truck Mounted Mixer Spreaders

Truck mounted mixer spreaders must comply with:

1. Rotating and reciprocating equipment must be covered with metal guards.
2. Proportion aggregate using a belt feeder with an adjustable cutoff gate. The Engineer verifies the height of the gate opening.
3. Belt feeder must have a depth monitor device. The depth monitor device must automatically shut down power to the belt feeder when the aggregate depth is less than 70 percent of the target depth.
4. Separate monitor device must detect the revolutions of the belt feeder. This device must automatically shut down power to the belt feeder if it detects no revolutions. If the belt feeder is an integral part of the equipment's drive chain, the monitor device is not required.
5. Aggregate belt feeder must be connected directly to the drive on the emulsion pump. The aggregate feeder drive shaft must have a revolution counter reading the nearest 0.10 revolution for micro-surfacing, and nearest 1 revolution for slurry seal.
6. Emulsion storage must be equipped with a device that automatically shuts down power to the emulsion pump and aggregate belt feeder when the level of stored emulsion is lowered. To allow for normal fluctuations, there may be a delay of 3 seconds between detection of low emulsion storage levels or low aggregate depths and automatic power shut down.
7. Emulsion storage must be located immediately before the emulsion pump.
8. Emulsion storage tank must have a temperature indicator at the pump suction level. The indicator must be accurate to ±5 degrees F.
9. No-flow and revolution warning devices must be in working condition. Low-flow indicators must be visible while walking alongside the equipment.

37-3.01C(3)(c) Continuous Self-Loading Mixer Spreaders

Continuous self-loading mixer spreaders must be automatically sequenced and self-propelled. The mixing machine must deliver each material to a double shafted mixer and discharge the mixed material on a continuous flow basis. The mixing machines must have sufficient storage capacity to maintain a continuous supply of material to the proportioning controls. The mixing machine operators must have full control of forward and reverse speeds during placement.

37-3.01C(3)(d) Spreader Boxes

The spreader boxes used to spread slurry seals and micro-surfacings must be:

1. Capable of spreading the slurry seal or micro-surfacing a minimum of 12 feet wide and preventing the loss of slurry seal or micro-surfacing.
2. Equipped with flexible rubber belting on each side. The belting must contact the pavement to prevent the loss of slurry seal or micro-surfacing from the box.
3. Equipped to uniformly apply the slurry seal or micro-surfacing on superelevated sections and shoulder slopes. Micro-surfacing spreader box must be equipped with reversible motor driven augers.
4. Equipped with a series of strike-off devices at its rear.
   - 4.1. The leading strike off device must be:
     - 4.1.1. Fabricated of a suitable material such as steel or stiff rubber
     - 4.1.2. Designed to maintain close contact with the pavement during spreading
     - 4.1.3. Capable of obtaining the specified thickness
     - 4.1.4. Capable of being adjusted to the various pavement cross sections
   - 4.2. The final strike-off device must be:
     - 4.2.1. Fabricated of flexible material that produces a uniform texture in the finished surface

4.2.2. Cleaned daily and changed if longitudinal scouring occurs in the slurry seal of micro-surfacing

5. Clean and free of slurry seal or micro-surfacing at the start of each work shift.

37-3.01C(3)(e) Shoulder Equipment

Spread the slurry seal or micro-surfacing on shoulders with a device such as an edge box that forms clean and straight joints and edges.

37-3.01C(3)(f) Equipment Calibration

Equipment calibration must comply with the *MPQP*. Notify the Engineer at least 5 business days before calibrating.

If the Department authorizes a truck or continuous mixer spreader, its calibration is valid for 6 months provided you:

1. Use the same truck or continuous mixer spreader verified with a unique identifying number
2. Use the same materials in compliance with the authorized mix design
3. Do not perform any repair or alteration to the proportioning systems

Calibrate the adjustable cut-off gate settings of each truck or continuous mixer spreader on the project to achieve the correct delivery rate of aggregate and emulsion per revolution of the aggregate feeder under the *MPQP*.

Checks must be performed for each aggregate source using an authorized vehicle scale.

Individual checks of the aggregate belt feeder's delivery rate to the pug mill mixer must not vary more than 2 percent from the average of 3 runs of at least 3 tons each.

Before using a variable-rate emulsion pump, the pump must be calibrated and sealed in the calibrated condition under the *MPQP*.

Individual checks of the emulsion pump's delivery rate to the pug mill mixer must not vary more than 2 percent from the average of 3 runs of at least 500 gal each.

37-3.01C(4) Surface Preparation

Immediately before applying slurry seals or micro-surfacings, clean the surface to receive slurry seals or micro-surfacings by removing any extraneous material affecting adhesion of the slurry seal or micro-surfacing with the existing surface. Use self-propelled power brooms or other methods such as flushing to clean the existing pavement.

37-3.01C(5) Placement

37-3.01C(5)(a) General

If truck-mounted mixer-spreaders are used, keep at least 2 operational spreaders at the job site during placement.

Spread slurry seals and micro-surfacings uniformly and do not spot, rehandle, or shift the mixture. However in areas inaccessible to spreading equipment, spread the slurry seal or micro-surfacing mixtures with hand tools or other authorized methods. If placing with hand tools, lightly dampen the area first.

You may fog the roadway surface with water ahead of the spreader box. The fog spray must be adjusted for pavement:

1. Temperature
2. Surface texture
3. Dryness

You determine the application rates for slurry seals or micro-surfacings and the Engineer authorizes the application rates. Spread within 10 percent of authorized rate.

The mixtures must be uniform and homogeneous after spreading, and there must not be separation of the emulsion and aggregate after setting.

37-3.01C(5)(b) Weather Conditions

Only place slurry seals or micro-surfacings if both the pavement and air temperatures are at least 50 degrees F and rising. The expected high temperature must be at least 65 degrees F within 24 hours after placement.

Do not place slurry seals or micro-surfacings if rain is imminent or the air temperature is expected to be below 36 degrees F within 24 hours after placement.

37-3.01C(5)(c) Joints

Transverse and longitudinal joints must be:

1. Uniform
2. Straight
3. Neat in appearance
4. Without material buildup
5. Without uncovered areas

Transverse joints must be butt-type joints.

Prevent double placement at transverse joints over previously placed slurry seals or micro-surfacings.

Place longitudinal joints:

1. On centerlines, lane lines, edge lines, or shoulder lines
2. With overlaps not more than 4 inches

You may request other longitudinal joint patterns if they do not adversely affect the slurry seals or micro-surfacings.

The maximum difference between the pavement surface and the bottom edge of a 12-foot straightedge placed perpendicular to the longitudinal joint must be 0.04 foot.

37-3.01C(5)(d) Finished Surfaces

Finished slurry seals or micro-surfacings must be smooth and free of irregularities such as scratch or tear marks. You may leave up to 4 marks that are up to 1 inch wide and 6 inches long per 75 linear feet of slurry seal or micro-surfacing placed. Do not leave any marks that are over 1 inch wide or 6 inches long.

37-3.01C(5)(e) Maintenance Sweeping

Sweep the slurry seals or micro-surfacings 24 hours after placement without damaging the slurry seals or micro-surfacings. For 4 days afterwards, sweep the slurry seals or micro-surfacings daily unless determined otherwise by the Engineer.

37-3.01C(5)(f) Repair of Early Distress

The slurry seals or micro-surfacings must not show bleeding, raveling, separation, or other distresses for 15 days after placing. If bleeding, raveling, delaminating, rutting, or wash-boarding occurs after placing the slurry seals or micro-surfacings, make repairs using an authorized method.

37-3.01D Payment

Not Used

37-3.02 SLURRY SEALS

37-3.02A General

37-3.02A(1) Summary

Section 37-3.02 includes specifications for applying slurry seals.

Applying a slurry seal consists of spreading a mixture of asphaltic emulsion or polymer modified asphaltic emulsion, aggregate, additives, and water on a surface or pavement.

37-3.02A(2) Definitions

Reserved

37-3.02A(3) Submittals

Immediately after sampling, submit two 1-quart wide mouth plastic containers of asphaltic emulsion or polymer modified asphaltic emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping containers.

37-3.02A(4) Quality Assurance

37-3.02A(4)(a) General

Reserved

37-3.02A(4)(b) Quality Control

37-3.02A(4)(b)(i) General

Take samples of asphaltic emulsion and polymer modified asphaltic emulsion from the tank truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer take two 1-quart samples in wide mouth plastic containers with lined, sealed lids for acceptance testing.

37-3.02A(4)(b)(ii) Asphaltic Emulsion

For asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

Asphaltic Emulsion

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Delivery truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge[a]			
Tests on Residue from Distillation Test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Delivery truck
Ductility	AASHTO T 51		
Solubility in tricloroethylene	AASHTO T 44		

[a]If the result of the particle charge is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

37-3.02A(4)(b)(iii) Polymer Modified Asphaltic Emulsion

For polymer modified asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

Polymer Modified Asphaltic Emulsion

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling Location
Tests on emulsion:			
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Delivery truck
Sieve test (%)	AASHTO T 59		
Storage stability after 1 day (%)	AASHTO T 59		
Residue by evaporation (min, %)	California Test 331		
Particle charge	AASHTO T 59		
Tests on residue by evaporation:			
Penetration at 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Delivery truck
Ductility at 25 °C (min, mm)	AASHTO T 51		
Torsional recovery (min, %) Or Polymer content based on residual asphalt (min, %)	California Test 332 California Test 401		

37-3.02A(4)(c) Department Acceptance

For a slurry seal asphaltic emulsion and polymer modified asphaltic emulsion, acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristics specified.

Aggregate acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Aggregate Acceptance Criteria

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211[a]	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	55
Sand equivalent (min) Type I Type II Type III	California Test 217	 45 55 60

[a]California Test 211 must be performed on the source aggregate before crushing.

A sand equivalent test represents 300 tons or 1 day's production, whichever is less.

If test results for sand equivalent do not comply with the specifications, you may remove the slurry seal represented by the test results or request it remain in place with a payment deduction. If your request is authorized, the Department deducts $1.75 per ton of slurry seal for each noncompliant sand equivalent test.

37-3.02B Materials

37-3.02B(1) General

Reserved

37-3.02B(2) Asphaltic Emulsions

An asphaltic emulsion must comply with the requirements in Section 94. The asphaltic emulsion must be Grade CQS1h.

37-3.02B(3) Polymer Modified Asphaltic Emulsions

A polymer modified asphaltic emulsion must:

1. Consist of an elastomeric polymer mixed with an asphaltic material uniformly emulsified with water and an emulsifying or stabilization agent.
2. Use either neoprene polymer or butadiene and styrene copolymer. The polymer must be homogeneous and milled into the asphaltic emulsion at the colloid mill.
3. Be Grade PMCQS1h and must comply with the requirements shown in the following table:

Polymer Modified Asphaltic Emulsion Requirements

Quality characteristic	Test method	Requirement
Tests on emulsion:		
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	15–90
Sieve test (%)	AASHTO T 59	0–0.3
Storage stability after 1 day (%)	AASHTO T 59	0–1
Residue by evaporation (min, %)	California Test 331	60
Particle charge	AASHTO T 59	Positive
Tests on residue by evaporation:		
Penetration at 25 °C	AASHTO T 49	40–90
Ductility at 25 °C (min, mm)	AASHTO T 51	400
Torsional recovery (min, %) Or Polymer content based on residual asphalt (min, %)	California Test 332 California Test 401	18 2.5

37-3.02B(4) Aggregate

Aggregate must comply with the quality characteristic requirements shown in the following table:

Aggregate Requirements

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211[a]	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	55
Sand equivalent (min) Type I Type II Type III	California Test 217	 45 55 60

[a]California Test 211 must be performed on the source aggregate before crushing. The aggregate supplier must certify that the crushed aggregate being used on the project is manufactured from the source aggregate complying with the LA rattler requirements.

37-3.02B(5) Slurry Seal Mix Design

The slurry seal mix design, using project source aggregate, an asphaltic emulsion, and set-control agents if any, must comply with the requirements shown in the following table:

Slurry Seal Mix Design Requirements

Quality characteristic	Test method[a]	Requirement
Consistency (max, mm)	Technical Bulletin 106	30
Wet stripping	Technical Bulletin 114	Pass
Compatibility	Technical Bulletin 115	Pass[b]
Cohesion test, within 1 hour (min, kg-mm)	Technical Bulletin 139	200
Wet track abrasion (max, g/m^2)	Technical Bulletin 100	810

[a]Test methods are by the International Slurry Surfacing Association.
[b]Mixing test must pass at the maximum expected air temperature at the job site during placement.

The mix design must have the percent of asphaltic residue, based on percentage by weight of the dry aggregate, within the ranges shown in the following table:

Slurry seal type	Residue range
Type I	10–16
Type II	7.5–13.5
Type III	6.5–12.0

Determine the exact percentage based on the design asphalt binder content and the asphalt residual content of the asphaltic emulsion furnished.

37-3.02C Construction

37-3.02C(1) General

Reserved

37-3.02C(2) Proportioning

After proportioning, slurry seal mixtures must be workable.

37-3.02C(3) Mixing and Spreading Equipment

Reserved

37-3.02C(4) Placement

The slurry seal spread rates must be within the ranges shown in the following table:

Slurry Seal Spread Rates

Slurry seal type	Application range (lb of dry aggregate/sq yd)
Type I	8–12
Type II	10–18
Type III	20–25

Within 4 hours after placement, slurry seals must be set enough to allow traffic without pilot cars. Protect slurry seals from damage until it has set and will not adhere or be picked up by vehicle tires. Slurry seals must not exhibit distress from traffic such as bleeding, raveling, separation or other distresses.

37-3.02D Payment

The payment quantity for slurry seal is the weight determined by combining the weights of the aggregate and asphaltic emulsion or polymeric asphaltic emulsion. The payment quantity for slurry seal does not include the weights of the added water and set-control additives.

37-3.03 MICRO-SURFACINGS

37-3.03A General

37-3.03A(1) Summary

Section 37-3.03 includes specifications for applying micro-surfacings.

Applying a micro-surfacing consists of spreading a mixture of a micro-surfacing emulsion, water, additives, mineral filler, and aggregate on the pavement.

37-3.03A(2) Definitions

Reserved

37-3.03A(3) Submittals

Immediately after sampling, submit two 1-quart wide mouth plastic containers of micro-surfacing emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping container.

37-3.03A(4) Quality Assurance

37-3.03A(4)(a) General

Reserved

37-3.03A(4)(b) Quality Control

37-3.03A(4)(b)(i) General

Reserved

37-3.03A(4)(b)(ii) Micro-surfacing Emulsions

Take samples from the truck tank at mid load from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take two 1-quart wide mouth plastic containers for acceptance testing.

For a micro-surfacing emulsion, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the quality characteristics shown in the following table:

Micro-Surfacing Emulsion

Quality characteristic	Test method	Minimum sampling and testing frequency	Sampling location
Tests on emulsion:			
Saybolt Furol Viscosity, at 25°C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Delivery truck
Storage stability, 1 day (max, %)[a]			
Sieve test (max, %)			
Residue by evaporation (min, %)	California Test 331	Minimum 1 per day per delivery truck	Delivery truck
Tests on residue from evaporation test:			
Penetration at 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Delivery truck
Softening point (min, ºC)	AASHTO T 53		

[a]Storage stability test will be run if the storage exceeds 48 hours

37-3.03A(4)(c) Department Acceptance

For micro-surfacing emulsions, acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Micro-surfacing Emulsion Acceptance Criteria

Quality characteristic	Test method	Requirement
Tests on emulsion:		
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	15–90
Sieve test (%)	AASHTO T 59	0.30
Storage stability, 1 day (max, %)	AASHTO T 59	0–1
Settlement[a], 5 days (max, %)	ASTM D244	5
Residue by evaporation (min, %)	California Test 331	62
Tests on residue by evaporation:		
Penetration at 25 °C	AASHTO T 49	40–90
Softening point (min, ºC)	AASHTO T 53	57

[a]Settlement test on emulsion is not required if used within 48 hours of shipment.

Acceptance of aggregate, except mineral filler, is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Aggregate Acceptance Criteria

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211[a]	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	65
Sand equivalent (min) Type II Type III	California Test 217	 65 65

[a]California Test 211 must be performed on the aggregate before crushing. The aggregate supplier must certify that the crushed aggregate being used on the project is manufactured from the source aggregate complying with the LA rattler requirements.

An aggregate sand equivalent test represents 300 tons or 1 day's production, whichever is less.

If the test results for aggregate sand equivalent do not comply with the specifications, you may remove the micro-surfacing represented by the test results or request it remain in place with a payment deduction. If your request is authorized, the Department deducts $2.00 per ton of micro-surfacing for each noncompliant aggregate sand equivalent test.

37-3.03B Materials

37-3.03B(1) General

Reserved

37-3.03B(2) Micro-surfacing Emulsions

A micro-surfacing emulsion must be a homogeneous mixture of asphalt, an elastomeric polymer and an emulsifier solution.

Add an elastomeric polymer modifier to asphalt or emulsifier solution before emulsification. An elastomeric polymer solid must be a minimum of 3 percent by weight of the micro-surfacing emulsion's residual asphalt.

A micro-surfacing emulsion must comply with the requirements shown in the following table:

Micro-surfacing Emulsion Requirements

Quality characteristic	Test method	Requirement
Tests on emulsion:		
Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)	AASHTO T 59	15–90
Sieve test (%)	AASHTO T 59	0.30
Storage stability, 1 day (max, %)	AASHTO T 59	0–1
Settlement[a], 5 days (max, %)	ASTM D244	5
Residue by evaporation (min, %)	California Test 331	62
Tests on residue by evaporation:		
Penetration at 25 °C	AASHTO T 49	40–90
Softening point (min, ºC)	AASHTO T 53	57

[a]Settlement test on emulsion is not required if used within 48 hours of shipment.

37-3.03B(3) Aggregate

Aggregate must comply with the quality characteristic requirements shown in the following table:

Aggregate Requirements

Quality characteristic	Test method	Requirement
Los Angeles Rattler loss (max, %) At 500 revolutions	California Test 211[a]	35
Percent of crushed particles (min, %)	California Test 205	95
Durability (min)	California Test 229	65
Sand equivalent (min) Type II Type III	California Test 217	 65 65

[a]California Test 211 must be performed on the source aggregate before crushing. The aggregate supplier must certify that the crushed aggregate being used on the project is manufactured from the source aggregate complying with the LA rattler requirements.

37-3.03B(4) Mineral Fillers

If a mineral filler is used, it must be type I or type II Portland cement. A mineral filler used during mix design must be used during production.

37-3.03B(5) Micro-Surfacing Mix Designs

The micro-surfacing mix design must have the material proportion limits shown in the following table:

Micro-surfacing Mix Design Proportion Limits

Material	Proportion limits
Micro-surfacing emulsion asphalt residual content (% of dry weight of aggregate)	5.5–10.5
Water and additives	As Required
Mineral filler (% of dry weight of aggregate)	0–3

The micro-surfacing mix design must comply with the requirements shown in the following table:

Micro-surfacing Mix Design Requirements

Quality characteristics	Test method[a]	Requirement
Wet cohesion At 30 minutes (set) (min, kg-cm) At 60 minutes (traffic) (min, kg-cm)	Technical Bulletin 139	 12 20
Excess asphalt (max, g/m^2)	Technical Bulletin 109	540
Wet stripping (min, %)	Technical Bulletin 114	90
Wet track abrasion loss 6-day soak (max, g/m^2)	Technical Bulletin 100	 810
Displacement Lateral (max, %) Specific gravity after 1000 cycles of 57 kg (max)	Technical Bulletin 147A	 5 2.10
Classification compatibility (min, grade points)	Technical Bulletin 144	(AAA, BAA) 11
Mix time at 25 °C (min)	Technical Bulletin 113	Controllable to 120 seconds

[a]Test methods are by the International Slurry Surfacing Association.

37-3.03B(6) Tack Coats

If there is a bid item for tack coat, you must coat the pavement surface with an asphaltic emulsion mixed with additional water before applying a micro-surfacing. The maximum ratio of water to asphaltic emulsion must be 2 to 1. Apply the tack coat at a rate from 0.08 to 0.15 gal/sq yd. The exact rate must be authorized.

You determine the grade of slow-setting or quick setting asphaltic emulsion to be used.

37-3.03C Construction

37-3.03C(1) General

Reserved

37-3.03C(2) Proportioning

Field conditions may require adjustments to the proportions within the authorized mix design during construction.

37-3.03C(3) Mixing and Spreading Equipment

37-3.03C(3)(a) General

Reserved

37-3.03C(3)(b) Scratch Course Boxes

Spread the scratch courses with the same type of spreader box used to spread micro-surfacings except use an adjustable steel strike-off device instead of a final strike-off device.

37-3.03C(3)(c) Wheel Path Depression Boxes

Each wheel path depression box must have adjustable strike-off device between 5 and 6 feet wide to regulate depth. The wheel path depression box must also have devices such as hydraulic augers capable of:

1. Moving the mixed material from the rear to the front of the filling chamber
2. Guiding larger aggregate into the deeper section of the wheel path depression
3. Forcing the finer material towards the outer edges of the spreader box

37-3.03C(4) Test Strips

If micro-surfacing placement will require more than 1 day, you must construct a test strip. The test strip must be:

1. From 300 to 450 feet long
2. The same as the full production micro-surfacing
3. On 1 of the application courses specified at an authorized location

4. At the same time of day or night the full production micro-surfacing is to be applied

If multiple application courses are specified, you may construct test strips over 2 days or nights.

The Engineer evaluates the test strip after traffic has used it for 12 hours. If the Engineer determines the mix design or placement procedure is unacceptable, make modifications and construct a new test strip for the Engineer's evaluation.

37-3.03C(5) Placement

37-3.03C(5)(a) General

Reserved

37-3.03C(5)(b) Repair Wheel Path Depressions

If repairing wheel path depressions is shown in plans, fill wheel path depressions and irregularities with micro-surfacing material before spreading micro-surfacing. If the depressions are less than 0.04 foot deep, fill with a scratch course. If the depressions are 0.04 foot deep or more, fill the depressions using a wheel path depression box.

Spread scratch courses by adjusting the steel strike-off of a scratch course box until it is directly in contact with the pavement surface.

Spread micro-surfacings with a wheel path depression box leaving a slight crown at the surface. Use multiple applications to fill depressions more than 0.12 foot deep. Do not apply more than 0.12 foot in a single application.

Allow traffic to compact each filled wheel path depression for a minimum of 12 hours before placing additional micro-surfacings.

37-3.03C(5)(c) Micro-surfacing Pavement Surfaces

The micro-surfacing spread rates must be within the ranges shown in the following table:

Micro-surfacing type	Application range (lb of dry aggregate/sq yd)
Type II	10–20
Type III[a]	20–32
Type III[b]	30–32

[a]Over asphalt concrete pavement
[b]Over concrete pavement and concrete bridge decks

Within 2 hours after placement, micro-surfacings must be set enough to allow traffic without pilot cars. Protect the micro-surfacings from damage until it has set and will not adhere or be picked up by vehicle tires. Micro-surfacings must not exhibit distress from traffic such as bleeding, raveling, separation or other distresses.

37-3.03D Payment

The payment quantity for micro-surfacing is the weight determined by combining the weights of the aggregate and micro-surfacing emulsion. The payment quantity for micro-surfacing does not include the weights of added water, mineral filler, and additives.

37-3.04 RUBBERIZED AND MODIFIED SLURRY SEALS

Reserved

37-4 FOG SEALS AND FLUSH COATS

37-4.01 GENERAL

37-4.01A General

37-4.01A(1) Summary

Section 37-4.01 includes general specifications for applying fog seals and flush coats.

37-4.01A(2) Definitions

Reserved

37-4.01A(3) Submittals

At least 15 days before use, submit:

1. Sample of asphaltic emulsion in two 1-quart plastic container with lined, sealed lid
2. Asphaltic emulsion information and test data as follows:
   - 2.1. Supplier
   - 2.2. Type/Grade of asphalt emulsion
   - 2.3. Copy of the specified test results for asphaltic emulsion

37-4.01B Materials

Not Used

37-4.01C Construction

37-4.01C(1) General

Reserved

37-4.01C(2) Weather Conditions

Only place a fog seal or flush coat if both the pavement and ambient temperatures are at least 50 degrees F and rising. Do not place a fog seal or flush coat within 24 hours of rain or within 24 hours of forecast rain or freezing temperatures.

37-4.01D Payment

Not Used

37-4.02 FOG SEALS

37-4.02A General

37-4.02A(1) Summary

Section 37-4.02 includes specifications for applying fog seals.

Applying a fog seal includes applying a diluted slow-setting or quick setting asphaltic emulsion.

37-4.02A(2) Definitions

Reserved

37-4.02A(3) Submittals

Immediately after sampling, submit two 1-quart plastic container of asphaltic emulsion taken in the presence of the Engineer. Samples must be submitted in insulated shipping container.

37-4.02A(4) Quality Assurance

37-4.02A(4)(a) General

Reserved

37-4.02A(4)(b) Quality Control

37-4.02A(4)(b)(i) General

Reserved

37-4.02A(4)(b)(ii) Asphaltic Emulsions

Circulate asphaltic emulsions in the distributor truck before sampling. Take samples from the distributor truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer, take asphalt emulsion sample in two 1-quart plastic container with lined, sealed lid.

For asphaltic emulsions, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

Asphaltic Emulsion

Quality characteristic	Test Method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furl seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge[a]			
Tests on Residue from Distillation Test:			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Ductility	AASHTO T 51		
Solubility in tricloroethylene	AASHTO T 44		

[a]If the result of the particle charge is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

37-4.02A(4)(b)(iii) Asphaltic Emulsion Spread Rates

For fog seals, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

Fog Seal Quality Control Requirements

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Asphaltic emulsion spread rate (gal/sq yd)	California Test 339	2 per day	Pavement surface

37-4.02A(4)(c) Department Acceptance

Fog seal acceptance is based on:

1. Visual inspection for the following:
   1.1. Uniform surface texture throughout the work limits
   1.2. Flushing consisting of the occurrence of a film of asphaltic material on the surface
   1.4 Streaking consisting of alternating longitudinal bands of asphaltic emulsion approximately parallel with the lane line
2. The Department's sampling and testing for compliance with the requirements for the quality characteristics specified in section 94 for asphaltic emulsion
3. Department's sampling and testing for compliance with the requirements for fog seal shown in the following table:

Fog Seal Acceptance Criteria

Quality Characteristic	Test Method	Requirement
Asphaltic emulsion spread rate (gal/sq yd)	California Test 339	TV ± 10%

37-4.02B Materials

You determine the grade of slow-setting or quick setting asphaltic emulsion to be used.

37-4.02C Construction

Apply asphaltic emulsions for fog seals at a residual asphalt rate from 0.02 to 0.06 gal/sq yd.

If additional water is added to the asphaltic emulsions, the resultant mixture must not be more than 1 part asphaltic emulsion to 1 part water. You determine the dilution rate.

If the fog seals become tacky, sprinkle water as required.

If fog seals and chip seals are on the same project, the joint between the seal coats must be neat and uniform.

37-4.02D Payment

The Department does not adjust the unit price for an increase or decrease in the asphaltic emulsion quantity.

37-4.03 FLUSH COATS

37-4.03A General

37-4.03A(1) Summary

Section 37-4.03 includes specifications for applying flush coats.

Applying a flush coat includes applying a fog seal coat followed by sand.

37-4.03A(2) Definitions

Reserved

37-4.03A(3) Submittals

At least 15 days before use, submit:

1. Proposed target X values for sand gradation.
2. Gradation test results for sand

Submit quality control test results for sand gradation within 2 business days of sampling.

37-4.03A(4) Quality Assurance

37-4.03A(4)(a) General

Reserved

37-4.03A(4)(b) Quality Control

For sand, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

Sand Quality Control

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Gradation (% passing by weight)	California Test 202	1 per day	See California Test 125

37-4.03A(4)(c) Department Acceptance

Flush coat acceptance is based on fog seal acceptance and the following:

1. Visual inspection for uniform application of sand.
2. Sand acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Sand Gradation Acceptance Criteria

Quality characteristic	Test method	Requirement
Gradation (% passing by weight) Sieve size:	California Test 202	
3/8"		100
No. 4		93–100
No. 8		61–99
No. 16		X ± 13
No. 30		X ± 12
No. 50		X ± 9
No.100		1–15
No. 200		0–10

NOTE: "X" is the gradation that you propose to furnish for the specific sieve size.

37-4.03B Material

37-4.03B(1) General

Reserved

37-4.03B(2) Sand

Sand must be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

Sand for a flush coat must comply with the gradations shown in the following table:

Sand Gradation

Quality characteristic	Test method	Requirement
Gradation (% passing by weight) Sieve size:	California Test 202	
3/8"		100
No. 4		93–100
No. 8		61–99
No. 16		X ± 13
No. 30		X ± 12
No. 50		X ± 9
No.100		1–15
No. 200		0–10

NOTE: "X" is the gradation that you propose to furnish for the specific sieve size.

Fine aggregate sizes must be distributed such that the difference between the total percentage passing the No. 16 and No. 30 sieves is from 10 to 40, and the difference between the percentage passing the No. 30 and No. 50 sieves is from 10 to 40.

37-4.03C Construction

37-4.03C(1) General

During flush coat activities, close adjacent lanes to traffic. Do not track asphaltic emulsion on existing pavement surfaces.

Apply sand immediately after applying asphaltic emulsions.

Spread sand aggregate with a mechanical device that spreads sand at a uniform rate over the full width of a traffic lane in a single application. Spread sand at a rate from 2 to 6 lb/sq yd. You determine the application rates for sand and the Engineer authorizes the application rate.

37-4.03C(2) Sweeping

Sweep loose sand material remaining on the surface 24 hours after application.

37-4.03D Payment

The Department does not adjust the unit price for an increase or decrease in the sand cover (seal) quantity.

37-5 PARKING AREA SEALS

37-5.01 GENERAL

37-5.01A Summary

Section 37-5 includes specifications for applying parking area seals. Sealing a parking area consists of spreading a mixture of asphaltic emulsion, aggregate, polymer, and water.

37-5.01B Definitions

Reserved

37-5.01C Submittals

At least 15 days before starting placement, submit a 20 lb sample of the aggregate to be used.

At least 10 days before starting placement, submit:

1. Name of the authorized laboratory to perform testing and mix design.
2. Laboratory report of test results and a proposed mix design. The report and mix design must include the specific materials to be used and show a comparison of test results and specifications. The mix design report must include the quantity of water allowed to be added at the job site. The authorized laboratory performing the tests must sign the original laboratory report and mix design.
3. Manufacturer's data for oil seal primer and polymer.

If the mix design consists of the same materials covered by a previous laboratory report, you may submit the previous laboratory report that must include material testing data performed within the previous 12 months for authorization.

If you request substitute materials, submit a new laboratory report and mix design at least 10 days before starting placement.

Submit a certificate of compliance for the parking area seal material.

Immediately after sampling, submit two 1-quart plastic containers of parking area seal taken in the presence of the Engineer. Samples must be submitted in insulated shipping containers.

37-5.01D Quality Assurance

37-5.01D(1) General

Reserved

37-5.01D(2) Quality Control

37-5.01D(2)(a) General

Reserved

37-5.01D(2)(b) Asphaltic Emulsions

For an asphaltic emulsion, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

Asphaltic Emulsion

Quality characteristic	Test Method	Minimum sampling and testing frequency	Sampling location
Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)	AASHTO T 59	Minimum 1 per day per delivery truck	Distributor truck
Sieve Test (%)			
Storage stability, 1 day (%)			
Residue by distillation (%)			
Particle charge[a]			
Tests on Residue from Distillation Test			
Penetration, 25 °C	AASHTO T 49	Minimum 1 per day per delivery truck	Distributor truck
Ductility	AASHTO T 51		
Solubility in trichloroethylene	AASHTO T 44		

[a]If the result of the particle char is inconclusive, the asphaltic emulsion must be tested for pH under ASTM E70. Grade QS1h asphaltic emulsion must have a minimum pH of 7.3. Grade CQS1h asphaltic emulsion must have a maximum pH of 6.7.

37-5.01D(2)(c) Sand

For sand, the authorized laboratory must perform sampling and testing at the specified frequency and location for the following quality characteristics:

Sand Quality Control

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Gradation (% passing by weight)	California Test 202	One per project	See California Test 125

37-5.01D(2)(d) Parking Area Seals

For a parking area seal, the authorized laboratory must perform quality control sampling and testing at the specified frequency for the following quality characteristics:

Parking Area Seal Requirements

Quality characteristic	Test method	Frequency
Mass per liter (kg)	ASTM D244	One per project
Cone penetration (mm)	California Test 413	
Nonvolatile (%)	ASTM D2042[a]	
Nonvolatile soluble in trichloroethylene (%)		
Wet track abrasion (g/m^2)	ASTM D3910	
Dried film color	--	
Viscosity (KU)[b]	ASTM D562	

[a]Weigh 10 g of homogenous material into a previously tarred, small can. Place in a constant temperature oven at 165 ± 5 °C for 90 ± 3 minutes. Cool, reweigh, and calculate nonvolatile components as a percent of the original weight.
[b]Krebs units

37-5.01D(3) Department Acceptance

Parking area seal acceptance is based on:

1. Visual inspection for:
   1.1. Uniform surface texture throughout the work limits
   1.2 Marks in the surface:
      1.2.1. Up to 4 marks in the completed parking area seal that are up to 1 inch wide and up to 6 inches long per 1,000 square feet of parking area seal placed.
      1.2.2. No marks in the completed parking area seal surface that are over 1 inch wide or 6 inches long.

1.2. Raveling consisting of the separation of the aggregate from the asphaltic emulsion
1.3. Bleeding consisting of the occurrence of a film of asphaltic material on the surface of the parking area seal
1.4 Delaminating of the parking area seal from the existing pavement
1.5 Rutting or wash-boarding

2. The Department's sampling and testing of aggregate for compliance with 100 percent passing no. 16 sieve under California Test 202
3. The Department's sampling and testing for compliance with the requirements shown in the following table:

Parking Area Seal Acceptance Criteria

Quality characteristic	Test method	Requirement
Mass per liter (min, kg)	ASTM D244	1.1
Cone penetration (mm)	California Test 413	340–700
Nonvolatile (min, %)	ASTM D2042[a]	50
Nonvolatile soluble in trichloroethylene (%)		10–35
Wet track abrasion (max, g/m^2)	ASTM D3910	380
Dried film color	--	Black
Viscosity (min, KU)[b]	ASTM D562	75

[a]Weigh 10 g of homogenous material into a previously tared, small ointment can. Place in a constant temperature oven at 165 ± 5 °C for 90 ± 3 minutes. Cool, reweigh, and calculate nonvolatile components as a percent of the original weight.
[b]Krebs units

37-5.02 MATERIALS

37-5.02A General

Aggregate must be clean, hard, durable, uncoated, and free from organic and deleterious substances. One hundred percent of the aggregate must pass the no. 16 sieve.

Asphaltic emulsion must be either Grade SS1h or CSS1h, except the values for penetration at 25 degrees C for tests on residue from distillation must be from 20 to 60.

Polymer must be either neoprene, ethylene vinyl acetate, or a blend of butadiene and styrene.

Oil seal primer must be a quick-drying emulsion with admixtures. Oil seal primer must be manufactured to isolate the parking area seal from pavement with residual oils, petroleum grease, and spilled gasoline.

Crack sealant must comply with section 37-6.

Water must be potable and not separate from the emulsion before the material is placed.

37-5.02B Mix Design

The proposed mix design for a parking area seal must comply with the requirements shown in the following table:

Parking Area Seal Mix Design Requirements

Quality characteristic	Test method	Requirement
Mass per liter (min, kg)	ASTM D244	1.1
Cone penetration (mm)	California Test 413	340–700
Nonvolatile (min, %)	ASTM D2042[a]	50
Nonvolatile soluble in trichloroethylene (%)		10–35
Wet track abrasion (max, g/m^2)	ASTM D3910	380
Dried film color	--	Black
Viscosity (min, KU)[b]	ASTM D562	75

[a]Weigh 10 g of homogenous material into a previously tarred, small ointment can. Place in a constant temperature oven at 165 ± 5 °C for 90 ± 3 minutes. Cool, reweigh, and calculate nonvolatile components as a percent of the original weight.
[b]Krebs units

A parking area seal must contain a minimum of 2 percent polymer by volume of undiluted asphaltic emulsion.

37-5.02C Proportioning

Parking area seal ingredients must be mixed at a central plant. The plant must include mechanical or electronic controls that consistently proportion the ingredients. Mix an asphaltic emulsion with the other ingredients mechanically.

Store the parking area seal in a tank equipped with mixing or agitation devices. Keep stored materials thoroughly mixed. Protect stored materials from freezing conditions.

37-5.03 CONSTRUCTION

37-5.03A General

Request that the Engineer shut off the irrigation control system at least 5 days before placing the seal. Do not water plants adjacent to the seal at least 24 hours before and after the seal coat placement.

37-5.03B Surface Preparations

If cracks in the existing pavement are from 1/4 to 1 inch wide, treat the cracks under section 37-6. Do not place the parking area seals until the Engineer determines that the crack treatments are cured.

If cracks in the existing pavement are greater than 1 inch wide, the Engineer orders the repair. This work is change order work.

After any crack treatment and before placing parking area seals, clean the pavement surface, including removal of oil and grease spots. Do not use solvents.

If cleaning the pavement with detergents, thoroughly rinse with water. Allow all water to dry before placing parking area seals.

You must seal oil and grease spots that remain after cleaning. Use an oil seal primer and comply with the manufacturer's instructions.

If the existing pavement has oil and grease spots that do not come clean and sealing is insufficient, the Engineer orders the repair of the pavement. This work is change order work.

Before placing the parking area seals, dampen the pavement surface using a distributor truck. Place the seal on the damp pavement but do not place it with standing water on the pavement.

37-5.03C Placement

If adding water at the job site based on the manufacturer's instructions for consistency and spreadability, do not exceed 15 percent by volume of undiluted asphaltic emulsion.

Place the parking area seals in 1 or more application. The seals must be uniform and smooth, free of ridges or uncoated areas.

If placing in multiple applications, allow the last application to thoroughly dry before the subsequent application.

Do not allow traffic on the parking area seals for at least 24 hours after placement.

Do not stripe over the parking area seals until it is dry.

37-5.04 PAYMENT

The payment quantity for parking area seal is the weight determined by combining the weights of the aggregate and asphaltic emulsion. The payment quantity for parking area seal does not include the added water and set-control additive.

37-6 CRACK TREATMENTS

37-6.01 GENERAL

37-6.01A Summary

Section 37-6 includes specifications for treating cracks in asphalt concrete pavement.

37-6.01B Definitions

Reserved

37-6.01C Submittals

If your selected crack treatment material is on the Authorized Material List for flexible pavement crack treatment material, submit a certificate of compliance including:

1. Manufacturer's name
2. Production location
3. Brand or trade name
4. Designation
5. Batch or lot number
6. Crack treatment material type
7. Contractor or subcontractor name
8. Contract number
9. Lot size
10. Shipment date
11. Manufacturer's signature

If your selected crack treatment material is not on the Authorized Material List for flexible pavement crack treatment material, submit a sample and test results from each batch or lot 20 days before use. Testing must be performed by an authorized laboratory and test results must show compliance with the specifications. Test reports must include the information specified for the certificate of compliance submittal. Each hot-applied crack treatment material sample must be a minimum of 3 lb and submitted in a silicone release container. Each cold-applied crack treatment material sample must be a minimum of 2 quarts and submitted in a plastic container.

At least 10 days before the start of work, submit sand gradation test results under California Test 202.

Submit the following with each delivery of crack treatment material to the job site:

1. Manufacturer's heating and application instructions
2. Manufacturer's SDS
3. Name of the manufacturer's recommended detackifying agent

37-6.01D Quality Assurance

37-6.01D(1) General

Hot-applied crack treatment material must be sampled at least once per project in the Engineer's presence. Collect two 3-pounds-minimum samples of crack treatment material from the dispensing wand into silicone release boxes.

Cold-applied crack treatment material must be sampled at least once per project in the Engineer's presence. Collect 2 samples of crack treatment material from the dispensing wand into 1-quart containers.

37-6.01D(2) Quality Control

Reserved

37-6.01D(3) Department Acceptance

Crack treatment acceptance is based on:

1. Visual inspection for uniform filling of cracks throughout the work limits including:
   1.2. Crack treatment is not more than a 1/4 inch below the specified level
   1.3. Sealant failures
   1.4. Crack re-opening
   1.5. Crack overbanding is less than 3 inches wide
2. The Department's sampling and testing for compliance with the requirements shown in the following table:

Crack Treatment Acceptance Criteria

Quality characteristic[a]	Test method[b]	Requirement				
		Type 1	Type 2	Type 3	Type 4	Type 5
Softening point (min, °C)	ASTM D36	102	96	90	84	84
Cone penetration at 77 °F (max)	ASTM D5329	35	40	50	70	90
Resilience at 77 °F, unaged (%)	ASTM D5329	20–60	25–65	30–70	35–75	40–80
Flexibility (°C)[c]	ASTM D3111	0	0	0	-11	-28
Tensile adhesion (min, %)	ASTM D5329	300	400	400	500	500
Specific gravity (max)	ASTM D70	1.25	1.25	1.25	1.25	1.25
Asphalt compatibility	ASTM D5329	Pass	Pass	Pass	Pass	Pass
Sieve test (% passing)	See note d	100	100	100	100	100

[a]Cold-applied crack treatment material residue collected under ASTM D6943, Method B and sampled under ASTM D140 must comply with the grade specified.
[b]Except for viscosity, cure each specimen at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 10 percent for 24 ± 2 hours before testing.
[c]For the flexibility test, the specimen size must be 6.4 ± 0.2 mm thick by 25 ± 0.2 mm wide by 150 ± 0.5 mm long. The test mandrel diameter must be 6.4 ± 0.2 mm. The bend arc must be 180 degrees. The bend rate must be 2 ± 1 seconds. At least 4 of 5 test specimens must pass at the specified test temperature without fracture, crazing, or cracking.
[d]For hot-applied crack treatment, dilute with toluene and sieve through a no. 8 sieve. For cold-applied crack treatment, sieve the material as-received through a no. 8 sieve. If the manufacturer provides a statement that added components passed the no. 16 sieve before blending, this requirement is void.

37-6.02 MATERIALS

37-6.02A General

Reserved

37-6.02B Crack Treatment Material

A crack treatment material must comply with the requirements shown in the following table:

Crack Treatment Material

Quality characteristic[a]	Test method[b]	Requirement				
		Type 1	Type 2	Type 3	Type 4	Type 5
Softening point (min, °C)	ASTM D36	102	96	90	84	84
Cone penetration at 77 °F (max)	ASTM D5329	35	40	50	70	90
Resilience at 77 °F, unaged (%)	ASTM D5329	20–60	25–65	30–70	35–75	40–80
Flexibility (°C)[c]	ASTM D3111	0	0	0	-11	-28
Tensile adhesion (min, %)	ASTM D5329	300	400	400	500	500
Specific gravity (max)	ASTM D70	1.25	1.25	1.25	1.25	1.25
Asphalt compatibility	ASTM D5329	Pass	Pass	Pass	Pass	Pass
Sieve test (% passing)	See note d	100	100	100	100	100

[a]Cold-applied crack treatment material residue collected under ASTM D6943, Method B and sampled under ASTM D140 must comply with the grade specifications.
[b]Except for viscosity, cure each specimen at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 10 percent for 24 ± 2 hours before testing.
[c]For the flexibility test, the specimen size must be 6.4 ± 0.2 mm thick by 25 ± 0.2 mm wide by 150 ± 0.5 mm long. The test mandrel diameter must be 6.4 ± 0.2 mm. The bend arc must be 180 degrees. The bend rate must be 2 ± 1 seconds. At least 4 of 5 test specimens must pass at the specified test temperature without fracture, crazing, or cracking.
[d]For hot-applied crack treatment, dilute with toluene and sieve through a no. 8 sieve. For cold-applied crack treatment, sieve the material as-received through a no. 8 sieve. If the manufacturer provides a statement that added components passed the no. 16 sieve before blending, this requirement is void.

A crack treatment material must be delivered to the job site with the information listed below. If crack treatment material is delivered to the job site in containers, each container must be marked with the following information.

1. Manufacturer's name
2. Production location
3. Brand or trade name
4. Designation
5. Crack treatment trade name
6. Batch or lot number
7. Maximum heating temperature
8. Expiration date for cold application only

Hot-applied crack treatment must be delivered to the job site premixed in cardboard containers with meltable inclusion liners or in a fully meltable package.

Cold-applied crack treatment must have a minimum shelf life of 3 months from the date of manufacture.

37-6.02C Sand

Sand applied to tacky crack treatment material must be clean, free of clay, and comply with the gradation shown in the following table:

Sand Gradation

Quality characteristic	Test method	Requirement
Gradation (% passing by weight) Sieve size:	California Test 202	
No. 4		100
No. 50		0–30
No. 200		0–5

37-6.03 CONSTRUCTION

Treat cracks from 1/4 to 1 inch in width for the entire length of the crack. Fill or repair cracks wider than 1 inch as ordered. Filling cracks wider than 1 inch is change order work.

If treating cracks on a traffic lane adjacent to a shoulder, treat the cracks on the shoulder.

For hot-applied crack treatment material, rout cracks or saw cut to form a reservoir.

Cracks must be clean and dry before treating. Before treating, blast cracks with oil-free compressed air at a pressure of at least 90 psi.

If the pavement temperature is below 40 degrees F or if there is evidence of moisture in the crack, use a hot air lance immediately before applying crack treatment. The hot air lance must not apply flame directly on the pavement.

Heat and apply hot-applied crack treatment material under with the manufacturer's instructions.

Apply cold-applied crack treatment material with a distributor kettle, a piston, or a diaphragm barrel pump that can deliver from 50 to 75 psi. The application line must have a pressure gauge and a filter. The pressure in the application line must not exceed 20 psi. The pressure gauge must have a regulator. Use a high-pressure hose with a 1/2-inch NPT swivel connection and a dispensing wand.

Apply crack treatment with a nozzle inserted into the crack. Fill the crack flush. If after 2 days the crack treatment is more than 1/4 inch below the specified level, the sealant fails, or the crack re-opens, re-treat the crack.

Immediately remove crack treatment material that is spilled or deposited on the pavement surface.

Before opening to traffic, apply sand or the manufacturer's recommended detackifying agent to tacky crack treatment material on the traveled way.

Sweep up excess sand before opening to traffic.

37-6.04 PAYMENT

The payment quantity for crack treatment is the length measured in lane miles along the edge of each paved lane parallel to the pavement's centerline. The payment for a lane includes crack treatment of the adjacent shoulder.

37-7–37-10 RESERVED

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39 ASPHALT CONCRETE

04-20-18

Replace *SP-2* at each occurrence in section 39 with:

01-15-16

MS-2

Replace the 3rd paragraph of section 39-2.01A(1) with:

07-15-16

WMA technologies must be on the Authorized Material List for WMA authorized technologies.

Add between the 3rd and 4th paragraphs of section 39-2.01A(1):

04-15-16

For HMA that uses asphalt binder containing crumb rubber modifier, submit a Crumb Rubber Usage Report form monthly and at the end of the project.

Replace the table in the 4th paragraph of section 39-2.01A(1) with:

07-21-17

Test method	Year of publication
AASHTO M 17	2011 (2015)
AASHTO M 323	2013
AASHTO R 30	2002 (2015)
AASHTO R 59	2011 (2015)
AASHTO T 27	2014
AASHTO T 49	2014
AASHTO T 59	2013
AASHTO T 96	2002 (2010)
AASHTO T 164	2014
AASHTO T 176	2008
AASHTO T 209	2012
AASHTO T 269	2014
AASHTO T 275	2007 (2012)
AASHTO T 283	2014
AASHTO T 304	2011
AASHTO T 305	2014
AASHTO T 308	2010
AASHTO T 312	2014
AASHTO T 313	2012 (2016)
AASHTO T 315	2012 (2016)
AASHTO T 324	2014
AASHTO T 329	2013
AASHTO T 335	2009
ASTM D36/D36M	$2014^{\varepsilon 1}$
ASTM D92	2012b
ASTM D217	2010
ASTM D297	2013
ASTM D445	2014
ASTM D1856	2009 (Reapproved 2015)
ASTM D2007	2011
ASTM D2074	2007 (Reapproved 2013)
ASTM D2995	1999 (Reapproved 2009)
ASTM D4791	2010
ASTM D5329	2009
ASTM D7741/D7741M	$2011^{\varepsilon 1}$
Asphalt Institute MS-2	7th edition (2015)

Replace items 1 and 2 in the 1st paragraph of section 39-2.01A(3)(b)(i) with:

07-21-17

1. Mix design documentation on a Contractor Hot Mix Asphalt Design Data form dated within 12 months of the submittal for the JMF verification.
2. JMF verification on a Caltrans Hot Mix Asphalt Verification form and the Contractor Hot Mix Asphalt Design Data form that was submitted for the JMF verification, if applicable.

Replace the 2nd paragraph of section 39-2.01A(3)(b)(i) with:

04-20-18

The Contractor Hot Mix Asphalt Design Data form must identify the AASHTO resource accredited lab responsible for the mix design and show documentation on aggregate quality.

Add to item 8 in the 4th paragraph of section 39-2.01A(3)(b)(i):

07-15-16

, except lime supplier and source

Replace the 1st paragraph of section 39-2.01A(3)(c) with:

04-20-18

At least 5 business days prior to the pre-paving meeting, submit a QC plan for HMA.

Replace the headings and paragraphs of section 39-2.01A(3)(i) with:

01-15-16

39-2.01A(3)(i) Reserved

Replace section 39-2.01A(3)(j) with:

04-20-18

39-2.01A(3)(j) Tack Coat

Prior to applying tack coat, submit calculations for the minimum spray rate required to achieve the minimum residual rate.

Replace the 2nd sentence in the 3rd paragraph of section 39-2.01A(4)(b) with:

01-15-16

Submit 3 parts and keep 1 part.

07-21-17

Delete item 3 in the 5th paragraph of section 39-2.01A(4)(b).

Replace the 8th paragraph of section 39-2.01A(4)(b) with:

04-20-18

If the Engineer's test results on plant-produced samples do not show compliance with the specifications, the Engineer notifies you. Submit a JMF adjusted after verification failure based on your testing unless the Engineer authorizes reverification without adjustments. Engineer authorized reverification without adjustment is not JMF adjusted after verification failure. A JMF adjusted after verification failure may include a change in:

1. Asphalt binder content TV up to ±0.20 percent from the OBC value submitted on the Contractor Hot Mix Asphalt Design Data form
2. Aggregate gradation TV within the TV limits specified in the aggregate gradation table

Replace the 10th paragraph of section 39-2.01A(4)(b) with:

04-20-18

For each HMA type and aggregate size specified, the Engineer verifies up to 2 proposed JMF submittals including a JMF adjusted after verification failure. Do not resubmit any of the 2 proposed submittals including a JMF adjusted after verification failure that failed verification on any other Caltrans projects. If you submit more than 2 JMFs for each type of HMA and aggregate size, the Engineer deducts $3,000 from payments for each verification exceeding this limit. This deduction does not apply to verifications initiated by the Engineer or if a JMF expires while HMA production is stopped longer than 30 days.

Replace *AASHTO Materials Reference Laboratory* in the paragraph of section 39-2.01A(4)(f)(i) with:

01-20-17

AASHTO re:source

Add between the 1st and 2nd paragraphs of section 39-2.01A(4)(h)(i):

04-20-18

Condition each at-the-plant sample of HMA mixture for AASHTO 324 and AASHTO 283 in compliance with sections 7.1.2, 7.1.3, and 7.1.4 of AASHTO R 30. Condition each at-the-plant sample of HMA mixture when composite aggregate absorption factor is greater than 2.0 percent as indicated by the JMF in compliance with sections 7.1.2, 7.1.3, and 7.1.4 of AASHTO R 30.

04-20-18

Delete section 39-2.01A(4)(h)(ix)

Replace the 5th paragraph of section 39-2.01A(4)(i)(i) with:

04-20-18

The Engineer conditions each at-the-plant sample of HMA mixture for AASHTO 324 and AASHTO 283 in compliance with sections 7.1.2, 7.1.3, and 7.1.4 of AASHTO R 30. The Engineer conditions each at-the-plant sample of HMA mixture when composite aggregate absorption factor is greater than 2.0 percent as indicated by the JMF in compliance with sections 7.1.2, 7.1.3, and 7.1.4 of AASHTO R 30.

07-21-17

Delete the 6th paragraph of section 39-2.01A(4)(i)(i).

Add between *single* and *test* in the 7th paragraph of section 39-2.01A(4)(i)(i):

07-15-16

aggregate or HMA

Replace *Engineer may accept* in the introductory clause of the 3rd paragraph of section 39-2.01A(4)(i)(ii) with:

07-21-17

Engineer must accept

Replace the table in section 39-2.01A(4)(i)(iii) with:

04-20-18

HMA Pavement Smoothness Acceptance Criteria

HMA thickness	Mean Roughness Index requirement
> 0.25 foot	60 in/mi or less
≤ 0.25 foot	75 in/mi or less

Note: These requirements do not apply to the OGFC surface. Smoothness requirements for OGFC are specified in section 39-2.04A(4)(c)(iii).

Replace *AASHTO Materials Reference Laboratory* in the 2nd paragraph of section 39-2.01A(4)(i)(iv) with:

01-20-17

AASHTO re:source

Replace the 1st paragraph of section 39-2.01B(2)(a) with:

07-21-17

The HMA mix design must comply with the superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute.

Replace the 1st paragraph of section 39-2.01B(2)(b) with:

07-15-16

If the proposed JMF indicates that the aggregate is being treated with dry lime or lime slurry with marination, or the HMA with liquid antistrip, then testing the untreated aggregate under AASHTO T 283 and AASHTO T 324 is not required.

If HMA treatment is required or being used by the Contractor, determine the plasticity index of the aggregate blend under California Test 204.

Add between *aggregate* and *with dry lime* in the 3rd and 4th paragraphs of section 39-2.01B(2)(b):

07-15-16

blend

Replace the 9th through 11th paragraphs of section 39-2.01B(8)(a) with:

07-15-16

HMA must be produced at the temperatures shown in the following table:

HMA Production Temperatures

HMA compaction	Temperature (°F)
HMA	
Density based	≤ 325
Method	305–325
HMA with WMA technology	
Density based	240–325
Method	260–325

Replace section 39-2.01B(11) with:

07-21-17

39-2.01B(11) Miscellaneous Areas and Dikes

For miscellaneous areas and dikes:

1. Choose the aggregate gradation from:
   1.1. 3/8-inch Type A HMA aggregate gradation
   1.2. 1/2-inch Type A HMA aggregate gradation
   1.3. dike mix aggregate gradation
2. Choose asphalt binder Grade PG 64-10, PG 64-16 or PG 70-10.
3. Minimum asphalt binder content must be:
   3.1. 6.40 percent for 3/8-inch Type A HMA aggregate gradation
   3.2. 5.70 percent for 1/2-inch Type A HMA aggregate gradation
   3.3. 6.00 percent for dike mix aggregate gradation

If you request and the Engineer authorizes, you may reduce the minimum asphalt binder content.

Aggregate gradation for dike mix must be within the TV limits for the specified sieve size shown in the following table:

Dike Mix Aggregate Gradation
(Percentage Passing)

Sieve size	Target value limit	Allowable tolerance
1/2"	100	--
3/8"	---	95 - 100
No. 4	73–77	TV ± 10
No. 8	58–63	TV ± 10
No. 30	29–34	TV ± 10
No. 200		0 - 14

For HMA used in miscellaneous areas and dikes, sections 39-2.01A(3), 39-2.01A(4), 39-2.01B(2), 39-2.01B(4)(c), and 39-2.01B(5)–(10) do not apply.

Replace item 4 in the 2nd paragraph of section 39-2.01C(1) with:

07-15-16

4. For method compaction:
   4.1. The temperature of the HMA and the HMA produced with WMA water injection technology in the windrow does not fall below 260 degrees F
   4.2. The temperature of the HMA produced using WMA additive technology in the windrow does not fall below 250 degrees F

Add to the list in the 7th paragraph of section 39-2.01C(1):

07-21-17

4. Marks
5. Tearing
6. Irregular texture

07-15-16

Delete item 3 in the 8th paragraph of section 39-2.01C(1).

Replace the 1st paragraph of section 39-2.01C(2)(c) with:

07-21-17

For method compaction, each paver spreading HMA must be followed by at least one of each of the following 3 types of rollers:

1. Breakdown roller must be a vibratory roller specifically designed to compact HMA. The roller must be capable of at least 2,500 vibrations per minute and must be equipped with amplitude and frequency controls. The roller's gross static weight must be at least 7.5 tons.
2. Intermediate roller must be an oscillating-type pneumatic-tired roller at least 4 feet wide. Pneumatic tires must be of equal size, diameter, type, and ply. The tires must be inflated to 60 psi minimum and maintained so that the air pressure does not vary more than 5 psi.
3. Finishing roller must be a steel-tired, 2-axle tandem roller. The roller's gross static weight must be at least 7.5 tons.

Replace *planning* in the 3rd paragraph of section 39-2.01C(3)(d) with:

07-21-17

planing

Replace *0.20 foot* in item 2 in the list in the 1st paragraph of section 39-2.01C(3)(e) with:

04-20-18

0.25 foot

Replace *39-2.01A(3)(m)(iv)* in the 6th paragraph of section 39-2.01C(3)(e) with:

01-15-16

36-3.01C(3)

Replace *2.06* in the 4th paragraph of section 39-2.01C(3)(f) with:

07-15-16

2.05

Replace section 39-2.01C(3)(g) with:

07-21-17

39-2.01C(3)(g) Geosynthetic Pavement Interlayer

Where shown, place geosynthetic pavement interlayer over a coat of asphalt binder and in compliance with the manufacturer's instructions. Do not place the interlayer on a wet or frozen surface. If the interlayer, in compliance with the manufacturer's instructions, does not require asphalt binder, do not apply asphalt binder before placing the interlayer.

Before placing the interlayer or asphalt binder:

1. Repair cracks 1/4 inch and wider, spalls, and holes in the pavement. This repair is change order work.
2. Clean the pavement of loose and extraneous material.

If the interlayer requires asphalt binder, immediately before placing the interlayer, apply asphalt binder at a rate specified by the interlayer manufacturer; at 0.25±0.03 gal per square yard of interlayer; or at a rate that just saturates the interlayer; whichever is greater. Apply asphalt binder the width of the interlayer plus 3 inches on each side. At an interlayer overlap, apply asphalt binder on the lower interlayer the same overlap distance as the upper interlayer.

If asphalt binder tracked onto the interlayer or brought to the surface by construction equipment causes interlayer displacement, cover it with a small quantity of HMA.

If the interlayer placement does not require asphalt binder, apply tack coat prior to placing HMA at the application rates specified under section 39-2.01C(3)(f) based on the condition of the underlying surface on which the interlayer was placed.

Align and place the interlayer with no overlapping wrinkles, except a wrinkle that overlaps may remain if it is less than 1/2 inch thick. If the overlapping wrinkle is more than 1/2 inch thick, cut the wrinkle out and overlap the interlayer no more than 2 inches.

Overlap the interlayer borders between 2 to 4 inches. In the direction of paving, overlap the following roll with the preceding roll at any break.

You may use rolling equipment to correct distortions or wrinkles in the interlayer.

Before placing HMA on the interlayer, do not expose the interlayer to:

1. Traffic, except for crossings under traffic control and only after you place a small HMA quantity

2. Sharp turns from construction equipment
3. Damaging elements

Pave HMA on the interlayer during the same work shift. The minimum HMA thickness over the interlayer must be 0.12 foot including at conform tapers.

Add to the end of section 39-2.01C(15)(b):

07-15-16

The compacted lift thickness must not exceed 0.25 foot.

Add between *rectangles* and *with* in the 4th paragraph of section 39-2.01C(16):

04-15-16

, half the lane width,

Add between *to* and *the* in item 1 of the 4th paragraph of section 39-2.01C(16):

04-15-16

and along

07-15-16

Delete *coat* in the 5th paragraph of section 39-2.01C(16).

Replace *37* in the 5th paragraph of section 39-2.01C(16) with:

07-15-16

37-4.02

Replace section 39-2.02A(3)(b) with:

01-15-16

The JMF must be based on the superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute.

Replace the 1st paragraph of section 39-2.02C with:

04-20-18

Where the pavement thickness shown is 0.30 foot or greater, you may place Type A HMA in multiple lifts not less than 0.15 foot each. If placing Type A HMA in multiple lifts:

1. Table in Section 39-2.02B(4)(b) does not apply
2. Aggregate gradation must comply with the requirements shown in the following table:

Aggregate Gradation Requirements

Type A HMA lift thickness	Gradation
0.15 to less than 0.20 foot	1/2 inch
0.20 foot to less than 0.25 foot	3/4 inch
0.25 foot or greater	3/4 inch or 1 inch

3. Apply a tack coat before placing a subsequent lift
4. The Engineer evaluates each HMA lift individually for compliance

Add between the 1st and 2nd paragraphs of section 39-2.02C:

07-15-16

If the ambient air temperature is below 60 degrees F, cover the loads in trucks with tarpaulins. If the time for HMA discharge to truck at the HMA plant until transfer to paver's hopper is 90 minutes or greater and if the ambient air temperature is below 70 degrees F, cover the loads in trucks with tarpaulins, unless the time from discharging to the truck until transfer to the paver's hopper or the pavement surface is less than 30 minutes. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or the pavement surface.

Replace the table in the 2nd paragraph of section 39-2.02C with:

07-15-16

Minimum Ambient Air and Surface Temperatures

Lift thickness (feet)	Ambient air (°F)		Surface (°F)	
	Unmodified asphalt binder	Modified asphalt binder	Unmodified asphalt binder	Modified asphalt binder
Type A HMA and Type A HMA produced with WMA water injection technology				
<0.15	55	50	60	55
≥0.15	45	45	50	50
Type A HMA produced with WMA additive technology				
<0.15	45	45	50	45
≥0.15	40	40	40	40

07-15-16

Delete the 3rd paragraph of section 39-2.02C.

Add between *HMA* and *placed* in the 1st sentence of the 4th paragraph of section 39-2.02C:

07-15-16

and Type A HMA produced with WMA water injection technology

Add between the 4th and the 5th paragraphs of section 39-2.02C:

07-15-16

For Type A HMA produced with WMA additive technology placed under method compaction, if the asphalt binder is:

1. Unmodified, complete:
   - 1.1 1st coverage of breakdown compaction before the surface temperature drops below 240 degrees F
   - 1.2. Breakdown and intermediate compaction before the surface temperature drops below 190 degrees F
   - 1.3. Finish compaction before the surface temperature drops below 140 degrees F
   - 1.4 You may continue static rolling below 140 degrees F to remove roller marks.
2. Modified, complete:
   - 2.1. 1st coverage of breakdown compaction before the surface temperature drops below 230 degrees F
   - 2.2. Breakdown and intermediate compaction before the surface temperature drops below 170 degrees F
   - 2.3. Finish compaction before the surface temperature drops below 130 degrees F
   - 2.4. You may continue static rolling below 130 degrees F to remove roller marks.

Replace the 2nd paragraph of section 39-2.03A(3)(b) with:

01-15-16

The JMF must be based on the superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute.

Replace the requirement in the row for *Voids in mineral aggregate on plant produced HMA* in the 2nd table in section 39-2.03A(4)(e)(i) with:

01-15-16

18.0-23.0

Add before the 1st paragraph of section 39-2.03A(4)(e)(ii)(C):

04-15-16

CRM used must be on the Authorized Materials List for Crumb Rubber Modifier.

CRM must be a ground or granulated combination of scrap tire crumb rubber and high natural scrap tire crumb rubber, CRM must be 75.0 ± 2.0 percent scrap tire crumb rubber and 25.0 ± 2.0 percent high natural scrap tire crumb rubber by total weight of CRM. Scrap tire crumb rubber and high natural scrap tire crumb rubber must be derived from waste tires described in Pub Res Code § 42703.

Replace the row for *Hamburg wheel track* in the table in section 39-2.03B(2) with:

01-15-16

Hamburg wheel track (min, number of passes at the inflection point)	AASHTO T 324 (Modified)[d]	
Binder grade:		
PG 58		10,000
PG 64		12,500
PG 70		15,000

Replace *AASHTO R 35* in the 4th paragraph of section 39-2.03B(2) with:

07-21-17

superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute

Replace *RHMA-G* in the 3rd and 5th paragraphs of section 39-2.03C with:

07-15-16

RHMA-G and RHMA-G produced with WMA water injection technology

Add between the 3rd and 4th paragraphs of section 39-2.03C:

01-20-17

Spread and compact RHMA-G produced with WMA addititive technology at an ambient air temperature of at least 50 degrees F and a surface temperature of at least 50 degrees F.

Add between the 5th and 6th paragraphs of section 39-2.03C:

07-15-16

For RHMA-G produced with WMA additive technology placed under method compaction:

1. Complete the 1st coverage of breakdown compaction before the surface temperature drops below 260 degrees F

2. Complete breakdown and intermediate compaction before the surface temperature drops below 230 degrees F
3. Complete finish compaction before the surface temperature drops below 180 degrees F
4. You may continue static rolling below 140 degrees F to remove roller marks

Replace *39-2.03A(4)(b)(ii)* in the 1st sentence of section 39-2.04A(4)(b)(ii) with:

01-20-17

39-2.03A(4)(c)(ii)

Replace the 6th and 7th paragraphs of section 39-2.04C with:

07-15-16

For HMA-O and HMA-O produced with WMA water injection technology:

1. With unmodified asphalt binder:
   1.1. Spread and compact only if the atmospheric temperature is at least 55 degrees F and the surface temperature is at least 60 degrees F.
   1.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 240 degrees F.
   1.3. Complete all compaction before the surface temperature drops below 200 degrees F.
2. With modified asphalt binder, except asphalt rubber binder:
   2.1. Spread and compact only if the atmospheric temperature is at least 50 degrees F and the surface temperature is at least 50 degrees F.
   2.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 240 degrees F.
   2.3. Complete all compaction before the surface temperature drops below 180 degrees F.

For HMA-O produced with WMA additive technology:

1. With unmodified asphalt binder:
   1.1. Spread and compact only if the atmospheric temperature is at least 45 degrees F and the surface temperature is at least 50 degrees F.
   1.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 230 degrees F.
   1.3. Complete all compaction before the surface temperature drops below 190 degrees F.
2. With modified asphalt binder, except asphalt rubber binder:
   2.1. Spread and compact only if the atmospheric temperature is at least 40 degrees F and the surface temperature is at least 40 degrees F.
   2.2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 230 degrees F.
   2.3. Complete all compaction before the surface temperature drops below 170 degrees F.

Replace *RHMA-O and RHMA-O-HB* in the 8th paragraph of section 39-2.04C with:

07-15-16

RHMA-O and RHMA-O produced with WMA water injection technology, and RHMA-O-HB and RHMA-O-HB produced with WMA water injection technology

Add between the 8th and 9th paragraphs of section 39-2.04C:

07-15-16

For RHMA-O produced with WMA additive technology and RHMA-O-HB produced with WMA additives technology:

1. Spread and compact if the ambient air temperature is at least 45 degrees F and the surface temperature is at least 50 degrees F

2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 270 degrees F
3. Complete all compaction before the surface temperature drops below 240 degrees F

Add to the 2nd paragraph of section 39-2.05A(3)(b):

01-15-16

The material transfer vehicle must receive HMA directly from the truck.

Replace *Table 6.1* at each occurrence in the table in section 39-2.05B(2) with:

01-15-16

Table 8.1

Replace *SP-2 Asphalt Mixture* in the 1st footnote in the table in the 2nd paragraph of section 39-2.05B(2)(b) with:

01-15-16

MS-2 Asphalt Mix Design Methods

Replace *Manual Series No. 2 (MS-2)* in the 1st footnote in the table in the 2nd paragraph of section 39-2.05B(2)(b) with:

01-15-16

MS-2 Asphalt Mix Design Methods

Replace *39-3.05* in the 1st paragraph of section 39-3.04A with:

01-15-16

39-3.04

Add to the end of section 39-3.04A:

07-15-16

Schedule cold planing activities such that the pavement is cold planed, the HMA is placed, and the area is opened to traffic during the same work shift.

Add to the 1st paragraph of section 39-3.04C(2):

04-20-18

You may adjust the planed depth up to ± 0.03 foot from the depth shown to achieve uniform pavement profile, cross slope, and surface smoothness. The average cold planed depth must be equal to or greater than the depth shown.

Add between the 3rd and 4th paragraph of section 39-3.04C(2):

04-20-18

If you encounter delaminations during planing operations notify the Engineer immediately. If authorized, adjust the planed depth up to ± 0.05 foot to eliminate delaminations. Authorized work beyond the ± 0.05 foot range or other authorized mitigation work is change order work.

07-15-16

Delete the 2nd sentence of the 1st paragraph in section 39-3.04C(4).

Replace *39-3.06* in the 1st paragraph of section 39-3.05A with:

01-15-16

39-3.05

^^

40 CONCRETE PAVEMENT

07-21-17

Add to the end of section 40-2.02C:

01-20-17

Inorganic zinc primer must comply with AASHTO M 300, Type I or II.

Replace *and wide flange beam terminal* in the 2nd paragraph of section 40-2.02D with:

01-20-17

, Types WF and AN,

Add to the end of section 40-2.02D:

01-20-17

Polyethylene bond breaker for wide flange beam terminal and expansion joint support slabs must comply with section 36-2.

Add to the end of section 40-2.03B:

01-20-17

Lap splice bar reinforcement under section 52-6. For low carbon, chromium-steel bar reinforcement, the length of lap splice must be at least 30 inches.

Replace the paragraph in section 40-2.03D with:

07-21-17

All welding must comply with AWS D1.1. Weld stud ends with an electric arc welder completely fusing the studs to the wide flange beam.

Replace studs dislodged in shipping or that can be dislodged with a hammer.

Add to the end of section 40-2.03D:

01-20-17

Clean surface of wide flange beam to receive prime coat under section 59-2.01C(3)(b)(ii). The thickness of the prime coat must be 6 mils.

Add after the second sentence of the 1st paragraph of section 40-2.03E(3)(a):

01-20-17

For low carbon, chromium-steel bar reinforcement, the length of lap splice must be at least 30 inches.

^^

42 GROOVE AND GRIND CONCRETE

01-20-17

Replace *Reserved* in section 42-1.03 with:

01-20-17

Do not store grooving or grinding residue within the highway.

^^^^^^^^^^^^^^^^^^^

You may submit a request to use alternative mounting brackets or wire termination hardware. Your request must include:

1. Structural design calculations and testing data sealed and signed by an engineer who is registered as a civil engineer in the State
2. Manufacturer's instructions

48-6.01C(2) Guy Wire Anchors

Submit the guy wire anchor manufacturer's product information and installation instructions. Do not install anchors unless authorized.

48-6.01D Quality Assurance

48-6.01D(1) General

Reserved

48-6.01D(2) Welding

Welding must comply with AWS D1.1.

48-6.02 MATERIALS

48-6.02A General

Wire used for messenger wires, tether wires, or guy wires must be 7-wire strand complying with ASTM A475, Utilities Grade.

Connection hardware for wires must provide a termination efficiency factor of not less than 0.80.

Wood poles, push braces, and stubs must comply with ANSI O5.1.

Treat wood under AWPA U1, Use Category UC4B, Commodity Specification D.

Except for wire, helical anchors, expanded steel plate anchors, cross plate anchors, and expanding rock anchors, steel components must comply with section 56-3.

48-6.02B Helical Anchors, Expanded Steel Plate Anchors, Cross Plate Anchors, and Expanding Rock Anchors

Fabricate helical anchors, expanded steel plate anchors, and cross plate anchors under section 75.

Fabricate attachable thimble eyes and expanding rock anchors from suitable ferrous material.

Welding must comply with AWS D1.1.

Fabricate as a continuous piece or as separate segments with mechanical connections between segments. Include integral thimble eye or include attachable thimble eye.

Galvanize all helical anchor parts under section 75.

Paint expanded steel plate anchors, cross plate anchors, and expanding rock anchors as specified for repairing damaged galvanized surfaces in section 75-1.02B.

The final assembly must have (1) a minimum ultimate tensile strength greater than the minimum required breaking strength of the guy wire and (2) a minimum ultimate torsional strength greater than twice the minimum installation torque.

48-6.02C Reuse of Materials and Relocation of Temporary Supports

You may reuse structural components and relocate temporary supports provided that the materials remain in acceptable condition for reuse, except do not reuse:

1. Components of high-strength bolt assemblies that have been or are required to be tensioned past snug tight
2. High-strength cap screws that have been or are required to be tensioned past snug tight
3. Tension control bolts

48-6.03 CONSTRUCTION

48-6.03A General

Install construction bracing as necessary to withstand all imposed loads during erection, construction, and removal of any temporary wood poles.

The Engineer may order you to install Type K temporary railing at temporary wood pole locations that are less than 15 feet from the edge of a traffic lane.

Install all temporary railing protecting temporary wood poles before erecting temporary wood poles. Do not remove temporary railing until authorized.

For overhead line construction not specifically covered in the contract documents, comply with Public Utility Commission General Order 95.

48-6.03B Foundations

Verify the design soil parameters before starting construction of temporary wood poles.

Remove any accumulated water from the pole excavation prior to placing granular backfill at the bottom of the pole excavation. Thoroughly compact and level the granular backfill at the bottom of the pole excavation prior to setting the pole.

Backfill around poles with manufactured sand that is free of rocks or other deleterious material. Place the backfill material in 4-inch thick layers. Moisten and thoroughly compact each layer.

Remove accumulated water from the anchor excavation prior to placing an expanded steel anchor. Expand the base of the expanded steel anchor prior to placing backfill. Place backfill around the expanded steel anchor in 4-inch thick layers. Thoroughly compact each layer.

Protect foundations from softening and undermining.

48-6.03C Erection

If temporary wood poles are over or adjacent to roadways or railroads, all construction bracing must (1) be installed at the time each element of the temporary wood pole is erected and (2) remain in place until the temporary wood pole is removed.

Suspend conductors from messenger wire by continuous lashing wire. No spare wire conductors or cables are allowed unless described.

Sag overhead bundles to maintain required clearances over the ambient temperature range of - 30 to 120 degrees F. The sag must be between 4.6 and 5.4 percent of horizontal span unless otherwise shown. Minimum vertical clearance over grade is 25 feet unless otherwise shown.

48-6.03D Attachments

If specific connection details are not shown, mount attachments under the manufacturer's written instructions and such that there is no loss of cross section.

48-6.03E Damping

If at any time during service the temporary structural support exhibits excessive vibration, immediately install dampers. Dampers must be effective in mitigating the vibration and must not compromise the structural supports or the supported hardware.

48-6.03F Removal

Remove temporary structural supports such that portions not yet removed remain stable at all times.

Remove temporary wood poles and helical anchors. Fill the void with excavated material or sand that is free of deleterious material. Place the backfill material in 4-inch thick layers. Moisten and thoroughly compact each layer.

Dispose of surplus excavated material uniformly along the adjacent roadway.

Dispose of temporary structural support materials and work debris.

48-6.03G Guy Wire Helical Anchors

48-6.03G(1) General

Reserved

48-6.03G(2) Installation Parameters

Use the minimum installation torque shown. You may request an alternative minimum installation torque based on a revised value for empirical torque factor.

For alternative minimum installation torque, use the following equation to calculate the installation torque:

$$T = Qa(FS/Kt)$$

where:
T = Minimum installation torque, ft-lb
FS = Factor of safety of 2.0
Qa = Minimum allowable tensile capacity shown, lb
Kt = Empirical torque factor, 1/ft (inverse foot)

Include a geotechnical report sealed and signed by a licensed geotechnical engineer with recommended values for empirical torque factor and alternative minimum installation torque with your request.

Do not start installation unless your alternative installation parameters are authorized.

Verify the installation parameters before the start of anchor installation.

48-6.03G(3) Installation

Install anchors under the manufacturer's written instructions and the following:

1. Do not install anchors underneath utilities or subsurface structures.
2. Maintain horizontal clearances as required by the Engineer.
3. Install to the minimum embedment length.
4. Continuously monitor and record torque during installation. If torque at the minimum embedment length is not equal to or greater than the minimum required, continue installation to greater embedment until the minimum installation torque is achieved for 2 continuous feet.

48-6.03G(4) Removal

After service is complete, remove anchors using reverse torque. Fill the void with excavated material or sand free of deleterious materials. Place the backfill material in 4-inch thick layers. Moisten and thoroughly compact each layer.

48-6.03H Expanded Steel Plate Anchors, Cross Plate Anchors, and Expanding Rock Anchors

48-6.03H(1) General

Reserved.

48-6.03H(2) Installation

Install anchors under the manufacturer’s written instructions.

Locate and mark all substructures and utilities. Do not install anchors underneath subsurface utilities or structures.

48-6.03H(3) Removal

After service is complete, remove anchors to a depth of at least 3 feet below finished grade. Fill the void with sand free of deleterious materials. Place the backfill material in 4-inch thick layers. Moisten and thoroughly compact each layer.

48-6.04 PAYMENT

Not Used

^^

49 PILING

04-20-18

04-15-16

Delete the 2nd paragraph of section 49-1.01A.

Replace the 1st sentence in the 5th paragraph of section 49-1.01D(3) with:

07-15-16

Load test and anchor piles must comply with the specifications for piling as described and Class N steel pipe piling.

Add to the list in 7th paragraph of section 49-1.01D(3):

07-15-16

5. Welds that connect the anchor pile and the anchor pile head must be tested under section 49-2.02A(4)(b)(iii)(C)

Replace the 10th paragraph of section 49-1.01D(3) with:

07-15-16

Furnish labor, materials, tools, equipment, and incidentals as required to assist the Department in the transportation, installation, operation, and removal of Department-furnished steel load test beams, jacks, bearing plates, drills, and other test equipment. This is change order work.

Add to the end of the 5th paragraph of section 49-1.01D(4):

04-20-18

Penetration and bearing analyses are specific to a driving submittal. Piles located within specified control zones are represented by the associated dynamically monitored pile for bearing acceptance criteria.

Replace the 6th paragraph of section 49-1.01D(4) with:

04-20-18

Except for load test piles and anchor piles, drive the 1st production pile in the control zone and perform dynamic monitoring as specified. Do not install any additional production piles until the Engineer provides you with the bearing acceptance criteria curves for any piles represented by the dynamically monitored piles.

Replace the 7th paragraph of section 49-1.01D(4) with:

04-20-18

Piles to be dynamically monitored must:

1. Have an additional length of 2 times the largest cross-sectional dimension of the pile plus 2 feet.
2. Be available to the Department at least 2 business days before driving.
3. Be safely supported at least 6 inches off the ground in a horizontal position on at least 2 support blocks. If ordered, rotate the piles on the blocks.
4. Be positioned to provide safe access to the entire pile length and circumference for the installation of anchorages and control marks for monitoring.

07-15-16

Delete *business* in item 6 in the list in the 8th paragraph of section 49-1.01D(4).

Add to the list in 9th paragraph of section 49-1.01D(4):

07-15-16

3. Cut pile to the specified cut-off elevation after bearing acceptance criteria is provided by the Department

04-15-16

Delete the 3rd paragraph of section 49-1.03.

04-15-16

Delete the 2nd paragraph of section 49-1.04.

01-15-16

Delete the 4th paragraph of section 49-2.01C(5).

Replace item 3 in the list in the 2nd paragraph of section 49-3.01A with:

07-15-16

3. CISS concrete piles

Add between *undisturbed material* and *in a dry* in the 1st paragraph of section 49-3.01C:

07-15-16

, casing, or steel shell

Replace the 2nd and 3rd paragraphs of section 49-3.01C with:

07-15-16

Place and secure reinforcement. Securely block the reinforcement to provide the minimum clearance shown between the reinforcing steel cage and the sides of the drilled hole, casing, or steel shell.

Steel shells, casings, and drilled holes must be clean and free of debris before reinforcement and concrete are placed.

Replace *dewatered* in the 4th paragraphs of section 49-3.01C with:

07-15-16

drilled

Add to section 49-3.02A(1):

07-15-16

Permanent steel casing and driven steel shell must comply with section 49-2.02.

Replace the paragraph of section 49-3.02A(2) with:

07-15-16

dry hole: A drilled hole that requires no work to keep it free of water.

dewatered hole: A drilled hole that:

1. Accumulates no more than 12 inches of water at the bottom during a 1 hour period without any pumping from the hole.
2. Has no more than 3 inches of water at the bottom immediately before placing concrete.
3. Does not require temporary casing to control the groundwater.

Replace item 8 in the list in the 1st paragraph of section 49-3.02A(3)(b) with:

07-15-16

8. Drilling plan and sequence
9. Concrete sequence and placement plan
10. If inspection pipes are required, methods for ensuring the inspection pipes remain straight, undamaged, and properly aligned during concrete placement

Replace section 49-3.02A(3)(c) with:

04-20-18

49-3.02A(3)(c) Inspection Pipe and Reinforcing Cage Coupler Log

If inspection pipes are required, submit a log of the locations of inspection pipe couplers and pile reinforcing cage couplers as an informational submittal within 2 business days of completion of concrete placement in the hole.

Replace *1 business day* in the paragraph of section 49-3.02A(3)(d) with:

07-15-16

2 business days

Add to section 49-3.02A(3)(d):

07-15-16

The log must:

1. Show the pile location, tip elevation, cutoff elevation, dates of excavation and concrete placement, total quantity of concrete placed, length and tip elevation of any casing, and details of any hole stabilization method and materials used.
2. Include an 8-1/2 by 11 inch graph of concrete placed versus depth of hole filled as follows:
   2.1. Plot the graph continuously throughout concrete placement. Plot the depth of drilled hole filled vertically with the pile tip at the bottom and the quantity of concrete placed horizontally.
   2.2. Take readings at each 5 feet of pile depth, and indicate the time of the reading on the graph.

Add after the sentence in the paragraph of section 49-3.02A(3)(e):

07-15-16

Allow 10 days for the review.

Replace the 3rd sentence in the paragraph of section 49-3.02A(3)(f) with:

07-15-16

Allow 10 days for the review and analysis of this report.

Add after *rejected pile* in the 1st sentence in the 1st paragraph of section 49-3.02A(3)(g):

07-15-16

to be mitigated

07-15-16

Delete the 2nd paragraph of section 49-3.02A(3)(g).

Replace item 3 in the list in the 3rd paragraph of section 49-3.02A(3)(g) with:

07-15-16

3. Step by step description of the mitigation work to be performed, including drawings if necessary. If the *ADSC Standard Mitigation Plan* is an acceptable mitigation method, include the most recent version. For the most recent version of the *ADSC Standard Mitigation Plan*, go to:
   http://www.dot.ca.gov/hq/esc/geotech/ft/adscmitplan.htm

Replace the 2nd sentence in the paragraph of section 49-3.02A(3)(i) with:

07-15-16

Allow 10 days for the review.

Add to section 49-3.02A(3):

07-15-16

49-3.02A(3)(j) Certifications

If synthetic slurry is used, submit as an informational submittal the names and certifications of your employees who are trained and certified by the synthetic slurry manufacturer.

04-20-18

49-3.02A(3)(k) Slurry Test Record

If slurry is used, submit a slurry test record as an informational submittal within 2 business days of completion of concrete placement in the hole.

Add after *excavated hole* in the 1st sentence in the 3rd paragraph of section 49-3.02A(4)(c):

07-15-16

lined with plastic

Replace the 1st paragraph of section 49-3.02A(4)(d)(i) with:

07-15-16

Section 49-3.02A(4)(d) applies to CIDH concrete piles except for piles (1) less than 24 inches in diameter or (2) constructed in dry or dewatered holes.

Replace *gamma-gamma logging* in the 2nd paragraph of section 49-3.02A(4)(d)(i) with:

07-15-16

GGL

Replace the 1st sentence in the 3rd paragraph of section 49-3.02A(4)(d)(i) with:

07-15-16

After notification by the Engineer of pile acceptance, fill the inspection pipes and cored holes with grout.

Replace *gamma-gamma logging* in section 49-3.02A(4)(d)(ii) with:

07-15-16

GGL

Replace the 3rd and 4th paragraphs of section 49-3.02A(4)(d)(iii) with:

07-15-16

The Department may perform CSL to determine the extent of the anomalies identified by GGL and to further evaluate a rejected pile for the presence of anomalies not identified by GGL. The pile acceptance test report will indicate if the Department intends to perform CSL and when the testing will be performed. Allow the Department 20 additional days for a total of 50 days to perform CSL and to provide supplemental results.

If authorized, you may perform testing on the rejected pile.

07-15-16

Delete the 8th paragraph of section 49-3.02A(4)(d)(iii).

Add to the end of section 49-3.02A(4)(d)(iii):

07-15-16

If the Engineer determines it is not feasible to repair the rejected pile, submit a mitigation plan for replacement or supplementation of the rejected pile.

Add to section 49-3.02A(4):

07-15-16

49-3.02A(4)(e) Certifications

If synthetic slurry is used, your employees who will be providing technical assistance in the slurry activities must be trained and certified by the synthetic slurry manufacturer to show their competency to perform inspection of slurry operations.

Replace section 49-3.02B(4) with:

07-15-16

49-3.02B(4) Reserved

Replace *near* in the 3rd, 4th, and 5th paragraphs of section 49-3.02B(6)(b) with:

07-15-16

within 2 feet of

Replace *twice per shift* in item 2 in the 3rd paragraph of section 49-3.02B(6)(b) with:

07-15-16

every 4 hours

07-15-16

Delete the 7th and 8th paragraphs of section 49-3.02B(6)(b).

07-15-16

Delete the 3rd paragraph of section 49-3.02B(6)(c).

Replace *near* in item 2 in the 4th paragraph of section 49-3.02B(6)(c) with:

07-15-16

within 2 feet of

Replace item 5 in the 4th paragraph of section 49-3.02B(6)(c) with:

07-15-16

5. After final cleaning and immediately before placing concrete.

Replace section 49-3.02B(9) with:

07-15-16

49-3.02B(9) Inspection Pipes

Inspection pipes must be schedule 40 PVC pipe complying with ASTM D1785 with a nominal pipe size of 2 inches.

Watertight PVC couplers complying with ASTM D2466 are allowed to facilitate pipe lengths in excess of those commercially available.

Add to the beginning of section 49-3.02C(1):

07-15-16

Unless otherwise authorized, drilling the hole and placing reinforcement and concrete in the hole must be performed in a continuous operation.

Replace the 5th paragraph of section 49-3.02C(2) with:

07-15-16

If slurry is used during excavation, maintain the slurry level at a height required to maintain a stable hole, but not less than 10 feet above the piezometric head.

Replace the 1st sentence in the 9th paragraph of section 49-3.02C(2) with:

07-15-16

Remove water that has infiltrated the dewatered hole before placing concrete, as required for dewatered hole.

Replace the 1st sentence in the 10th paragraph of section 49-3.02C(2) with:

07-15-16

If authorized, to control caving or water seepage, you may enlarge portions of the hole, backfill the hole with slurry cement backfill, concrete, or other material, and redrill the hole to the diameter shown.

Replace the 4th paragraph of section 49-3.02C(3) with:

07-15-16

Remove the temporary casing during concrete placement. Maintain the concrete in the casing at a level required to maintain a stable hole, but not less than 5 feet above the bottom of the casing, to prevent displacement of the concrete by material from outside the casing.

Replace the 5th paragraph of section 49-3.02C(4) with:

07-15-16

For a single CIDH concrete pile supporting a column:

1. If the pile and the column share the same reinforcing cage diameter, this cage must be accurately placed as shown
2. If the pile reinforcing cage is larger in diameter than the column cage:
   2.1. Maintain a clear horizontal distance of at least 3.5 inches between the two cages, if the concrete is placed under dry conditions

2.2. Maintain a clear horizontal distance of at least 5 inches between the two cages if the concrete is placed under slurry
2.3. The offset between the centerlines of the two cages must not exceed 6 inches

Replace the paragraphs in section 49-3.02C(5) with:

04-20-18

For acceptance testing, install and test vertical inspection pipes as follows:

1. Log the location of the inspection pipe couplers and pile reinforcing cage couplers with respect to the plane of pile cutoff.
2. Cap each inspection pipe at the bottom. Extend the pipe from 3 feet above the pile cutoff to the bottom of the reinforcing cage. Provide a temporary top cap or similar means to keep the pipes clean before testing. If pile cutoff is below the ground surface or working platform, extend inspection pipes to 3 feet above the ground surface or working platform.
3. If any changes are made to the pile tip, extend the inspection pipes to the bottom of the reinforcing cage.
4. Install inspection pipes in a straight alignment and parallel to the main reinforcement. Securely fasten inspection pipes in place and provide protective measures to prevent misalignment or damage to the inspection pipes during installation of the reinforcement and placement of concrete in the hole. Construct CIDH concrete piles such that the relative distance of inspection pipes to vertical steel reinforcement remains constant.
5. After concrete placement is complete, fill inspection pipes with water to prevent debonding of the pipe.
6. Provide safe access to the tops of the inspection pipes.
7. After placing concrete and before requesting acceptance testing, test each inspection pipe in the Engineer's presence by passing a rigid cylinder through the length of pipe. The rigid cylinder must:
   7.1 Be 1-1/4-inch diameter by 4.5-foot long
   7.2 Weigh 12 pounds or less
   7.3 Be able to freely pass down through the entire length of the pipe under its own weight and without the application of force
8. When performing acceptance testing, inspection pipes must provide a 2-inch-diameter clear opening and be completely clean, unobstructed, and either dry or filled with water as authorized.
9. After acceptance testing is complete, completely fill the inspection pipes with water.

07-15-16

If the rigid cylinder fails to pass through the inspection pipe:

1. Completely fill the inspection pipes in the pile with water immediately.
2. Core a nominal 2-inch-diameter hole through the concrete for the entire length of the pile for each inspection pipe that does not pass the rigid cylinder. Coring must not damage the pile reinforcement.
3. Locate cored holes as close as possible to the inspection pipes they are replacing and no more than 5 inches clear from the reinforcement.

Core holes using a double wall core barrel system with a split tube type inner barrel. Coring with a solid type inner barrel is not allowed.

Coring methods and equipment must provide intact cores for the entire length of the pile.

Photograph and store concrete cores as specified for rock cores in section 49-1.01D(5).

The coring operation must be logged by an engineering geologist or civil engineer licensed in the State and experienced in core logging. Coring logs must comply with the Department's *Soil and Rock Logging, Classification, and Presentation Manual* for rock cores. Coring logs must include core recovery, rock quality designation of the concrete, locations of breaks, and complete descriptions of inclusions and voids encountered during coring.

The Department evaluates the portion of the pile represented by the cored hole based on the submitted coring logs and concrete cores. If the Department determines a pile is anomalous based on the coring logs and concrete cores, the pile is rejected.

Replace item 2 in the list in the 2nd paragraph of section 49-3.02C(7) with:

07-15-16

2. Extend at least 5 feet below the construction joint. If placing casing into rock or a dry hole, the casing must extend at least 2 feet below the construction joint.

Add to the beginning of section 49-3.02C(9):

07-15-16

49-3.02C(9)(a) General

Replace the 2nd sentence of the 3rd paragraph of section 49-3.02C(9) with:

04-15-16

Do not vibrate the concrete.

Add after *concrete pump* in the 8th paragraph of section 49-3.02C(9):

07-15-16

and slurry pump

Replace item 3 in the list in the 11th paragraph of section 49-3.02C(9) with:

07-15-16

3. Maintain the slurry level at a height required to maintain a stable hole, but not less than 10 feet above the piezometric head.

Replace the 13th paragraph of section 49-3.02C(9) with:

07-15-16

Maintain a log of concrete placement for each drilled hole.

Replace 14th and 15th paragraphs of section 49-3.02C(9) with:

07-15-16

If a temporary casing is used, maintain concrete placed under slurry at a level required to maintain a stable hole, but not less than 5 feet above the bottom of the casing. The withdrawal of the casing must not cause contamination of the concrete with slurry.

The equivalent hydrostatic pressure inside the casing must be greater than the hydrostatic pressure on the outside of the casing to prevent intrusion of water, slurry, or soil into the column of freshly placed concrete.

Remove scum, laitance, and slurry-contaminated concrete from the top of the pile.

Add to section 49-3.02C(9):

07-15-16

49-3.02C(9)(b) Mineral Slurry

Remove any caked slurry on the sides or bottom of hole before placing reinforcement.

If concrete is not placed immediately after placing reinforcement, the reinforcement must be removed and cleaned of slurry, the sides of the drilled hole must be cleaned of caked slurry, and the reinforcement again placed in the hole for concrete placement.

49-3.02C(9)(c) Synthetic Slurry

A manufacturer's representative must:

1. Provide technical assistance for the use of their material
2. Be at the job site before introduction of the synthetic slurry into the drilled hole
3. Remain at the job site until released by the Engineer

After the manufacturer's representative has been released by the Engineer, your employee certified by the manufacturer must be present during the construction of the pile under slurry.

Replace the heading of section 49-3.03 with:

07-15-16

CAST-IN-STEEL SHELL CONCRETE PILING

Replace the 1st paragraph of section 49-3.03A(1) with:

07-15-16

Section 49-3.03 includes specifications for constructing CISS concrete piles consisting of driven open-ended or closed-ended steel shells filled with reinforcement and concrete.

Add to the end of section 49-3.03A(1):

07-15-16

CISS concrete piles include Class 90 Alternative V and Class 140 Alternative V piles.

Add to section 49-3.03A(3):

01-15-16

Submit a Pile and Driving Data Form under section 49-2.01A(3)(a) if specified in the special provisions.

Replace the paragraph of section 49-3.03D with:

07-15-16

Furnish piling is measured along the longest side of the pile from the specified tip elevation shown to the plane of pile cutoff.

Replace section 49-4.03 with:

01-15-16

49-4.03 CONSTRUCTION

49-4.03A General

Reserved

49-4.03B Drilled Holes

Drill holes for steel soldier piles into natural foundation material. Drilled holes must be accurately located, straight, and true.

Furnish and place temporary casings or tremie seals where necessary to control water or to prevent caving of the hole.

Before placing the steel soldier pile, remove loose materials existing at the bottom of the hole after drilling operations have been completed.

Do not allow surface water to enter the hole. Remove all water in the hole before placing concrete.

If temporary casings are used, they must comply with section 49-3.02C(3).

49-4.03C Steel Soldier Piles

Plumb and align the pile before placing concrete backfill and lean concrete backfill. The pile must be at least 2 inches clear of the sides of the hole for the full length of the hole to be filled with concrete backfill and lean concrete backfill. Ream or enlarge holes that do not provide the clearance around steel piles.

Maintain alignment of the pile in the hole while placing backfill material.

Clean and prepare piles in anticipated heat affected areas before splicing steel piles or welding concrete anchors.

^^

50 PRESTRESSING CONCRETE

04-20-18

Add to the end of section 50-1.01C:

07-15-16

50-1.01C(8) Post-tensioning Jack Calibration Chart

Submit the post-tensioning jack calibration plot.

50-1.01C(9) Pretensioning Jack Calibration Chart

For any pretensioning jack calibrated by an authorized laboratory, submit a certified calibration plot.

Replace section 50-1.01D(2)(b) with:

07-15-16

50-1.01D(2)(b) Equipment and Calibration

50-1.01D(2)(b)(i) General

Each jack body must be permanently marked with the ram area.

Each pressure gauge must be fully functional and have an accurately reading, clearly visible dial or display. The dial must be at least 6 inches in diameter and graduated in 100 psi increments or less.

Each load cell must be calibrated and have an indicator that can be used to determine the force in the prestressing steel.

The range of each load cell must be such that the lower 10 percent of the manufacturer's rated capacity is not used in determining the jacking force.

Each jack must be calibrated equipped with its gauges.

Mechanically calibrate the gauges with a dead weight tester or other authorized means before calibration of the jacking equipment.

50-1.01D(2)(b)(ii) Post-tensioning

Equip each hydraulic jack used to tension prestressing steel with 2 pressure gauges or 1 pressure gauge and a load cell. Only 1 pressure gauge must be connected to the jack during stressing.

Each jack used to tension prestressing steel permanently anchored at 25 percent or more of its specified minimum ultimate tensile strength must be calibrated by METS within 1 year of use and after each repair. You must:

1. Schedule the calibration of the jacking equipment with METS.
2. Verify that the jack and supporting systems are complete, with proper components, and are in good operating condition.
3. Provide labor, equipment, and material to (1) install and support the jacking and calibration equipment and (2) remove the equipment after the calibration is complete.
4. Plot the calibration results.

Each jack used to tension prestressing steel permanently anchored at less than 25 percent of its specified minimum ultimate tensile strength must be calibrated by an authorized laboratory within 180 days of use and after each repair.

50-1.01D(2)(b)(iii) Pretensioning

04-20-18

Each jack used to pretension prestressing steel must be calibrated, equipped with its gauges, by a laboratory on the Authorized Laboratories List to perform pretensioning calibrations within 1 year of use and after each repair.

07-15-16

Calibrate pretensioning jacks:

1. Under ASTM E4 using an authorized laboratory. Certification that the calibration is performed to ASTM accuracy is not required.
2. In the presence of the Engineer. Notify the Engineer at least 2 business days before calibrating the jack.
3. Using 3 test cycles. Average the forces from each test cycle at each increment.
4. To cover the load range used in the work.

Gauges for pretensioning jacks may:

1. Be electronic pressure indicators that display either:
   1.1. Pressure in 100 psi increments or less
   1.2. Load to 1 percent of the maximum sensor/indicator capacity or 2 percent of the maximum load applied, whichever is smaller
2. Have a dial less than 6 inches in diameter

Gauges displaying pressure must have been calibrated within 1 year of the jack calibration.

Each hydraulic jack used for pretensioning must be equipped with either 2 gauges or 1 gauge and a load cell or you must have a calibrated standby jack with its gauge present on site during stressing.

^^

51 CONCRETE STRUCTURES

07-21-17

Replace the 7th item in the list in the 2nd paragraph of section 51-1.01A with:

01-20-17

7. Pipe culvert headwalls, endwalls, and wingwalls

Add to the list in the 2nd paragraph of section 51-1.01A:

04-15-16

8. Pile extensions

07-15-16

9. Drainage inlets

Add to the list in the 6th paragraph of section 51-1.01A:

07-15-16

7. Drainage inlets

01-20-17

8. Pipe culvert headwalls and endwalls for a pipe with a diameter of less than 5 feet

Add to section 51-1.01B:

07-21-17

age of break: Age in hours, determined by your testing, at which RSC attains its minimum specified compressive strength.

01-20-17

Delete the 1st paragraph of section 51-1.01C(5).

01-20-17

Delete the 5th item in the list in the 4th paragraph of section 51-1.01C(5).

Replace section 51-1.01D(2)(b) with:

07-21-17

51-1.01D(2)(b) Rapid Strength Concrete

51-1.01D(2)(b)(i) General

Reserved

51-1.01D(2)(b)(ii) Prequalification of Mix Design

Prequalify RSC under section 90-1.01D(5)(b) before use. Prequalification of an RSC mix design includes determining the opening age and attaining the specified minimum 28-day compressive strength.

Determine the opening age of the RSC mix design as follows:

1. Fabricate at least 5 test cylinders to be used to determine the age of break.
2. Immediately after fabrication of the 5 test cylinders, store the cylinders in a temperature medium of 70 ± 3 degrees F until the cylinders are tested.
3. Determine the age of break to attain an average strength of the 5 test cylinders.
4. Opening age is the age of break plus 1 hour.

The average strength of the 5 test cylinders must be at least the minimum specified compressive strength. Not more than 2 test cylinders may have a strength of less than 95 percent of the minimum specified compressive strength.

If compressive strength tests performed in the field show that the RSC has attained the minimum specified compressive strength, you may open the lane to traffic at the age of break. Perform the compressive strength tests under the specifications for sampling and testing cylinders in section 90-1.01D(5)(a). If you choose to use this option, notify the Engineer before starting construction.

51-1.01D(2)(b)(iii) Mock-ups

Reserved

Replace the 1st sentence in the 3rd paragraph of section 51-1.01D(3)(b)(iii) with:

01-20-17

If portions of completed deck surfaces or approach slabs have a coefficient of friction of less than 0.35, those portions must be ground or grooved parallel to the center line to produce a coefficient of friction of not less than 0.35.

Add to section 51-1.02I:

07-15-16

Metal frames, covers, grates, and other miscellaneous iron and steel used with drainage inlets must comply with section 75-2.

Add to section 51-1.03B:

07-15-16

You may use PC drainage inlets as an alternative to CIP drainage inlets.

Add between the 10th and 11th paragraphs of section 51-1.03C(2)(a):

07-15-16

For drainage inlets, extend the outside forms at least 12 inches below the top of the inlet. You may place concrete against excavated earth below this depth except:

1. You must use full-depth outside forms or other protection when work activities or unstable earth may cause hazardous conditions or contamination of the concrete.
2. You must increase the wall thickness 2 inches if placing concrete against the excavated surface. The interior dimensions must be as shown.

Add to section 51-1.03C(2)(b):

07-15-16

For drainage inlets, remove exterior forms to at least 12 inches below the final ground surface. Exterior forms below this depth may remain if their total thickness is not more than 1 inch.

Add to the end of section 51-1.03D(1):

07-21-17

If using a mobile volumetric mixer, before each work shift and after each time the mixer is washed out, discharge at least 2 cubic feet of RSC into a concrete waste container before placing RSC into the work.

Replace the 1st paragraph of section 51-1.03E(5) with:

01-20-17

For drill and bond dowel (chemical adhesive), install dowels under the chemical adhesive manufacturer's instructions.

Add to the list in the 2nd paragraph of section 51-1.03F(2):

07-15-16

4. Interior and top surfaces of drainage inlets

Replace the paragraphs of section 51-1.03F(5)(b)(i) with:

01-20-17

Except for bridge widenings and bridge decks to be covered with an overlay, texture roadway surfaces of bridge decks, approach slabs, and sleeper slabs, and other roadway surfaces of concrete structures longitudinally by grinding and grooving or by longitudinal tining.

For bridge widenings, texture the roadway surfaces longitudinally by longitudinal tining.

For bridge decks that are to be covered with an overlay, texture the deck using a burlap drag or broom device that produces striations either parallel or transverse to the centerline. If these structures are opened to traffic before the overlay is placed, the deck surface must meet the coefficient of friction requirement in section 51-1.01D(3)(b)(iii).

Replace the 3rd paragraph of section 51-1.03F(5)(b)(ii) with:

01-20-17

Grind and groove the deck surface to within 18 inches of the toe of the barrier as follows:

1. Grind the surface under section 42-3. Grinding must not reduce the concrete cover on reinforcing steel to less than 1-3/4 inches.
2. Groove the ground surfaces longitudinally under section 42-2. The grooves must be parallel to the centerline.

Replace the 2nd sentence of the 3rd paragraph in section 51-1.03F(5)(b)(iii) with:

01-20-17

Grooves must be from 1/8 to 3/16 inch deep after concrete has hardened.

Replace the 8th paragraph of section 51-1.03H with:

07-21-17

Section 90-3.03 does not apply to curing RSC for bridge decks. Cure bridge decks constructed with RSC as follows:

1. Immediately after strike-off, continually mist the deck with water using atomizing nozzles. Continue misting until the concrete reaches a compressive strength of at least 2000 psi.
2. After misting, apply curing compound no. 1 to the deck under section 90-1.03B(3).

Repair any damage to the film of the curing compound with additional curing compound. Repairing damaged curing compound after the deck is opened to traffic is not required.

Add to section 51-1.04:

07-15-16

The payment quantity for structural concrete, drainage inlet is the volume determined from the dimensions shown for CIP drainage inlets.

Replace the 2nd paragraph of section 51-2.02D(2)(a) with:

07-21-17

Bolts, nuts, and washers must comply with ASTM F3125, Grade A325.

Add to section 51-4.01C(1):

07-15-16

For PC drainage inlets, submit field repair procedures and a patching material test sample before repairs are made. Allow 10 days for the Engineer’s review.

Add to section 51-4.01C(2)(a):

07-15-16

For drainage inlets with oval or circular cross sections, submit shop drawings with calculations. Shop drawings and calculations must be sealed and signed by an engineer who is registered as a civil engineer in the State. Allow 15 days for the Engineer's review.

Add to section 51-4.01D(3):

07-15-16

The Engineer may reject PC drainage inlets exhibiting any of the following:

1. Cracks more than 1/32 inch wide
2. Nonrepairable honeycombed or spalled areas of more than 6 square inches
3. Noncompliance with reinforcement tolerances or cross sectional area shown
4. Wall, inlet floor, or lid less than minimum thickness
5. Internal dimensions less than dimensions shown by 1 percent or 1/2 inch, whichever is greater
6. Defects affecting performance or structural integrity

Add to section 51-4.02C:

07-15-16

Materials for PC drainage inlets must comply with the following:

1. Preformed flexible joint sealant must be butyl-rubber complying with ASTM C990
2. Resilient connectors must comply with ASTM C923
3. Sand bedding must comply with section 19-3.02F(2)
4. Bonding agents must comply with ASTM C1059/C1059, Type II

Add to section 51-4.02D:

07-15-16

51-4.02D(8) Drainage Inlets

PC units for drainage inlets must be rectangular, round, or oval in cross section, or any combination. Transitions from a rectangular grate opening to a round or oval basin must be made in not less than 8 inches. Provide means for field adjustment to meet final grade, paving, or surfacing.

If oval or circular shape cross-sections are furnished, they must comply with *AASHTO LRFD Bridge Design Specifications, Sixth Edition with California Amendments*.

Wall and slab thicknesses may be less than the dimensions shown by at most 5 percent or 3/16 inch, whichever is greater.

Reinforcement placement must not vary more than 1/2 inch from the positions shown.

Add to section 51-4.03:

07-15-16

51-4.03H Drainage Inlets

Repair PC drainage inlet sections to correct damage from handling or manufacturing imperfections before installation.

Center pipes in openings to provide a uniform gap. Seal gaps between the pipe and the inlet opening with nonshrink grout under the grout manufacturer's instructions. For systems designated as watertight, seal these gaps with resilient connectors.

Match fit keyed joints to ensure uniform alignment of walls and lids. Keys are not required at the inlet floor level if the floor is precast integrally with the inlet wall. Seal keyed joint locations with preformed butyl rubber joint sealant. You may seal the upper lid and wall joint with nonshrink grout.

Clean keyed joint surfaces before installing sealant. Joint surfaces must be free of imperfections that may affect the joint. Use a primer if surface moisture is present. Use a sealant size recommended by the sealant manufacturer. Set joints using sealant to create a uniform bearing surface.

Flat drainage inlet floors must have a field-cast topping layer at least 2 inches thick with a slope of 4:1 (horizontal:vertical) toward the outlet. Use a bonding agent when placing the topping layer. Apply the bonding agent under the manufacturer's instructions.

Add to section 51-5.03D(1):

01-20-17

Approach slab (aggregate base) includes using AB to fill voids that remain after removing subsealing material or CTB beneath existing approach slabs.

Add to section 51-5.03E:

07-21-17

If using magnesium phosphate concrete, modified high-alumina-based concrete, or portland-cement-based concrete complying with section 51-1.02C to construct the paving notch extension, allow 1 hour between placing the paving notch extension concrete and placing the approach slab concrete.

If using RSC to construct the paving notch extension, the RSC must have a minimum compressive strength of 1,200 psi before placing the approach slab concrete and a minimum compressive strength of 2,500 psi before opening the overlaying approach slab to traffic.

Add to section 51-5.04:

01-20-17

Structural concrete used to fill voids below the approach slab that are caused by removal of subsealing material or CTB is paid for as aggregate base (approach slab). The payment quantity does not include the volume of structure concrete used to fill an overexcavation.

Replace the 2nd paragraph of section 51-7.01A with:

07-15-16

Minor structures include structures described as minor structures.

07-15-16

Delete the 4th paragraph of section 51-7.01B.

07-15-16

Delete the 1st and 3rd paragraphs of section 51-7.01C.

07-15-16

Delete the heading and paragraph of section 51-7.02.

^^

52 REINFORCEMENT

04-20-18

Add to section 52-1.02:

01-20-17

52-1.02E Dowels

Reinforcing steel dowels must be deformed bars complying with section 52-1.02B.

Threaded rods used as dowels must comply with section 75-1.02A.

Replace item 1 in the list in the 2nd paragraph of section 52-5.01D(4)(b) with:

04-20-18

1. At a laboratory on the Authorized Laboratories List for testing reinforcing steel splices

Replace *Reserved* in section 52-6.01B with:

07-21-17

group: Set of 5 or fewer consecutive lots after the 1st lot.

Replace *Reseved* in section 52-6.01C(2)(a) with:

07-21-17

Reserved

Replace *Reseved* in section 52-6.01C(3)(a) with:

07-21-17

Reserved

Replace the 2nd paragraph of section 52-6.01C(4)(b) with:

07-21-17

Each QC test report must include:

1. Group number, lot number, and location
2. Bar size
3. Splice type
4. Mechanical splice length
5. Location of fracture
6. Physical condition of splice test sample
7. Notable defects
8. Total measured slip
9. Ultimate tensile strength of each splice
10. The following for ultimate butt splices:
    10.1. Location of visible necking area
    10.2. Largest measured strain

Replace the paragraph in section 52-6.01C(6)(c) with:

07-21-17

For each bar size of each coupler model type of service splice or ultimate butt splice to be used in the work, submit a splice prequalification report that includes:

1. Copy of the manufacturer's product literature giving complete data on the splice material and installation procedures
2. Names of the operators who will be performing the splicing
3. Descriptions of the positions, locations, equipment, and procedures that will be used in the work
4 Certified test results from the authorized laboratory for the prequalification splice test samples
5. Certifications from the fabricator for operator and procedure prequalification
6. Manufacturer's QC Process Manual

Add between the 2nd and 3rd paragraphs of section 52-6.01D(1):

07-21-17

Before starting service or ultimate butt splicing activities, select the lots that constitute each group for QA testing.

Replace the last paragraph of section 52-6.01D(1) with:

07-21-17

Section 11-2 does not apply to resistance-butt-welded splices.

Replace the 2nd paragraph of section 52-6.01D(2)(b) with:

07-21-17

For each bar size of each splice coupler model type to be used, each operator must prepare 4 prequalification splice test samples.

Replace the last paragraph of section 52-6.01D(2)(b) with:

07-21-17

Splice test samples and testing must comply with the QC testing requirements specified in section 52-6.01D(4)(b) for the type of splice to be used in the work.

Replace the 1st paragraph of section 52-6.01D(3)(a) with:

07-21-17

Prepare splice test samples under California Test 670.

Replace the 4th paragraph of section 52-6.01D(3)(a) with:

07-21-17

When preparing or removing splice test samples for QC testing, concurrently prepare or remove 4 Department acceptance splice test samples from the same lot during:

1. 1st QC test
2. 1 QC test from each group, randomly selected by the Engineer

Add to section 52-6.01D(3)(a):

07-21-17

If splices from a lot will be encased in concrete prior to receiving passing Department acceptance test results, you must prepare additional samples selected by the Engineer from the same lot for additional Department acceptance testing. You may prepare the samples as specified for service splice test samples in section 52-6.01D(4)(b)(iii). The Department will test service splice test samples as specified for service splices and ultimate butt splice test samples as specified for ultimate butt splices.

Replace item 3 in the list in the 2nd paragraph of section 52-6.01D(4)(b)(i) with:

04-20-18

3. At a laboratory on the Authorized Laboratories List for testing reinforcing steel splices

Add to the list in the 5th paragraph of section 52-6.01D(4)(b)(i):

07-21-17

4. Group number of each lot

Add between the 1st and 2nd paragraphs of section 52-6.01D(5):

07-21-17

If a Department acceptance test result does not comply with the material and QA requirements, the Department rejects all splices in the lot and the group.

For the other lots in the rejected group that pass QC testing, you may request the Engineer to perform additional Department acceptance testing for additional splice samples. If a Department acceptance splice test result complies with the material and QA requirements, the Department accepts all splices in that lot.

If a lot of splices is rejected, prepare a splice rejection mitigation report for that rejected lot as specified in section 52-6.01D(4)(b)(i).

If the QC and the Department acceptance test results have different compliance determinations, the Department will sample and test all subsequent lots until QC and the Department acceptance test compliance determinations are consistent for 2 consecutive lots before resuming sampling and testing of 1 lot from every group.

Replace the paragraph in section 52-6.02B(3) with:

07-21-17

Ultimate butt splice test samples must demonstrate necking as either of the following:

1. Except for 30-inch and smaller diameter hoops, for *Necking Option I* as specified in California Test 670, the test sample must fracture in the reinforcing bar outside of the affected zone and show visible necking. For 30-inch and smaller diameter hoops, the test sample must show visible necking at fracture at any location.
2. For *Necking Option II* as specified in California Test 670, the largest measured strain must be at least:
   2.1. 6 percent for no. 11 and larger bars
   2.2. 9 percent for no. 10 and smaller bars

Replace the 3rd paragraph of section 52-6.03B with:

01-15-16

For uncoated and galvanized reinforcing bars complying with ASTM A615/A615M, Grade 60, ASTM A706/A706M, or ASTM A767/A767M, Class 1, the length of lap splices must be at least:

1. 45 diameters of the smaller bar spliced for reinforcing bars no. 8 or smaller
2. 60 diameters of the smaller bar spliced for reinforcing bars nos. 9, 10, and 11

For epoxy-coated reinforcing bars and alternatives to epoxy-coated reinforcing bars complying with ASTM A775/A775M, ASTM A934/A934M, ASTM A1035/A1035M, or ASTM A1055/A1055M, the length of lap splices must be at least:

1. 65 diameters of the smaller bar spliced for reinforcing bars no. 8 or smaller
2. 85 diameters of the smaller bar spliced for reinforcing bars nos. 9, 10, and 11

^^

53 SHOTCRETE

01-15-16

Replace *632* in item 1 in the list in the 3rd paragraph of section 53-1.02 with:

01-15-16

675

Replace item 2 in the list in the 3rd paragraph of section 53-1.02 with:

01-15-16

2. You may substitute a maximum of 30 percent coarse aggregate for the fine aggregate. Coarse aggregate must comply with section 90-1, except section 90-1.02C(4)(d) does not apply. The gradation for the coarse aggregate must comply with the gradation specified in section 90-1.02C(4)(b) for the 1/2 inch x No. 4 or the 3/8 inch x No. 8 primary aggregate nominal size.

Replace *shotcrete* in the 2nd sentence of the 4th paragraph of section 53-1.02 with:

01-15-16

concrete

^^

55 STEEL STRUCTURES

04-20-18

Replace *Welder* in the 1st paragraph of section 55-1.01D(3)(a) with:

07-21-17

Welding

Replace the heading of the table in the 5th item in the 2nd paragraph of section 55-1.01D(3)(b)(iii)(2) with:

07-21-17

Table 1: Grade A325 Snug-Tight Tension Values

Replace the table in the 7th item in the 2nd paragraph of section 55-1.01D(3)(b)(iii)(2) with:

07-21-17

Table 3: Grade A325 Minimum Tension Values

Bolt diameter (inches)	Minimum tension (kips)
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1-1/8	64
1-1/4	81
1-3/8	97
1-1/2	118

Replace the table in the 5th item in the 3rd paragraph of section 55-1.01D(3)(b)(iii)(2) with:

07-21-17

Table 4: Grade A325 Turn Test Tension Values

Bolt diameter (inches)	Turn test tension (kips)
1/2	14
5/8	22
3/4	32
7/8	45
1	59
1-1/8	74
1-1/4	94
1-3/8	112
1-1/2	136

Replace the table in the 4th item in the 2nd paragraph of section 55-1.01D(3)(b)(iii)(3) with:

07-21-17

Table 5 Grade A325 Maximum Allowable Torque

Bolt diameter (inches)	Torque (ft-lb)
1/2	150
5/8	290
3/4	500
7/8	820
1	1230
1-1/8	1730
1-1/4	2450
1-3/8	3210
1-1/2	4250

Replace *ASTM A325, Type 1* in the 2nd table of section 55-1.02D(1) with:

07-21-17

ASTM F3125, Grade A325, Type 1

Replace *ASTM F1852, Type 1* in the 2nd table of section 55-1.02D(1) with*:*

07-21-17

ASTM F3125, Grade F1852, Type 1

Replace *Certification* in the 5th paragraph of section 55-5.01C(1) with:

04-20-18

Test Reports

^^

56 OVERHEAD SIGN STRUCTURES, STANDARDS, AND POLES

04-20-18

Replace section 56-1.01 with:

07-15-16

56-1.01 GENERAL

56-1.01A Summary

Section 56-1 includes general specifications for constructing overhead sign structures, standards, and poles.

56-1.01B Definitions

Reserved

56-1.01C Submittals

Reserved

56-1.01D Quality Assurance

56-1.01D(1) General

Reserved

56-1.01D(2) Quality Control

56-1.01D(2)(a) General

Reserved

56-1.01D(2)(b) Nondestructive Testing

56-1.01D(2)(b)(i) General

Perform NDT of steel members under AWS D1.1 and the requirements shown in the following table:

Nondestructive Testing for Steel Standards and Poles

Weld location	Weld type	Minimum required NDT
Circumferential splices around the perimeter of tubular sections, poles, and arms	CJP groove weld with backing ring	100% UT or RT
Longitudinal seam	CJP or PJP groove weld	Random 25% MT
Longitudinal seam within 6 inches of a circumferential splice	CJP groove weld	100% UT or RT
Welds attaching base plates, flange plates, pole plates, or mast arm plates to poles or arm tubes	CJP groove weld with backing ring and reinforcing fillet	t≥ 5/16 inch: 100% UT and 100% MT t< 5/16 inch: 100% MT after root weld pass and final weld pass
	External (top) fillet weld for socket-type connections	100% MT
Hand holes and other appurtenances	Fillet and PJP welds	MT full length on random 25% of all standards and poles

NOTE: t = pole or arm thickness

Nondestructive Testing for Overhead Sign Structures

Weld location	Weld type	Minimum required NDT
Base plate to post	CJP groove weld with backing ring and reinforcing fillet	100% UT and 100% MT
Base plate to gusset plate	CJP groove weld	100% UT
Circumferential splices of pipe or tubular sections	CJP groove weld with backing ring	100% UT or RT
Split post filler plate welds	CJP groove weld with backing bar	100% UT or RT
Longitudinal seam weld for pipe posts	CJP groove weld	t < 1/4 inch: 100% MT t ≥ 1/4 inch: 100% UT or RT
	PJP groove weld	Random 25% RT
Chord angle splice weld	CJP groove weld with backing bar	100% UT or RT
Truss vertical, diagonal, and wind angles to chord angles	Fillet weld	Random 25% MT
Upper junction plate to chord (cantilever type truss)	Fillet weld	Random 25% MT
Bolted field splice plates (tubular frame type)	CJP groove weld	100% UT and 100% MT
Cross beam connection plates (lightweight extinguishable message sign)	Fillet weld	Random 25% MT
Arm connection angles (lightweight extinguishable message sign)	Fillet weld	100% MT
Mast arm to arm plate (lightweight extinguishable message sign)	CJP groove weld with backing ring	t ≥ 5/16 inch: 100% UT and 100% MT t < 5/16 inch: 100% MT after root weld pass and final weld pass
Post angle to post (lightweight extinguishable message sign)	Fillet weld	100% MT
Hand holes and other appurtenances	Fillet and PJP welds	MT full length on random 25% of all sign structures

NOTE: t = pole or arm thickness

56-1.01D(2)(b)(ii) Ultrasonic Testing

04-20-18

For UT of welded joints with any members less than 5/16 inch thick or tubular sections less than 13 inches in diameter, the acceptance and repair criteria must comply with Clause 9.27.1 of AWS D1.1.

07-15-16

For UT of other welded joints, the acceptance and repair criteria must comply with Table 6.3 of AWS D1.1 for cyclically loaded nontubular connections.

After galvanization, perform additional inspection for toe cracks along the full length of all CJP groove welds at tube-to-transverse plate connections using UT.

When performing UT, use an authorized procedure under AWS D1.1, Annex S.

56-1.01D(2)(b)(iii) Radiographic Testing

The acceptance criteria for radiographic or real time image testing must comply with AWS D1.1 for tensile stress welds.

56-1.01D(2)(b)(iv) Longitudinal Seam Welds

The Engineer selects the random locations for NDT.

Grind the cover pass smooth at the locations to be tested.

If repairs are required in a portion of a tested weld, perform NDT on the repaired portion and on 25 percent of the untested portions of the weld. If more repairs are required, perform NDT on the entire weld.

56-1.01D(3) Department Acceptance

Reserved

Replace section 56-2.01D(2)(b) with:

07-15-16

Reserved

Replace the 2nd sentence of the 1st paragraph of section 56-2.02F with:

07-15-16

Manufactured pipe posts must comply with one of the following:

Add to the list in the 1st paragraph of section 56-2.02F:

07-15-16

4. ASTM A1085, Grade A

Replace the 2nd paragraph of section 56-2.02F with:

07-15-16

You may fabricate pipe posts from structural steel complying with ASTM A36/A36M, ASTM A709/A709M, Grade 36, or ASTM A572/A572M, Grades 42 or 50.

07-15-16

Delete the last sentence in the 1st paragraph of section 56-2.02K(2).

07-15-16

Delete the 3rd paragraph of section 56-2.02K(2).

Replace the 2nd paragraph of section 56-2.02K(4) with:

07-15-16

Safety cable at walkways must not be kinked, knotted, deformed, frayed, or spliced.

Replace the 1st sentence of the paragraph in section 56-2.02K(5) with:

07-15-16

The edges of handholes and other large post and arm openings must be ground smooth.

Replace the heading of section 56-3 with:

07-15-16

56-3 STANDARDS, POLES, PEDESTALS, AND POSTS

Replace the paragraph in section 56-3.01A with:

07-15-16

Section 56-3 includes general specifications for fabricating and installing standards, poles, pedestals, and posts.

Replace section 56-3.01B(2)(b) with:

07-15-16

Standards with handholes must comply with the following:

1. Include a UL-listed lug and 3/16-inch or larger brass or bronze bolt for attaching the bonding jumper for non-slip-base standards.
2. Attach a UL-listed lug to the bottom slip base plate with a 3/16-inch or larger brass or bronze bolt for attaching the bonding jumper for slip-base standards.

Replace the 1st sentence of the 3rd paragraph of section 56-3.01C(2)(a) with:

07-15-16

After each standard, pole, pedestal, and post is properly positioned, place mortar under the base plate.

Replace the 2nd sentence of the 4th paragraph of section 56-3.01C(2)(a) with:

07-15-16

The top of the foundation at curbs or sidewalks must be finished to curb or sidewalk grade.

Replace the 10th paragraph of section 56-3.01C(2)(a) with:

07-15-16

Except when located on a structure, construct foundations monolithically.

Replace the 13th paragraph of section 56-3.01C(2)(a) with:

07-15-16

Do not erect standards, poles, pedestals, or posts until the concrete foundation has cured for at least 7 days.

Replace the 14th paragraph in section 56-3.01C(2)(a) with:

07-15-16

The Engineer selects either the plumbing or raking technique for standards, poles, pedestals, and posts. Plumb or rake by adjusting the leveling nuts before tightening nuts. Do not use shims or similar devices. After final adjustments of both top nuts and leveling nuts on anchorage assemblies have been made and each standard, pole, pedestal, and post on the structure is properly positioned, tighten nuts as follows:

1. Tighten leveling nuts and top nuts, following a crisscross pattern, until bearing surfaces of all nuts, washers, and base plates are in firm contact.
2. Use an indelible marker to mark the top nuts and base plate with lines showing relative alignment of the nut to the base plate.
3. Tighten top nuts following a crisscross pattern:
   - 3.1. Additional 1/6 turn for anchor bolts greater than 1-1/2 inches in diameter.
   - 3.2. Additional 1/3 turn for other anchor bolts.
   - 3.3. Tightening tolerance for all top nuts is ± 1/8 turn.

Replace the 1st sentence of the 4th paragraph of section 56-3.01C(2)(b) with:

07-15-16

If shown, use sleeve nuts on Type 1 standards.

Add to section 56-3.01C(2)(b):

07-15-16

Spiral reinforcement must be continuous above the bottom of the anchor bolts. The top termination must be either:

1. 1'-6" lap beyond the end of pitch with a 90-degree hook extending to the opposite side of the cage, or
2. 1'-6" lap beyond the end of pitch with 2 evenly spaced authorized mechanical couplers

Replace the 1st sentence of the paragraph in section 56-3.02A(4)(b) with:

07-15-16

For cast slip bases for standards and poles with shaft lengths of 15 feet or more, perform RT on 1 casting from each lot of a maximum of 50 castings under ASTM E94.

Replace the 2nd paragraph of section 56-3.02B(1) with:

07-15-16

Material for push button posts, pedestrian barricades, and guard posts must comply with ASTM A53/A53M or ASTM A500/A500M.

Add to section 56-3.02B(1):

07-15-16

Steel pipe standards and mast arms must be hot dip galvanized after manufacturing. Remove spikes from galvanized surfaces.

Replace the 2nd paragraph of section 56-3.02B(2) with:

07-15-16

HS anchor bolts, nuts, and washers must comply with section 55-1.02D(1) and the following:

1. Bolt threads must be rolled
2. Hardness of HS anchor bolts must not exceed 34 HRC when tested under ASTM F606
3. Galvanization must be by mechanical deposition
4. Nuts must be heavy-hex type
5. Each lot of nuts must be proof load tested

Replace the 8th paragraph of section 56-3.02B(2) with:

07-21-17

HS cap screws for attaching arms to standards must comply with ASTM F3125 Grade A325 or ASTM A449, and the mechanical requirements in Grade A325 after galvanizing. Coat threads of cap screws with a colored lubricant that is clean and dry to the touch. The lubricant color must contrast the zinc coating color on the cap screw such that the presence of the lubricant is visually obvious. The lubricant must be insoluble in water or the fastener components must be shipped to the job site in a sealed container.

Replace the 2nd sentence of the 9th paragraph of section 56-3.02B(2) with:

07-15-16

During manufacturing, properly locate the position of the luminaire arm on the arm plate to avoid interference with the cap screw heads.

Add to section 56-3.02B(3)(a):

07-15-16

Steel having a nominal thickness greater than 2 inches that is used for tube-to-transverse plate connections must have a minimum CVN impact value of 20 ft-lb at 20 degrees F when tested under ASTM E23.

Add to section 56-3.02B(3)(c):

07-15-16

The length of telescopic slip-fit splices must be at least 1.5 times the inside diameter of the exposed end of the female section.

For welds connecting reinforced handholes or box-type pole plate connections to a tubular member, the start and stop points must be at points located on a longitudinal axis of symmetry of the tube coinciding with the axis of symmetry of the hand hole or pole plate.

Replace the table in the 1st paragraph of section 56-3.02C with:

07-15-16

Slip Base Bolt Tightening Requirements

Standard type	Torque (ft-lb)
15-SB	150
15-SBF	150
30	150
31	200

Replace the 1st sentence of the 2nd paragraph of section 56-3.02C with:

07-15-16

Bolted connections attaching signal or luminaire arms to standards, poles, and posts are considered slip critical.

Add to section 56-3.06B:

07-15-16

Manufacture the mast arm from standard pipe, free from burrs. Each mast arm must have an insulated wire inlet and wood pole mounting brackets for the mast arm and tie-rod cross arm. Manufacture tie rod from structural steel and pipe.

07-15-16

Delete the 2nd paragraph of section 56-3.06C.

Replace the 1st sentence of the 3rd paragraph of section 56-3.06C with:

07-15-16

Mount the mast arm for luminaires to provide a 34-foot mounting height for a 165 W LED luminaire and a 40-foot mounting height for a 235 W LED luminaire.

^^

58 SOUND WALLS

04-20-18

Replace *2010 CBC* at each occurrence in section 58-2.01D(2)(c) with:

04-20-18

2016 CBC

Replace *section 1704* in the 1st paragraph of section 58-2.01D(2)(c)(i) with:

04-20-18

section 1705

Replace *section 1704.5* in the 1st paragraph of section 58-2.01D(2)(c)(ii) with:

04-20-18

section 1705.4

^^

59 STRUCTURAL STEEL COATINGS

04-20-18

Replace *Type S* in the 2nd paragraph of section 59-1.02A with:

01-15-16

Type M or Type S

Add to the list in the 2nd paragraph of section 59-1.02B:

07-15-16

5. Manufactured abrasives.

Replace *Mineral and slag* in the 3rd paragraph of section 59-1.02B with:

07-15-16

Mineral, manufactured, and slag

Replace the 2nd paragraph of section 59-2.01A(3)(c) with:

04-20-18

Submit the work plan after attending the prepainting meeting and include:

1. Names of the painting contractor and any subcontractors to be used.
2. 1 copy of each applicable ASTM and SSPC specification and qualification procedure.
3. Coating manufacturer's guidelines and instructions for surface preparation, painting, drying, curing, handling, shipping, and storage of painted structural steel. Include testing methods and maximum allowable levels for soluble salts.
4. Materials, methods, and equipment to be used.
5. Proof of required SSPC-QP certifications. For work requiring SSPC-QP 1 or SSPC-QP 2 certification, include:
   - 5.1. List of all personnel who will perform blast cleaning or spray painting work.
   - 5.2. Proof of CAS certifications, as required under (1) SSPC-QP 1, Mandatory Annex A and (2) the SSPC CAS Implementation Schedule in effect at the time of contract advertisement.
6. Methods to control environmental conditions.
7. Methods to protect the coating during curing, shipping, handling, and storage.

8. Rinse-water collection plan.
9. Detailed paint repair plan for damaged areas.
10. Procedures for containing blast media and water.
11. Examples of proposed daily reports for testing to be performed, including type of testing, location, lot size, time, weather conditions, test personnel, and results.

07-15-16

Delete the 4th paragraph of section 59-2.01C(1).

Replace section 59-4.01 with:

04-20-18

59-4.01 GENERAL

Section 59-4 includes specifications for preparing and painting sign structures.

Preparing and painting of sign structures must comply with sections 59-2 and 59-3.

^^

60 EXISTING STRUCTURES

04-20-18

Replace section 60-3.02A with:

04-20-18

60-3.02A(1) General

60-3.02A(1) Summary

Section 60-3.02 includes specifications for (1) repairing concrete deck surfaces and (2) preparing concrete deck surfaces to receive an overlay or a deck treatment.

60-3.02A(2) Definitions

Reserved

60-3.02A(3) Submittals

Submit a work plan for chip seal removal. Include:

1. Description of equipment for chip seal removal
2. Procedure for residual chip seal removal from the deck after grinding or micro milling operations
3. Procedure for chip seal removal next to bridge rails, undulations, or drains

60-3.02A(4) Quality Assurance

Reserved

Add between the 5th and 6th paragraphs of section 60-3.02C(1):

04-20-18

Micro milling equipment must:

1. Have a minimum concrete removal depth of 0.04 inch
2. Provide a surface relief of at most 0.045 inch
3. Provide a 5/32-inch grade tolerance
4. Produce consistent depth of texture in the finished surface

Micro milling equipment must have:

1. 3 or 4 riding tracks

2. Automatic grade control system with electronic averaging and 3 sensors on each side
3. Conveyer system that leaves no debris on the bridge
4. Drum that operates in an up-milling direction
5. Bullet tooth tools with polycrystalline diamond enhanced cutting tips
6. Maximum tool spacing of 0.20 inch
7. Maximum operating weight of 66,000 lb
8. Maximum track unit weight of 6,000 lb/ft
9. New tooth tools at the start of the work

Produce the finished surface using 2 passes of the micro milling equipment.

Add to section 60-3.02C(1):

04-20-18

Dust must not be blown into the air while blowing the deck.

Replace the 2nd paragraph of section 60-3.02C(2) with:

04-20-18

Before removing concrete, clean the deck surface by vacuuming, then blow the deck clean with high-pressure air.

Replace the 3rd paragraph of section 60-3.02C(2) with:

04-20-18

Remove the deck surface by micro milling or high-pressure water jetting.

Replace the paragraphs in section 60-3.02C(4) with:

04-20-18

Where shown, remove bituminous chip seals, bituminous slurry seals, and polymer chip seals entirely from bridge decks by grinding or micro milling. Remove no more than 1/4 inch of concrete deck surface.

Grinding must comply with section 42-3.

Any residual chip seals and other foreign materials remaining in the bridge deck after the grinding or micro milling operation must be removed by other authorized means.

Replace the 1st paragraph of section 60-3.02C(6) with:

04-20-18

Before placing rapid setting concrete patches, abrasive blast clean the contact surfaces of existing concrete and reinforcing steel. Remove at least 1/8 inch of concrete and all foreign material. Immediately before placing new concrete, clean surfaces by vacuuming and (1) pressure jetting or (2) other authorized means to remove debris.

Replace the 2nd paragraph of section 60-3.02C(7) with:

04-20-18

Perform the following activities in the order listed:

1. Abrasive blast the deck surface with steel shot. Steel shot must comply with SSPC-AB 3. Recycled steel shot must comply with SSPC-AB 2.
2. Clean the deck surface by vacuuming.
3. Blow the deck surface clean using high-pressure oil-free air.

Replace the last paragraph of section 60-3.02C(7) with:

04-20-18

If the deck surface becomes contaminated or you allow traffic on the clean deck before placing the deck treatment or overlay, abrasive blast clean the contaminated area, clean the deck by vacuuming, and blow the deck surface clean using high-pressure oil-free air.

Replace the 1st paragraph of section 60-3.03B(1)(c) with:

04-20-18

Submit a work plan for applying the methacrylate resin treatment. Include in the plan:

1. Schedule of work for the test area and for each bridge
2. Procedure for storing and handling resin components and absorbent material
3. Description of equipment for applying resin
4. Range of gel time and final cure time for resin
5. Description of absorbent material to be used
6. Description of equipment for applying and removing excess sand and absorbent material
7. Procedure for removing resin from the deck and equipment to be used
8. Procedure for avoiding spills or discharges of methacrylate, including materials and equipment
9. Procedure for cleaning up spills or discharges of methacrylate, including materials and equipment
10. Procedure for preventing resin from dripping from the structures
11. Procedure for disposing of excess resin and containers

Replace the 4th paragraph of section 60-3.03B(1)(d) with:

04-20-18

The Engineer performs friction testing of the treated test area under California Test 342. After completion of the test area, allow 10 days for the Engineer to perform the testing.

Replace the table in the 2nd paragraph of section 60-3.03B(2) with:

04-20-18

Quality characteristic	Test method	Requirement
Volatile content[a] (max, %)	ASTM D2369	30
Viscosity[a] (max, cP, Brookfield RV with UL adaptor , 50 RPM, at 25 °C)	ASTM D2196	25
Specific gravity[a] (min, at 25 °C)	ASTM D1475	0.90
Flash point[a] (min, °C)	ASTM D3278	82
Vapor pressure[a] (max, mm Hg, at 25 °C)	ASTM D323	1.0
Tack-free time (max, minutes) except Sample 50 ± 5g Test 2 ± 0.05g in 55 ± 5 mm diameter disposable aluminum weighing dish	ASTM C679	400
PCC-saturated surface-dry bond strength (min, psi, at 24 hours and 70 ± 2 °F)	California Test 551	500

[a]Perform test before adding the initiator.

Replace the 9th paragraph of section 60-3.03B(3) with:

04-20-18

Traffic or equipment is not allowed on the treated surface until you have verified that the following requirements have been met and the opening of the treated surface to traffic and equipment is authorized:

1. Treated deck surface is tack free and not oily
2. Sand cover adheres and resists brushing by hand
3. Excess sand and absorbent material has been removed
4. No material will be tracked beyond the limits of treatment by traffic

Replace the 1st paragraph of section 60-3.04B(1)(c) with:

04-20-18

Submit a work plan for the placement of the deck overlay. Include the following in the work plan:

1. Schedule of overlay work for each bridge and a schedule of work for any trial overlays
2. Method for storage and handling of methacrylate resin and polyester concrete components
3. Description of equipment for applying methacrylate resin
4. Description of equipment for measuring, mixing, placing, and finishing the polyester concrete overlay
5. Method for isolating expansion joints and drainage
6. Cure time for polyester concrete
7. Description of equipment for applying sand
8. Method for avoiding spills or discharges of methacrylate and polyester concrete, including materials and equipment
9. Method for cleaning up spills or discharge of methacrylate and polyester concrete, including materials and equipment
10. Procedure for preventing resin from dripping from the structures
11. Method for disposal of excess methacrylate resin, polyester concrete, and containers

Replace the 3rd paragraph of section 60-3.04B(1)(c) with:

04-20-18

Submit test samples of methacrylate resins, polyester resins, and aggregates with a certificate of compliance and manufacturer's test results at least 15 days before use.

Replace the 4th paragraph of section 60-3.04B(1)(d) with:

04-20-18

The Engineer performs friction testing of the trial overlay under California Test 342. After completion of the trial overlay, allow 10 days for the Engineer to perform the testing.

Add to the section 60-3.04B(1)(d):

04-20-18

Place polyester concrete overlay on:

1. Portland cement concrete no sooner than 28 days after concrete placement
2. Portland cement based RSC no sooner than 14 days after concrete placement and your test results for prequalification of RSC show that the concrete attained at least 3,500 psi compressive strength
3. RSC using hydraulic cement other than portland cement no sooner than 3 days after concrete placement and your test results for prequalification of RSC show that the concrete attained at least 3,500 psi compressive strength
4. Magnesium phosphate based rapid setting concrete patch material no sooner than 3 days after final set
5. Modified high alumina based rapid setting concrete patch material no sooner than 30 minutes after final set

Replace the 3rd paragraph of section 60-3.04B(3)(b) with:

04-20-18

Clean the deck by vacuuming, then blow the deck clean with high-pressure oil-free air. Dust must not be blown into the air while blowing the deck.

04-20-18

Delete the 6th paragraph of section 60-3.04B(3)(b).

Replace the 3rd paragraph of section 60-3.04B(3)(c) with:

04-20-18

Finishing equipment for polyester concrete must:

1. Have grade control capabilities resulting in a roadway surface that meets the smoothness requirements of section 51-1.01D(3)(b)(ii) and is capable of adjusting for a variable thickness overlay along and across the existing deck surface. The use of fixed height skid-supported strike off equipment is not allowed.
2. Be used to consolidate the polyester concrete.
3. Have a 12-foot minimum paving width.
4. Be self-propelled and equipped with automatic screed controls and sensing devices that control the thickness, longitudinal grade, and transverse screed slope. Advancing the finishing equipment with winches or a pulling device is not allowed.

07-15-16

Delete the 2nd sentence in the 11th paragraph of section 60-3.04B(3)(c).

Replace the 4th paragraph of section 60-4.02C(1) with:

04-20-18

Clean prepared areas of dust and loose and deleterious materials by vacuuming, abrasive blast cleaning, and using high-pressure oil-free air. Re-blast contaminated areas before starting concrete placement activities. Dust must not be blown into the air while blowing the deck.

Replace the 1st paragraph of section 60-4.02C(2) with:

04-20-18

Abrasive-blast clean concrete surfaces to be refinished. Clean blast-cleaned surfaces by vacuuming, then blow them clean using high-pressure oil-free air. Dust must not be blown into the air while blowing the deck.

Replace the paragraphs in section 60-4.02C(3) with:

04-20-18

Blow surfaces to be refinished with high-pressure oil-free air immediately before placing rapid setting concrete. Abrasive-blast clean concrete surfaces that are contaminated before the concrete is placed.

Allow traffic on new concrete under the manufacturer’s instructions and when authorized.

Replace the 3rd paragraph of section 60-4.03C(5) with:

04-20-18

Allow traffic on new concrete under the manufacturer’s instructions and when authorized.

Replace *clause 3.13.2* in item 2 in the list in the 1st paragraph of section 60-4.06A(4) with:

04-20-18

clause 3.13.2(2)

Replace *Suffix B* in the 3rd paragraph of section 60-4.06B(1) with:

Suffix D

^^^

64-3.02C Concrete Backfill

Concrete for concrete backfill for slotted plastic pipe must comply with the specifications for minor concrete. You may use RSC instead of minor concrete for concrete backfill.

If RSC is used for concrete backfill, the RSC must:

1. Contain at least 590 pounds of cementitious material per cubic yard
2. Comply with section 90-3.02A, except section 90-1 does not apply
3. Comply with section 90-2

64-3.02D Heel-Resistant Grates

Heel-resistant grate must:

1. Be designed to carry traffic loadings
2. Comply with ADA requirements
3. Be constructed of steel or cast iron
4. Be provided by the same manufacturer of the slotted plastic pipe
5. Comply with the manufacturer's instructions

64-3.02E Bar Reinforcement

Bar reinforcement must comply with ASTM A615/A615M, Grade 60 or ASTM A706/A706M, Grade 60.

64-3.02F Miscellaneous Metal

Ductile iron, nuts, bolts, and washers must comply with section 75.

64-3.02G Grout

Grout must be non-shrink grout complying with ASTM C1107/C1107M.

64-3.02H Curing Compound

Non-pigmented curing compound must comply with ASTM C309, Type 1, Class B.

64-3.02I End Caps

End cap must:

1. Be provided by the same manufacturer of the slotted plastic pipe
2. Prevent concrete backfill from entering the pipe

64-3.03 CONSTRUCTION

64-3.03A General

Cover the grate slots with heavy-duty tape or other authorized covering during paving and concrete backfilling activities to prevent material from entering the slots.

64-3.03B Preparation

Pave adjacent traffic lanes before installing slotted plastic pipes.

Excavation must comply with section 19-3.

64-3.03C Installation

Lay and join slotted plastic pipes under the pipe manufacturer’s instructions.

Lay pipes to line and grade with sections closely jointed and adequately secured to prevent separation during placement of the concrete backfill. If the pipes do not have a positive interlocking mechanism like a slot and tongue connection, secure the sections together with nuts, bolts, and washers before backfilling.

The top of slotted plastic pipes must not extend above the completed surface. Position the pipes so that the concrete backfill is flush with the surrounding grade and above the top of the grate from 1/8 to 1/4 inch.

Place channels with the male and female ends facing each other.

Place lateral support bar reinforcement on both sides of the grate slots. The support bar reinforcement must run the full length of the slots.

Anchor heel-resistant grates to the concrete backfill under the manufacturer's instructions.

64-3.03D Concrete Backfill

Wherever minor concrete is used for concrete backfill for slotted plastic pipe, do not allow traffic on top of the backfill within 7 days of placement.

Wherever RSC is used for concrete backfill for slotted plastic pipe, do not allow traffic on top of the backfill before the required cure time of 2,000 psi is achieved.

Place concrete backfill where shown.

Consolidate the concrete backfill with high-frequency internal vibrators.

Texture the concrete backfill surface with a broom or burlap drag to produce a durable skid-resistant surface.

Apply a non-pigmented curing compound to the exposed concrete backfill surface whenever the atmospheric temperature is 90 degrees F or greater after placement.

64-3.03E Transition Fittings

Use transition fittings to connect slotted plastic pipes to drainage inlets. The transition fittings must be supplied by the same pipe manufacturer.

Where welds are required in transition fittings, welds must comply with the pipe manufacturer's instructions. The completed welds must not have visible pinholes.Fill the gaps around the pipes in the inlet structure wall with non-shrink grout where the pipes connect to an existing drainage structure. Install the grout under the pipe manufacturer's instructions.

Cut the pipes as shown after the grout used to seal the transition fitting has cured for at least 24 hours.

64-3.04 PAYMENT

Slotted plastic pipe is measured along the centerline of the pipe and parallel with the slope line. If the pipe is cut to fit a structure or slope, the payment quantity is the length of pipe necessary to be placed before cutting, measured in 2-foot increments.

^^

68 SUBSURFACE DRAINS

07-21-17

Replace the 1st sentence in the 12th paragraph of section 68-4.03 with:

07-21-17

Place Type G pavement markers with retroreflective face facing away from the oncoming traffic under section 81-3.02C on paved shoulders or dikes at outlet, vent, and cleanout locations where authorized.

^^

70 MISCELLANEOUS DRAINAGE FACILITIES

04-20-18

Replace section 70-6 with:

04-20-18

70-6 GRATED LINE DRAINS

70-6.01 GENERAL

70-6.01A Summary

Section 70-6 includes specifications for installing grated line drains.

Use only 1 type of grated line drain.

70-6.01B Definitions

Reserved

70-6.01C Submittals

Submit the following:

1. Certificate of compliance for the grated line drains from the manufacturer
2. Documentation of the channel discharge capacity
3. Inspection report of the completed grated line drain

70-6.01D Quality Assurance

Reserved

70-6.02 MATERIALS

70-6.02A General

Grated line drain must be on the Authorized Material List for grated line drains and must have (1) a channel discharge capacity equal to or greater than the capacity shown and (2) the minimum slope shown.

Line drain sections must be either non-sloped uniform depth sections from 4-7/16 to 12 inches or pre-sloped sections with a minimum continuous 0.6 percent slope with graduated depths from 4-7/16 to 12 inches.

Concrete backfill must comply with the specifications for minor concrete.

In freeze-thaw areas, add an air entraining admixture at a rate to achieve an air content of 4 ± 1.5 percent in the freshly mixed concrete.

Reinforcing bars must be Grade 60 and comply with section 52. Mechanical splice couplers must be commercial-quality double-sleeve type with friction locking screws for use with Grade 60 steel.

70-6.02B Line Drain Channel

Line drain channel may be monolithic polymer concrete, fiberglass, high density polyethylene, or cast-in-place using expanded polystyrene form. End caps must be provided by the line drain manufacturer.

Drain channel sections must not have side extensions. The interior surface of the line drain channel must be smooth below the level of the frame, grate, and associated connections.

70-6.02C Line Drain Frames and Grates

Grated line drain frames and grates must comply with section 75-2 except grates must be ductile iron. Frames and grates include bolts, nuts, frame anchors, connector cover and other connecting hardware. Steel frame must be galvanized under section 75-1.

Frames and grates must comply with AASHTO M306 and be classified heavy duty traffic rated with a transverse proof-load strength of 25,000 pounds.

Frames and grates must be anchored into the body of the line drain or concrete backfill. Grates must be non-removable.

Steel anchoring rods and shear studs, if used, must comply with ASTM A1044.

Steel cover plate must comply with ASTM A36 and be galvanized under section 75-1.02B. Except for grates installed within designated pedestrian paths of travel, grate design must accept inflow of runoff through openings consisting of a minimum of 60 percent of the total top surface area of the grate. Individual openings or slots must have a dimension not greater than 2 inches measured in the direction of the grated line drain flow line.

Grates installed within designated pedestrian paths of travel must be certified as conforming to the provisions of the ADA.

70-6.03 CONSTRUCTION

Excavation and backfill must comply with section 19-3.

Grated line drains must be installed in trenches excavated to the lines and grades established by the Engineer. Grade and prepare the bottom of the trench to provide a firm and uniform bearing throughout the entire length of the grated line drain.

Installation of grated line drains and joints must comply with the manufacturer's instructions.

Install grated line drains with sections closely jointed and secured such that no separation of the line drains occur during backfilling.

The frame or grate must not extend above the level of the surrounding concrete backfill.

Connect grated line drains to new or existing drainage facilities as shown. Drill and bond dowels must comply with section 51-1.03E(5).

Place concrete backfill in the trench as shown. Place against undisturbed material at the sides and bottom of the trench in a manner that prevents (1) floating or shifting of the grated line drain and (2) voids or segregation in the concrete.

Immediately remove foreign material that falls into the trench before or during concrete placement. Prevent material from entering the grated line drain during construction.

Where necessary, construct and compact earth plugs at the ends of the concrete backfill to contain the concrete within the trench.

Place a 1/2-inch isolation joint where grated line drain is placed in PCC pavement. Isolation joint must comply with section 40-1.

Contraction and expansion joints must comply with section 73-2.

Secure frame and grate or line drain wall to the surrounding concrete backfill with steel anchoring rods as shown. Alternative securing methods must provide a minimum pullout resistance of 685 lb/ft of length of grated line drain frame.

Concrete backfill must be finished flush with the adjacent surfacing.

The surface of the concrete must be textured with a broom or burlap drag to produce a durable skid-resistant surface.

Remove all forming material from the cast-in-place drain channel without gouging or marring the surface. Patch spalls, holes or rock pockets with mortar with a cement to sand ratio of 1 to 3 by volume.

Do not allow traffic or equipment on the concrete backfill until 7 days after placement or before the concrete has attained a strength of 2,000 psi, whichever is sooner.

70-6.04 PAYMENT

Not Used

^^

71 EXISTING DRAINAGE FACILITIES

07-21-17

Replace items 5 and 6 in the list in the 1st paragraph of section 71-3.01D with:

01-15-16

5. Performing postrehabilitation inspection

Add after the 4th paragraph of section 71-3.01D:

01-15-16

Record the quantity of grout that is installed and submit this quantity. The Department does not pay for grout that leaks through to the inside of the culvert. The Department does not pay for grout material that is wasted, disposed of, or remaining on hand after the completion of the work.

Replace *EDPM* in the heading of section 71-3.05 with:

07-21-17

EPDM

Replace the 2nd heading in section 71-5.03 with:

01-15-16

71-5.03B Frames, Covers, Grates, and Manholes

^^^

Rock Gradation

Nominal RSP class by median particle diameter[b]		Nominal median particle weight W_{50}[c,d]	d_{15}[c] (inches)		d_{50}[c] (inches)		d_{100}[c] (inches)	Placement
Class[a]	Diameter (inches)		Min	Max	Min	Max	Max	Method
I	6	20 lb	3.7	5.2	5.7	6.9	12.0	B
II	9	60 lb	5.5	7.8	8.5	10.5	18.0	B
III	12	150 lb	7.3	10.5	11.5	14.0	24.0	B
IV	15	300 lb	9.2	13.0	14.5	17.5	30.0	B
V	18	1/4 ton	11.0	15.5	17.0	20.5	36.0	B
VI	21	3/8 ton	13.0	18.5	20.0	24.0	42.0	A or B
VII	24	1/2 ton	14.5	21.0	23.0	27.5	48.0	A or B
VIII	30	1 ton	18.5	26.0	28.5	34.5	48.0	A or B
IX	36	2 ton	22.0	31.5	34.0	41.5	52.8	A
X	42	3 ton	25.5	36.5	40.0	48.5	60.5	A
XI	46	4 ton	28.0	39.4	43.7	53.1	66.6	A

[a]For RSP Classes I–VIII, use Class 8 RSP fabric. For RSP Classes IX–XI, use Class 10 RSP fabric.
[b]Intermediate or B dimension (i.e., width) where A dimension is length and C dimension is thickness.
[c]d%, where % denotes the percentage of the total weight of the graded material.
[d]Values shown are based on the minimum and maximum particle diameters shown and an average specific gravity of 2.65. Weight will vary based on specific gravity of rock available for the project.

Replace the table in section 72-2.02C with:

07-15-16

Fabric Class

Class	Largest rock gradation class used in slope protection
8	Classes I–VIII
10	Classes IX–XI

Replace the table in the 1st paragraph of section 72-3.02C with:

07-15-16

Concreted-Rock Gradation

Nominal RSP class by median particle diameter[b]		Nominal median particle weight W_{50}[c,d] Weight[a]	d_{15}[c]		d_{50}[c]		d_{100}[c]
Class[a]	Size (inches)		Min	Max	Min	Max	Max
I	6	20 lb	3.7	5.2	5.7	6.9	12.0
II	9	60 lb	5.5	7.8	8.5	10.5	18.0
III	12	150 lb	7.3	10.5	11.5	14.0	24.0
V	18	1/4 ton	11.0	15.5	17.0	20.5	36.0
VII	24	1/2 ton	14.5	21.0	23.0	27.5	48.0

[a]Use Class 8 RSP fabric.
[b]Intermediate or B dimension (i.e., width) where A dimension is length and C dimension is thickness.
[c]d%, where % denotes the percentage of the total weight of the graded material.
[d]Values shown are based on the minimum and maximum particle diameters shown and an assumed specific gravity of 2.65. Weight will vary based on specific gravity of rock available for the project.

Replace the table in section 72-3.03E with:

07-15-16

Minimum Concrete Penetration

	Rock class				
	VII	V	III	II	I
Penetration (inches)	18	14	10	8	6

Replace the 1st paragraph of section 72-11.01D with:

07-21-17

The payment quantity for slope paving (concrete) constructed with minor concrete or shotcrete is the product of (1) the area computed from measurements along the slope of the actual areas constructed and (2) the thickness shown for the concrete slope paving.

^^

73 CONCRETE CURBS AND SI`DEWALKS

04-20-18

Add to the beginning of the introductory clause of the 3rd paragraph of section 73-1.03B:

07-21-17

Prepare subgrade to required grade and cross section.

Replace section 73-3.01A with:

07-15-16

Section 73-3 includes specifications for constructing sidewalks, gutter depressions, island paving, curb ramps, and driveways.

Replace *Not Used* in section 73-3.04 with:

04-20-18

The payment quantity for minor concrete (curb ramp) does not include detectable warning surface.

Add to the end of the 1st paragraph of section 73-10.03:

07-21-17

Removal of concrete includes the removal of detectable warning surfaces.

Replace *Not Used* in section 73-10.04 with:

07-21-17

Detectable warning surface placed on existing concrete is paid for as a separate bid item.

^^

74 PUMPING EQUIPMENT AND CONTROLS

04-15-16

Replace *87-1.03K* in the 4th paragraph of section 74-3.03B(2) with:

04-15-16

87

^^

75 MISCELLANEOUS METAL

04-20-18

Replace *ASTM A325, Type 1* in the row for *Bolts* in table in the 1st paragraph of section 75-1.02A with:

07-21-17

ASTM F3125, Grade A325, Type 1

Replace *ASTM F1852, Type 1* in the row for *Tension control bolts* in the table in the 1st paragraph of section 75-1.02A with:

07-21-17

ASTM F3125, Grade F1852, Type 1

Replace *ASTM F593 or F738M* in the row for *Bolts, screws, studs, threaded rods, and nonheaded anchor bolts* in the table in the 1st paragraph of section 75-1.02A with:

04-20-18

ASTM F593

Replace *A325* in the *Material* column in the table in the 1st paragraph of section 75-1.02B with:

07-21-17

F3125, Grade A325

Replace *A325* in the second footnote in the table in the 1st paragraph of section 75-1.02B with:

07-21-17

F3125, Grade A325

Replace *compounds* in the 4th paragraph of section 75-3.02B with:

04-20-18

systems

^^

78 INCIDENTAL CONSTRUCTION

07-21-17

Add between the 1st and 2nd paragraphs of section 78-2.01:

07-21-17

Notify the Engineer at least 7 days before you construct a survey monument or adjust a monument cover to grade. Do not disturb a survey monument without authorization.

Replace section 78-4.03 with:

07-21-17

78-4.03 PAINTING CONCRETE

78-4.03A General

78-4.03A(1) General

78-4.03A(1)(a) Summary

Section 78-4.03A includes general specifications for preparing and painting concrete surfaces.

78-4.03A(1)(b) Definitions

Reserved

78-4.03A(1)(c) Submittals

Submit the coating manufacturer's application instructions at least 7 days before use.

78-4.03A(1)(d) Quality Assurance

78-4.03A(1)(d)(i) General

Reserved

78-4.03A(1)(d)(ii) Test Panels

Reserved

78-4.03A(2) Materials

78-4.03A(2)(a) General

Coatings for concrete must be white.

78-4.03A(2)(b) Paint

Coatings for concrete must comply with the specifications for acrylic emulsion paint for exterior masonry.

78-4.03A(2)(c) Sealer

Reserved

78-4.03A(2)(d) Sealing Compound

Reserved

78-4.03A(3) Construction

78-4.03A(3)(a) General

Do not paint new concrete until it is at least 28 days old. Anywhere metal is adjacent to a joint, seal the joint between surfaces to be painted and the adjacent metal with a sealing compound before applying the paint.

78-4.03A(3)(b) Surface Preparation

Prepare concrete surfaces under SSPC-SP 13/NACE no. 6.

Pressure rinse the prepared surfaces before applying the coating. The surfaces must be thoroughly dry at the time of painting. You may use artificial drying methods if authorized.

78-4.03A(3)(c) Application

Apply at least 2 coats under the manufacturer's instructions and SSPC-PA 7. Protect adjacent surfaces during painting using an authorized method.

78-4.03A(4) Payment

Not Used

78-4.03B Simulated Stone Masonry and Textured Concrete

Reserved

78-4.03C–78-4.03G Reserved

Replace the paragraph of section 78-4.04A(3)(a) with:

07-21-17

Anywhere metal is adjacent to a joint, seal the joint between the surfaces to be stained and the adjacent metal with a sealing compound before applying the stain.

Replace the heading of section 78-4.04B(1)(c)(iii) with:

07-21-17

Staining Quality Work Plan

Replace *an application plan* in the 1st sentence in the paragraph of section 78-4.04B(1)(c)(iii) with:

07-21-17

a staining quality work plan

Replace *application* in the 2nd sentence in the paragraph of section 78-4.04B(1)(c)(iii) with:

07-21-17

work

Replace *application plan* in the 1st sentence in the paragraph of section 78-4.04B(1)(d)(iii) with:

07-21-17

staining quality work plan

^^

80 FENCES

04-20-18

Add to the list in the 2nd paragraph of section 80-3.02B:

04-20-18

3. Group IC, 50,000 psi yield, for round steel pipes

Add between the 2nd and 3rd paragraphs of section 80-3.02B:

04-20-18

Group IC, 50,000 psi yield, for round steel pipes may be used instead of group IA, regular grade steel round pipes of the same diameter.

Replace *3-1/4-inch-vertical and 5-1/4-inch-horizontal mesh* in the 4th paragraph of section 80-3.02C with:

04-20-18

3-1/2-inch-vertical and 5-inch-horizontal mesh

Replace section 80-4 with:

07-15-16

80-4 WILDLIFE EXCLUSION FENCES

80-4.01 GENERAL

80-4.01A General

Section 80-4 includes specifications for constructing wildlife exclusion fences.

Constructing a wildlife exclusion fence includes the installation of any signs specified in the special provisions.

80-4.01B Materials

Each T post must:

1. Comply with ASTM A702
2. Be metal and have an anchor plate
3. Be painted black or galvanized

80-4.01C Construction

Not Used

80-4.01D Payment

Not Used

80-4.02 DESERT TORTOISE FENCES

80-4.02A General

Section 80-4.02 includes specifications for constructing desert tortoise fences.

80-4.02B Materials

80-4.02B(1) Permanent Desert Tortoise Fences

80-4.02B(1)(a) General

Each wire tie and hog ring for a permanent desert tortoise fence must comply with section 80-2.02F.

Each hold down pin must:

1. Be U-shaped, with 2 minimum 6-inch long legs
2. Have pointed ends
3. Be at least 11-gauge wire
4 Be galvanized
5. Be commercial quality

80-4.02B(1)(b) Hardware Cloth

The hardware cloth must:

1. Comply with ASTM A740
2. Be welded or woven galvanized steel wire fabric
3. Be made of at least 14-gauge wire
4. Be 36 inches wide

80-4.02B(1)(c) Barbless Wire

The barbless wire must:

1. Comply with ASTM A641/A641M

2. Be at least 14-gauge wire
3. Have a Class 1 zinc coating

80-4.02B(1)(d) Posts

Each post must:

1. Comply with ASTM F1083
2. Be standard weight, schedule 40 steel pipe with a nominal pipe size of 1 inch
3. Be galvanized steel fence post conforming to ASTM A702

80-4.02B(2) Temporary Desert Tortoise Fences

The materials for a temporary desert tortoise fence must comply with section 80-4.02B(1), except the hardware cloth must be made of at least 16-gauge wire.

80-4.02C Construction

80-4.02C(1) General

Extend the hardware cloth a minimum of 24 inches above the ground.

Plumb the posts and pull the hardware cloth taut. Correct any alignment issues.

80-4.02C(2) Permanent Desert Tortoise Fences

Excavate the ground to form a trench before installing the posts and hardware cloth. Embed the posts at maximum 5-foot intervals into the ground. If T posts are used, use 5-foot lengths and embed the posts to match the above-ground height shown for the posts.

Securely fasten the hardware cloth to the posts with wire ties and to barbless wire with hog rings as shown. Pass the wire ties through the hardware cloth. Encircle the posts and barbless wire with the ties and tie them by twisting a minimum of 3 complete turns.

Bend the twisted ends of the ties down to prevent possible snagging. Close hog rings with their ends overlapping.

Bury the hardware cloth a minimum of 12 inches into the ground. Install the cloth in 1 continuous piece. You may cut the cloth into shorter segments if authorized.

Overlap the hardware cloth segments at posts, with a minimum overlap of 6 inches centered at a post. Wire tie the overlapped cloth to posts as shown. Prevent fraying by threading barbless wire along the vertical edges of the hardware cloth on either side of the post or use 3 equally spaced hog rings (6 hog rings per location) along each wire cloth edge.

Where bedrock or caliche substrate is encountered, use the bent hardware cloth detail if authorized. Transitions from buried-to-bent or bent-to-buried configuration must occur at a post location with a minimum 6-inch overlap of the hardware cloth as shown. The maximum spacing for hold down pins is 24 inches on center. Anchor in place with hold down pins the beginning and end corners of the hardware cloth placed on the ground.

Backfill the removed earth material into the trench created to install the hardware cloth and posts. Use an 8 lb or heavier hand tamper to compact the backfill around the posts and hardware cloth. Install a post at each corner of the cloth segments.

If a gate must be installed, attach the hardware cloth to the gate frame such that there is contact along the entire length of the gate between the finished ground surface and the lower edge of the cloth. Install the gate under section 80-10.

80-4.02C(3) Temporary Desert Tortoise Fences

Fold the horizontal edge of the hardware cloth at a 90° angle toward the tortoise habitat area. Ensure the clearance to the ground at the bend is from 0 to 2 inches.

Where the hardware cloth overlaps, secure the bend piece with one of the following:

1. Barbless wire threaded along the width of the cloth
2. Minimum of 4 hog rings equally spaced along the edge

Fasten the bent piece to the ground with hold down pins pushed completely into the ground.

When the temporary fence is no longer needed, compact soil into post holes with an 8 lb or heavier hand tamper.

80-4.02D Payment

Not Used

80-4.03–80-4.09 RESERVED

Replace *length* at each occurrence in section 80-10.02 with:

07-21-17

width

^^^

requirements in ASTM F3125, Grade A325/A325M after galvanizing. The nuts and washers must comply with ASTM F3125, Grade A325/A325M.

Replace the row for *Bolts* in the table in the 1st paragraph of section 83-2.08B with:

07-21-17

Bolts	ASTM F3125, Grade A325/A325M

Replace the row for *Nuts and washers for bolts and threaded rods* in the table in the 1st paragraph of section 83-2.08B with:

07-21-17

Nuts for bolts and threaded rods	ASTM A563/A563M
Washers for bolts and threaded rods	ASTM F436/F436M

^^

84 MARKINGS

04-20-18

Add to the end of item 2 in the list in the 1st paragraph of section 84-2.01C:

04-20-18

, except for thermoplastic

Add to the list in the 1st paragraph of section 84-2.01C:

07-21-17

4. Material data sheet for thermoplastic primer

Add between the 1st and 2nd paragraphs of section 84-2.01C:

04-20-18

For each lot or batch of thermoplastic, submit a manufacturer's certificate of compliance with test results for the tests specified in section 84-2.01D. The date of test must be within 1 year of use.

Add to the end of section 84-2.01D:

04-20-18

Each lot or batch of thermoplastic must be tested under California Test 423 for:

1. Brookfield Thermosel viscosity
2. Hardness
3. Yellowness index, white only
4. Daytime luminance factor
5. Yellow color, yellow only
6. Glass bead content
7. Binder content

During the installation of thermoplastic traffic stripes or markings at the job site, apply a test stripe of the thermoplastic on suitable material in the presence of the Engineer. The test stripe must be at least 1 foot in length. The test stripe will be tested for yellow color, daytime luminance factor, and yellowness index requirements.

Replace the list in the1st paragraph of section 84-2.03C(2)(a) with:

07-21-17

1. To all roadway surfaces except for asphaltic surfaces less than 6 months old
2. At a minimum rate of 1 gallon per 300 square feet
3. To allow time for the thermoplastic primer to dry and become tacky prior to application of the thermoplastic

Replace *0.20 lb of thermoplastic per foot of 4-inch-wide solid stripe* in the 2nd paragraph of section 84-2.03C(2)(b) with:

07-21-17

0.36 lb of thermoplastic per foot of 6-inch-wide solid stripe

Replace *0.13 lb of thermoplastic per foot of 4-inch-wide solid stripe* in the 2nd paragraph of section 84-2.03C(2)(c) with:

07-21-17

0.24 lb of thermoplastic per foot of 6-inch-wide solid stripe

Replace *0.38 lb of thermoplastic per foot of 4-inch-wide solid stripe* in the 2nd paragraph of section 84-2.03C(2)(e) with:

07-21-17

0.57 lb of thermoplastic per foot of 6-inch-wide solid stripe

Replace *4-inch-wide yellow stripes* at each occurrence in section 84-2.03C(3)(a) with:

07-21-17

6-inch-wide yellow stripes

Replace *4-inch-wide yellow stripes* at each occurrence in section 84-2.04 with:

07-21-17

6-inch-wide yellow stripes

Add to the beginning of section 84-8.03A:

07-15-16

Select the method and equipment for constructing ground-in indentations.

Replace the 1st paragraph of section 84-8.03A with:

07-15-16

Do not construct rumble strips:

1. On structures, approach slabs, or concrete weigh-in-motion slabs
2. At intersections
3. Bordering two-way left turn lanes, driveways, or other high-volume turning areas
4. Within 6 inches of any concrete pavement joint

Add between the 2nd and 3rd paragraphs of section 84-8.03A:

07-15-16

Modify rumble strip spacing to avoid locating a groove on a concrete pavement joint.

Replace the 3rd paragraph of section 84-8.03A with:

07-15-16

Indentations must comply with the dimensions shown and not vary more than:

1. 10 percent in length
2. 0.06 inch in depth
3. 10 percent in width
4. 1 inch in center-to-center spacing between rumble strips

Add to the end of section 84-8.03A:

07-15-16

The noise level created by the combined grinding activities must not exceed 86 dBA when measured at a distance of 50 feet at right angles to the direction of travel.

Break rumble strips before and after intersections, driveways, railroad crossings, freeway gore areas, and freeway ramps. Place breaks and break distances as shown. You may adjust breaks and the break distances as needed at low-volume driveways or other locations if authorized.

07-15-16

Delete *new* in the 1st paragraph of section 84-8.03B.

07-15-16

Add to the end of section 84-8.03B:

Remove grinding residue under section 13-4.03E(7).

Replace the 1st paragraph of section 84-8.03C with:

07-15-16

Construct rumble strips in the top layer of HMA and asphalt concrete surfacing by the ground-in method.

Add between the 2nd and 3rd paragraphs of section 84-8.03C:

07-15-16

Dispose of the removed material.

07-15-16

Delete the 2nd paragraph of section 84-8.03C.

Replace *37-2* in the 3rd paragraph of section 84-8.03C with:

07-15-16

37-4.02

Replace section 84-8.04 with:

07-15-16

The payment quantity for any type of rumble strip is the length measured by the station along the length of the rumble strip without deductions for gaps between indentations.

Replace the 2nd paragraph of section 84-9.03B with:

04-15-16

Completely remove traffic stripes and pavement markings, including any paint in the gaps, by methods that do not remove pavement to a depth of more than 1/8 inch.

Add between the 2nd and 3rd paragraphs of section 84-9.03B:

04-15-16

Submit your proposed method for removing traffic stripes and pavement markings at least 7 days before starting the removal work. Allow 2 business days for the review.

Remove pavement marking such that the old message cannot be identified. Make any area removed by grinding rectangular. Water must not puddle in the ground areas. Fog seal ground areas on asphalt concrete pavement.

04-15-16

Delete *materially* in the 1st paragraph of section 84-9.03D.

Replace the list in the 1st paragraph of section 84-9.04 with:

07-21-17

1. 1.34 for a single 8-inch-wide traffic stripe
2. 2 for a double traffic stripe
3. 3 for a triple traffic stripe

^^^

ambient sound level: Background sound level in dB at a given location.

ambient sound sensing microphone: Microphone that measures the ambient sound level in dB and automatically adjusts the accessible pedestrian signal speaker's volume.

audible speech walk message: Audible prerecorded message that communicates to pedestrians which street has the walk interval.

channel: Discrete information path.

CALiPER: Commercially Available LED Product Evaluation and Reporting. A U.S. Department of Energy program that individually tests and provides unbiased information on the performance of commercially available LED luminaires and lights.

controller assembly: Assembly for controlling a system's operations, consisting of a controller unit and auxiliary equipment housed in a waterproof cabinet.

controller unit: Part of the controller assembly performing the basic timing and logic functions.

correlated color temperature: Absolute temperature in kelvin of a blackbody whose chromaticity most nearly resembles that of the light source.

detector: Detector as defined in the *California MUTCD*.

electrolier: Assembly of a lighting standard and luminaire.

07-21-17

fastening hardware [ICF1]: Bolts, nuts, washer, fasteners, hex nuts, lock nuts, or other metal components to secure or lock down a device or equipment.

04-15-16

flasher: Device for opening and closing signal circuits at a repetitive rate.

flashing beacon control assembly: Assembly of switches, circuit breakers, terminal blocks, flasher, wiring, and other necessary electrical components housed in a single enclosure for operating a beacon.

house side lumens: Lumens from a luminaire directed to light up areas between the fixture and the pole, such as sidewalks at intersection or areas off the shoulders on freeways.

illuminance gradient: Ratio of the minimum illuminance on a 1-foot square of sign panel to that on an adjacent 1-foot square of sign panel.

inductive loop detector: Detector capable of being actuated by an inductance change caused by a vehicle passing or standing over the loop. An inductive loop detector includes a loop or group of loops installed in the roadway and a lead-in cable installed and connected inside a controller cabinet.

junction temperature: Temperature of the electronic junction of the LED device. The junction temperature is critical in determining photometric performance, estimating operational life, and preventing catastrophic failure of the LED.

L70: Extrapolated life in hours of the luminaire when the luminous output depreciates 30 percent from the initial values.

lighting standard: Pole and mast arm supporting the luminaire.

04-20-18

link: Part of a system which provides a data connection between a transmitter and receiver.

04-15-16

LM-79: Test method from the Illumination Engineering Society of North America specifying the test conditions, measurements, and report format for testing solid state lighting devices, including LED luminaires.

LM-80: Test method from the Illumination Engineering Society of North America specifying the test conditions, measurements, and report format for testing and estimating the long-term performance of LEDs for general lighting purposes.

luminaire: Assembly that houses the light source and controls the light emitted from the light source.

04-20-18

mid-span access method: Procedure in which fibers from a single buffer tube are accessed and spliced to a multi buffer tube cable without cutting the unused fibers in the buffer tube, or disturbing the remaining buffer tubes in the cable.

04-15-16

National Voluntary Laboratory Accreditation Program: U.S. Department of Energy program that accredits independent testing laboratories.

04-20-18

optical time domain reflectometer (OTDR): Fiber optic test equipment that is used to measure the total amount of power loss between two points and over the corresponding distance. 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 and or defects in the fiber.

07-21-17

pedestrian change interval: Pedestrian change interval as defined in the *California MUTCD*.

04-15-16

powder coating: Coating applied electrostatically using exterior-grade, UV-stable, polymer powder.

power factor: Ratio of the real power component to the complex power component.

04-20-18

power meter: A portable fiber optic test equipment that, when coupled with a light source, is used to perform end-to-end attenuation testing. Its display indicates the amount of power injected by the light source at the designed wavelength of the system under testing that arrives at the receiving end of the link.

04-15-16

pretimed controller assembly: Assembly operating traffic signals under a predetermined cycle length.

programming mechanism: Device to program the accessible pedestrian signal operation.

pull box: Box with a cover that is installed in an accessible place in a conduit run to facilitate the pulling in of wires or cables.

push button information message: Push button information message as defined in the *California MUTCD.*

push button locator tone: Push button locator tone as defined in the *California MUTCD*.

04-20-18

segment: A continuous cable terminated by 2 splices, 2 connectors or 1 splice and 1 connector.

04-15-16

signal face: Signal face as defined in the *California MUTCD*.

signal head: Signal head as defined in the *California MUTCD*.

signal indication: Signal indication as defined in the *California MUTCD*.

signal section: Signal section as defined in the *California MUTCD*.

signal standard: Pole with or without mast arms carrying 1 or more signal faces.

street side lumens: Lumens from a luminaire directed to light up areas between the fixture and the roadway, such as traveled ways and freeway lanes.

surge protection device: Subsystem or component that protects equipment against short-duration voltage transients in power line.

total harmonic distortion: Ratio of the rms value of the sum of the squared individual harmonic amplitudes to the rms value of the fundamental frequency of a complex waveform.

traffic-actuated controller assembly: Assembly for operating traffic signals under the varying demands of traffic as registered by detector actuation.

traffic phase: Traffic phase as defined in the *California MUTCD*.

vehicle: Vehicle as defined in the *California Vehicle Code*.

vibrotactile pedestrian device: Vibrotactile pedestrian device as defined in the *California MUTCD*.

86-1.01C Submittals

86-1.01C(1) General

Within 15 days after Contract approval, submit a list of equipment and materials you propose to install.

Submit the list before shipping equipment and materials to the job site. The list must include:

1. Manufacturer's name
2. Make and model number
3. Month and year of manufacture
4. Lot and serial numbers
5. Contract number
6. Your contact information

Submit confirmation of the vendor's acceptance of the order for the electrical equipment and materials as an informational submittal.

Submit 3 sets of computer-generated, schematic wiring diagrams for each cabinet.

Diagrams, plans, and drawings must be prepared using graphic symbols in IEEE 315, "Graphic Symbols for Electrical and Electronic Diagrams."

Submit a schedule of values within 15 days after Contract approval.

Do not include costs for the traffic control system in the schedule of values.

Submit a manufacturer's maintenance manual or combined maintenance and operation manual as an informational submittal. The manual must have a master item index that includes:

1. Specifications
2. Design characteristics
3. General operation theory
4. Function of all controls
5. Troubleshooting procedure
6. Parts list, descriptions, stock numbers, and settings
7. Block circuit diagram
8. Layout of components
9. Schematic diagrams

04-20-18

Submit a digital file for geographic information system mapping for:

1. Conduit
2. Pull Boxes
3. Cabinets
4. Enclosures

The digital file must consist of:

1. Longitudinal and latitude coordinates, in accordance with the WGS84 reference coordinate system. The coordinates must be in decimal format having 6 significant figures after the decimal point. Coordinates must be read at the center of pull boxes, cabinet and enclosures; and on top of conduit at 200 foot intervals before backfill.
2. Type, depth and size for conduits.
3. Type for pull boxes, cabinets and enclosures.

04-15-16

86-1.01C(2) Pull Boxes

Submit the manufacturer's installation instructions for pull boxes, including:

1. Quantity and size of entries that can be made without degrading the strength of the pull box below the load rating
2. Locations where side entries can be made
3. Acceptable method for creating the entry

07-21-17

Submit load-rating test reports for pull boxes from a laboratory that is accredited to International Standards Organization/International Electrotechnical Commission 17025 by the American Association for Laboratory Accreditation (A2LA) or the ANSI-ASQ National Accreditation Board (ANAB).

04-15-16

86-1.01C(3) LED Luminaires

Submit for an LED luminaire:

1. Maximum power in watts
2. Maximum designed junction temperature
3. Heat sink area in square inches
4. Designed junction-to-ambient thermal resistance calculation with thermal resistance components clearly defined
5. L70 in hours when extrapolated for the average nighttime operating temperature
6. Life expectancy based on the junction temperature
7. Manufacturer's data sheet for the power supply, including the rated life

Submit the manufacturer's QC test data for LED luminaires as an informational submittal.

86-1.01C(4) Low-Pressure Sodium Luminaires

Submit the manufacturer's QC test data for low-pressure sodium luminaires as an informational submittal.

86-1.01C(5) Service Equipment Enclosures

Submit shop drawings for a service equipment enclosure to METS.

86-1.01C(6) Signal Heads

Submit a certificate of compliance and the manufacturer's QC test data for signal heads as an informational submittal.

86-1.01C(7) LED Signal Modules

Submit the manufacturer's QC test data for LED signal modules as an informational submittal.

86-1.01C(8) Visors

Submit a certificate of compliance and the manufacturer's QC test data for visors as an informational submittal.

86-1.01C(9) LED Countdown Pedestrian Signal Face Modules

Submit the manufacturer's QC test data for LED countdown pedestrian signal face modules as an informational submittal.

86-1.01C(10) Accessible Pedestrian Signals

Submit the manufacturer's QC test data for accessible pedestrian signals as an informational submittal.

86-1.01D Quality Assurance

86-1.01D(1) General

Electrical equipment must comply with one or more of the following standards:

1. ANSI
2. ASTM
3. EIA/ECIA
4. NEMA
5. NETA
6. UL/NRTL
7. TIA

Materials must comply with:

1. FCC rules
2. ITE standards
3. NEC
4. California Electrical Code

86-1.01D(2) Source Quality Control

Service equipment enclosures and cabinets must be inspected and tested at the source.

86-1.01D(3) Department Acceptance

Deliver material and equipment for testing to METS.

Allow 30 days for testing. The Department notifies you when testing is complete.

If the Department accepts the material or equipment, you must pick it up from the test site and deliver it to the job site.

If the Department rejects material or equipment, remove it within 5 business days after you are notified it is rejected. If it is not removed within that period, the Department may remove it and ship it to you and deduct the costs of labor, material and shipping.

Resubmit a new sample and allow 30 days for retesting. The retesting period starts when the replacement material or equipment is delivered to METS.

86-1.02 MATERIALS

86-1.02A General

Anchor bolts, anchor bars or studs, and nuts and washers must comply with section 75-1.02.

Bolt threads must accept galvanized standard nuts without requiring tools or causing removal of protective coatings.

86-1.02B Conduit and Accessories

86-1.02B(1) General

Conduit and fittings must comply with the requirements shown in the following table:

Conduit and Fitting Requirements

Type	Requirement
1	Must be hot-dip galvanized rigid steel complying with UL 6 and ANSI C80.1. The zinc coating must comply with copper sulfate test requirements in UL 6. Fittings must be electrogalvanized and certified under UL 514B.
2	Must comply with requirements for Type 1 conduit and be coated with PVC or polyethylene. The exterior thermoplastic coating must have a minimum thickness of 35 mils. The internal coating must have a minimum thickness of 2 mils. Coated conduit must comply with NEMA RN 1, or NRTL PVC-001.
3	Must be Type A, extruded, rigid PVC conduit complying with UL 651 or must be HDPE conduit complying with UL 651A.
4	Must have an inner, flexible metal core covered by a waterproof, nonmetallic, sunlight-resistant jacket, and must be UL listed for use as a grounding conductor. Fittings must be certified under UL 514B.
5	Must be intermediate steel complying with UL 1242 and ANSI C80.6. The zinc coating must comply with copper sulfate test requirements specified in UL 1242. Fittings must be electrogalvanized and certified under UL 514B.

Bonding bushings installed on metal conduit must be insulated and either a galvanized or zinc-alloy type.

04-20-18

Conduit used for horizontal directional drilling must be high density polyethylene Type IPS, DR 9 and comply with ASTM F714. The conduit material must comply with ASTM D3350.

Conduit for fiber optic cable systems must be high density polyethylene schedule 40 high density polyethylene, complying with NEMA TC-7, except for horizontal directional drilling.

Sealing plug must:

1. Be reusable
2. Withstand a pressure of 5 psi
3. Provide an airtight seal
4. Seal conduit and innerducts simultaneously

Sealing plug for empty conduit must have a rope tie.

Innerduct must be:

1. HDPE tubing or fabric mesh pouch.
2. Nominal 1 inch inside diameter, with a minimum Standard Dimension Ratio (SDR) rating of 11
3. Continuous without splices or joints.
4. Ribbed inside and outside when used inside a conduit.
5. Ribbed inside and smooth on the outside for direct burial.
6. Unique color throughout the entire length of the conduit segment.
7. Shipped and stored on a reel, covered to protect colors from UV deterioration. The reel must be marked with:
   - 7.1. Manufacturer's name
   - 7.2. Contract number
   - 7.3. Size and length of the innerduct

Polyethylene for innerduct must:

1. Comply with ASTM D3485, D3035, D2239, and D2447, and NEMA TC7 and TC2
2. Have a tensile yield strength of a minimum 3300 psi under ASTM D638
3. Have a density of 59.6187 lb/ft3 ± 0.3121 lb/in3 under ASTM D1505

Tracer wire must be a minimum No. 12 solid copper conductor with orange insulation Type TW, THW, RHW, or USE.

04-15-16

86-1.02B(2) Structures Accessories

Steel hangers, steel brackets, and other fittings used to support conduit in or on a wall or bridge superstructure must comply with section 75-3.

Precast concrete cradles for conduit must be made of minor concrete and commercial-quality welded wire fabric. The minor concrete must contain a minimum of 590 lb of cementitious material per cubic yard. The cradles must be moist cured for a minimum of 3 days.

86-1.02C Pull Boxes

86-1.02C(1) General

07-21-17

A pull box cover must have a nonskid surface.

A metal pull box cover must include a fitting for a bonding conductor.

A pull box cover must have a marking on the top that is:

1. Clearly defined
2. Uniform in depth
3. Parallel to the longer side
4. From 1 to 3 inches in height

The cover marking must include CALTRANS and one of the following:

1. *SERVICE* for service circuits between a service point and service disconnect
2. *SERVICE IRRIGATION* for circuits from a service equipment enclosure to an irrigation controller
3. SERVICE BOOSTER PUMP for circuits from a service equipment enclosure to the booster pump
4. *TDC POWER* for circuits from a service equipment enclosure to telephone demarcation cabinet
5. *LIGHTING* for a lighting system
6. *SIGN ILLUMINATION* for a sign illumination system
7. *SIGNAL AND LIGHTING* for a signal and lighting system
8. *RAMP METER* for a ramp metering system
9. *TMS* for a traffic monitoring station
10. *FLASHING BEACON* for a flashing beacon system
11. *CMS* for a changeable message sign system
12. *INTERCONNECT* for an interconnect conduit and cable system
13. *CALTRANS* if more than one system is shared in the same pull box

The following circuits must not include CALTRANS in the cover marking:

1. Electrical service
2. Sprinkler-control
3. Telephone service

The load rating must be:

1. Stenciled or stamped on the inside and outside of the pull box
2. Stamped on the outside of the cover

If a transformer or other device must be placed in the pull box, include recesses for a hanger.

The hardware must be stainless steel containing 18 percent chromium and 8 percent nickel.

04-15-16

86-1.02C(2) Nontraffic Pull Boxes

A nontraffic pull box and cover must comply with ANSI/SCTE 77, "Specification for Underground Enclosure Integrity," for Tier 22 load rating and must be gray or brown.

07-21-17

The cover markings must be cast in the mold of the cover or be engraved on a metal or UV resistant ABS plate secured in the cover with stainless steel screws.

04-15-16

Each new pull box must have a cover with an electronic marker cast inside.

A pull box extension must be made of the same material as the pull box. The extension may be another pull box if the bottom edge of the pull box fits into the opening for the cover.

07-21-17

The bolts, nuts, and washers must be a captive design. Captive bolts for securing the cover of nontraffic pull boxes must be capable of withstanding a torque from 55 to 60 ft-lb and a minimum pull-out strength of 750 lb.

04-15-16

86-1.02C(3) Traffic Pull Boxes

07-21-17

A traffic pull box and cover must comply with AASHTO HS20-44 and AASHTO M 306.

The frame must be anchored to the box.

04-15-16

Nuts must be vibration-resistant, zinc-plated, carbon steel and have a wedge ramp at the root of the thread.

07-21-17

For a cast iron cover or before galvanizing a steel cover, the manufacturer must apply the cover marking by one of the following methods:

1. Use a cast iron strip at least 1/4 inch thick with letters raised a minimum of 1/16 inch. Fasten the strip to the cover with 1/4-inch, flathead, stainless steel machine bolts and nuts. Peen the bolts after tightening.
2. Use a sheet steel strip at least 0.027 inch thick with letters raised a minimum of 1/16 inch. Fasten the strip to the cover by spot welding, tack welding, or brazing with 1/4-inch stainless steel rivets or 1/4-inch, roundhead, stainless steel machine bolts and nuts. Peen the bolts after tightening.
3. Bead weld the letters on the cover such that the letters are raised a minimum of 3/32 inch.
4. Cast the logo into the cast iron cover.

The steel cover must:

1. Be countersunk approximately 1/4 inch to accommodate the bolt head. When tightened, the hold down bolt head must be no more than 1/8 inch above the top of the cover.
2. Have slot holes for lifting with a guard under the cover to prevent entry of more than 3 inches below the bottom surface of the cover without deflection to protect the pull box contents.

04-20-18

Hold-down bolts must be a Penta Head 1/2-13UNC and must have a thread lock material.

07-21-17

86-1.02C(4) Tamper Resistant Pull Boxes

04-20-18

86-1.02C(4)(a) General

Not Used

86-1.02C(4)(b) Tamper-Resistant Nontraffic Pull Box

A tamper resistant nontraffic pull box must include a pull box with one of the following:

1. Anchored cover
2. Lockable cover
3. Pull box insert

86-1.02C(4)(c) Tamper Resistant Traffic Pull Box

A tamper resistant traffic pull box must include a pull box with an anchored cover.

86-1.02C(4)(d) Anchored Cover

The anchored cover must:

1. Be of 1/2-inch-thick mild steel, hot dip galvanized, post fabrication.
2. Be hot dip galvanized after manufacturing with spikes removed from the galvanized surfaces.
3. Have a center space for a top lock nut that must be torqued to 200 ft-lb.
4. Have a center opening for a stainless steel threaded cap to cover the lock nut.
5. Weigh a minimum of 85 lb.
6. Include an all-around security skirt of 1/4-inch thick steel. The skirt must be sized to encase a nontraffic pull box or sized to fit within a traffic pull box.
7. Be welded to the skirt.

86-1.02C(4)(e) Lockable Cover

The lockable cover must:

1. Be manufactured from minimum 3/16-inch-thick galvanized steel or a polymer of minimum strength equal to 3/16 inch steel
2. Be secured to the pull box with a locking mechanism of equal or greater strength than the manufactured material
3. Have 1/2-by-2-inch slot holes for lifting
4. Have dimensions complying with one of the following:
   - 4.1. Department's standards for pull covers as shown if the lockable cover is secured to the inside lip of the pull
   - 4.2. Department's standards for LO and WO for the length and width as shown for pull box covers if the lockable cover is secured to the top of the pull box

86-1.02C(4)(f) Pull Box Insert

The pull box insert must:

1. Be made of minimum 3/16-inch-thick or 10 gauge mild hot-dipped galvanized steel
2. Have a minimum of 2 mounting brackets that rest under the side or end wall
3. Be lockable with a padlock having a minimum 3/8-inch shackle
4. Have dimensions complying with the Department's standards for LI and WI for the length and width as shown for pull box covers

04-15-16

86-1.02D Tapes

86-1.02D(1) General

Reserved

86-1.02D(2) Pull Tape

Pull tape must be a flat, woven, lubricated, soft-fiber, polyester tape with a minimum tensile strength of 1,800 lb. The tape must have sequential measurement markings every 3 feet.

04-20-18

86-1.02D(3) Warning Tape

Warning tape must comply with requirements shown in the following table:

Warning Tape Requirements

Description	Parameters
Thickness	Minimum 4 mil
Width	4 inches
Material	Orange color polyolefin film
Tensile strength of material	Minimum of 2800 psi
Elongation	Minimum of 500 percent elongation before breakage
Printed message content	CAUTION: CALTRANS FACILITIES BELOW
Printed message text height and color	1 inch, black color text over bright orange background
Message spacing intervals	3 feet

Warning tape must be water and corrosion resistant.

07-21-17

86-1.02E Piezoelectric Axle Sensors

04-20-18

Piezoelectric axle sensors must be Class II and must be for vehicle classification purposes.

Each sensor must:

1. Be 1/4 inch wide by 6 feet long by 1/16 inch thick.
2. Have a screen transmission cable attached. The screened transmission cable must be RG-58C/U coaxial cable, jacketed with high-density polyethylene, rated for direct burial and resistant to nicks and cuts.
3. Operate over a temperature range from -40 to 160 degrees F.
4. Have a signal to noise ratio equal to or greater than 10 to 1.
5. Have an output uniformity range of plus or minus 20 percent.
6. Have an output signal of a minimum 250 mV for a wheel load of 400 lb at 55 mph and 70 degrees F.
7. Have an insulation resistance greater than 500 MΩ.
8. Have a life cycle of a minimum 25 million equivalent single axle loadings.

04-20-18

86-1.02F Conductors and Cables

86-1.02F(1) General

Conductors and cables must be clearly and permanently marked the entire length of their outer surface with:

1. Manufacturer's name or trademark
2. Insulation-type letter designation
3. Conductor size
4. Voltage
5. Temperature rating
6. Number of conductors for a cable

The minimum insulation thickness and color code requirements must comply with NEC.

86-1.02F(2) Conductors

86-1.02F(2)(a) General

A conductor must be UL listed or NRTL certified and rated for 600 V(ac).

Conductors must be identified as shown in the following table:

Conductor Identification

Circuit	Signal phase or function	Identification			Copper Size
		Insulation color		Band symbols	
		Base	Stripe[a]		

Signals (vehicle)[a, b]	2, 6	Red, yellow, brown	Black	2, 6	14
	4, 8	Red, yellow, brown	Orange	4, 8	14
	1, 5	Red, yellow, brown	None	1, 5	14
	3, 7	Red, yellow, brown	Purple	3, 7	14
	Ramp meter 1	Red, yellow, brown	None	No band required	14
	Ramp meter 2	Red, yellow, brown	Black	No band required	14
Pedestrian signals	2p, 6p	Red, brown	Black	2p, 6p	14
	4p, 8p	Red, brown	Orange	4p, 8p	14
	1p, 5p	Red, brown	None	1p, 5p	14
	3p, 7p	Red, brown	Purple	3p, 7p	14
Push button assembly or accessible pedestrian signal	2p, 6p	Blue	Black	P-2, P-6	14
	4p, 8p	Blue	Orange	P-4, P-8	14
	1p, 5p	Blue	None	P-1, P-5	14
	3p, 7p	Blue	Purple	P-3, P-7	14
Traffic signal controller cabinet	Ungrounded circuit conductor	Black	None	CON-1	6
	Grounded circuit conductor	White	None	CON-2	6
Highway lighting pull box to luminaire	Ungrounded - line 1	Black	None	No band required	14
	Ungrounded - line 2	Red	None	No band required	14
	Grounded	White	None	No band required	14
Multiple highway lighting	Ungrounded - line 1	Black	None	ML1	10
	Ungrounded - line 2	Red	None	ML2	10
Lighting control	Ungrounded - Photoelectric unit	Black	None	C1	14
	Switching leg from Photoelectric unit or SM transformer	Red	None	C2	14
Service	Ungrounded - line 1 (signals)	Black	None	No band required	6
	Ungrounded - line 2 (lighting)	Red	None	No band required	8
Sign lighting	Ungrounded - line 1	Black	None	SL-1	10
	Ungrounded - line 2	Red	None	SL-2	10
Flashing beacons	Ungrounded between flasher and beacons	Red or yellow	None	F-Loc.[c]	14
Grounded circuit conductor	Push button assembly or accessible pedestrian signal	White	Black	No band required	14
	Signals and multiple lighting	White	None	No band required	10
	Flashing beacons and sign lighting	White	None	No band required	12
	Lighting control	White	None	C-3	14
	Service	White	None	No band required	14
Railroad		Black	None	R	14

preemption					
Spares		Black	None	No band required	14

Notes:
[a]On overlaps, the insulation is striped for the 1st phase in the designation, e.g., phase (2+3) conductor is striped as for phase 2.
[b]Band for overlap and special phases as required
[c]Flashing beacons having separate service do not require banding.

The insulation color must be homogeneous throughout the full depth of the insulation. The identification stripe must be continuous throughout the length of the conductor.

Conductors size no. 8 to size no. 2 must be aluminum except for bonding jumpers and equipment grounding conductors.

86-1.02F(2)(b) Aluminum Conductors

Aluminum conductors must comply with ASTM B800 and 801.

Insulation for aluminum conductors must be one of the following:

1. Type XHHW-2
2. Type USE, RHH, or RHW cross-linked polyethylene

86-1.02F(2)(c) Copper Conductors

86-1.02F(2)(c)(i) General

Copper wire must comply with ASTM B3 and B8.

Insulation for no. 14 to no. 4 conductors must be one of the following:

1. Type TW PVC under ASTM D2219
2. Type THW PVC
3. Type USE, RHH, or RHW cross-linked polyethylene

The insulation for no. 2 and larger conductors must be one of the above or THWN.

86-1.02F(2)(c)(ii) Bonding Jumpers and Equipment Grounding Conductors

A bonding jumper must be copper wire or copper braid of the same cross-sectional area as a no. 8 conductor or larger.

An equipment grounding conductor may be bare or insulated.

86-1.02F(2)(c)(iii) Inductive Loop Conductors

An inductive loop conductor must comply with the requirements shown in the following table:

Conductor Requirements for Inductive Loop Detectors

Loop wire	Requirement
Type 1	Type RHW-USE neoprene-jacketed or Type USE cross-linked polyethylene, insulated, no. 12, stranded copper wire with a minimum 40-mils insulation thickness at any point.
Type 2	Type THWN or Type XHHW, no. 14, stranded copper wire in a plastic tubing. The plastic tubing must be polyethylene or vinyl rated for use at 105 degrees C and resistant to oil and gasoline. The outside diameter of the tubing must be at most 0.27 inch with a wall thickness of at least 0.028 inch.

86-1.02F(2)(d) Reserved

86-1.02F(3) Cables

86-1.02F(3)(a) General

Not Used

86-1.02F(3)(b) Aluminum Cables

86-1.02F(3)(b)(i) General

Not Used

86-1.02F(3)(b)(ii) Direct Burial Cables

Direct burial cable must be aluminum.

The direct burial aluminum cable must:

1. Be a metal-clad type
2. Be UL listed or NRTL certified for direct burial and concrete encasement
3. Include conductors rated for 90 degrees C
4. Have a galvanized steel or aluminum interlocking metal tape sheath with PVC jacket
5. Have a minimum no. 6 AWG aluminum or copper-clad aluminum equipment grounding conductor

86-1.02F(3)(c) Reserved

86-1.02F(3)(d) Copper Cables

86-1.02F(3)(d)(i) General

Not Used

86-1.02F(3)(d)(ii) Conductor Signal Cables

A conductor signal cable must have a black polyethylene jacket with an inner polyester binder sheath. The cable jacket must be rated for 600 V(ac) and 75 degrees C. Filler material, if used, must be polyethylene.

The individual conductors in the cable must be solid copper complying with ASTM B286 with Type THWN insulation. The minimum thickness of insulation must comply with NEC for conductor sizes no. 14 to no.10. The minimum thickness of the nylon jacket must be 4 mils.

Cable must comply with the requirements shown in the following table:

Cable typea	Conductor quantity and type	Cable jacket thickness (mils)		Maximum nominal outside diameter (inch)	Conductor color code
		Average	Minimum		

3CSC	3 no. 14	44	36	0.40	Blue/black, blue/orange, white/black stripe
5CSC	5 no. 14	44	36	0.50	Red, yellow, brown, black, white
9CSC	8 no. 14 1 no. 12	60	48	0.65	No. 12 - white, no. 14 - red, yellow, brown, black, and red/black, yellow/black, brown/black, white/black stripe
12CSC	11 no. 14 1 no. 12	60	48	0.80	No. 12 - white, no. 14 - red, yellow, brown, red/black stripe, yellow/black stripe, brown/black stripe, black/red stripe, black/white stripe, black, red/white stripe, brown/white stripe
28CSC	27 no. 14 1 no. 10	80	64	0.90	No. 10 - white no. 14 - red/black stripe, yellow/black stripe, brown/black stripe, red/orange stripe, yellow/orange stripe, brown/orange stripe, red/silver stripe, yellow/silver stripe, brown/silver stripe, red/purple stripe, yellow/purple stripe, brown/purple stripe, red/2 black stripes, brown/2 black stripes, red/2 orange stripes, brown/2 orange stripes, red/2 silver stripes, brown/2 silver stripes, red/2 purple stripes, brown/2 purple stripes, blue/black stripe, blue/orange stripe, blue/silver stripe, blue/purple stripe, white/black stripe, black/red stripe, black

86-1.02F(3)(d)(iii) Detector Lead-in Cables

Conductors for a loop detector lead-in cable must be two no. 16, 19-by-29, stranded, tinned copper wires with calculated cross-sectional areas complying with ASTM B286, Table 1 and the requirements shown in the following table:

Conductor Requirements for Loop Detector Lead-In Cables

Lead-in cable	Requirement
Type B	Insulated with 20 mils of high-density polyethylene. Conductors must be twisted together with at least 2 turns per foot, and the twisted pair must be protected with a copper or aluminum polyester shield. A minimum no. 20 copper drain wire must be connected to the equipment ground within the cabinet. Cable must have a high-density polyethylene or high-density polypropylene outer jacket with a nominal thickness of 32 mils. Include an amorphous, interior, moisture penetration barrier of nonhydroscopic polyethylene or polypropylene fillers.
Type C	Comply with International Municipal Signal Association Specification no. 50-2. A minimum no. 20 copper drain wire must be connected to the equipment ground within the cabinet.

86-1.02F(3)(d)(iv) Reserved

86-1.02F(3)(d)(v) Signal Interconnect Cables

A signal interconnect cable must be a 6-pair type with stranded, tinned, copper no. 20 conductors. The insulation for each conductor must be color-coded polypropylene with a minimum 13-mils nominal thickness. The conductors must be in color-coded, twisted pairs. Each pair must be wrapped with an aluminum polyester shield and have a no. 22 or larger, stranded, tinned, copper drain wire inside the shielded pair.

The cable jacket must be black HDPE rated for a minimum of 300 V(ac) and 60 degrees C. The jacket must have a minimum nominal wall thickness of 40 mils.

86-1.02F(3)(d)(vi) Communication Cables

86-1.02F(3)(d)(vi)(a) General

Not Used

86-1.02F(3)(d)(vi)(b) Category 5E Cables

A category 5E cable must be a 4-pair, unshielded, outdoor rated, nongel-filled type and comply with ANSI/TIA/EIA 568-B.

86-1.02F(3)(d)(vi)(c) Category 6 Cables

A category 6 cable must be a 4-pair, unshielded, outdoor rated, nongel-filled type and comply with ANSI/TIA/EIA 568-C.

86-1.02F(3)(d)(vi)(d) Telephone Cables

A telephone cable must be a 6-pair type with solid, tinned, copper no. 22 conductors and comply with RUS Bulletin 1735F-205 (PE-39).

07-21-17

86-1.02G Equipment Identification Characters

Equipment identification characters must be 2-1/2 inch, series D lettering, except on wood poles, they must be 3-inch lettering.

The characters must be self-adhesive reflective labels or paint, except on wood poles, they must be embossed on aluminum.

04-20-18

Labels must have a white back ground, all black capital characters, and must extend beyond the character by a minimum of 1/4 inch.

07-21-17

86-1.02H Splicing Materials

Splicing materials include:

1. Connectors
2. Electrical insulating coating

3. PVC electrical tape
4. Butyl rubber stretchable tape
5. PVC pressure-sensitive adhesive tape
6. Heat shrink tubing

Connectors must be C-shaped compression or butt type.

Electrical insulating coating must be a fast drying sealant with low nontoxic fumes.

PVC electrical tape must have a minimum thickness of 80 mils.

Butyl rubber stretchable tape with liner must have a minimum thickness of 120 mils.

PVC pressure-sensitive adhesive electrical tape must have a minimum thickness of 6 mils.

Electrical tapes must be self-fusing, oil- and flame-resistant, synthetic rubber and be UL listed or NRTL certified.

Heat-shrink tubing must be made of irradiated polyolefin tubing with a minimum wall thickness of 40 mils before contraction and an adhesive mastic inner wall. When heated, the inner wall must melt and fill the crevices and interstices of the covered splice area and the outer wall must shrink to form a waterproof insulation.

Heat-shrink tubing must comply with the requirements for extruded, insulating tubing at 600 V(ac) specified in UL Standard 468D and ANSI C119.1 and the requirements shown in the following table:

Heat-Shrink Tubing Requirements

Quality characteristic	Requirement
Shrinkage ratio of supplied diameter[a] (max, %)	33
Dielectric strength (min, kV/in)	350
Resistivity (min, Ω/in)	25×10^{13}
Tensile strength (min, psi)	2,000
Operating temperature (°C)	-40–90 (135 °C in emergency)
Water absorption (max, %)	0.5

[a]When heated to 125 °C and allowed to cool to 25 °C

04-20-18

86-1.02I Connectors and Terminals

Copper connectors must comply with UL-486A.

Aluminum connector must comply with UL-486 B.

Connectors and terminals must be rated for the conductors' size and material type and be prefilled with oxide-inhibiting compound.

Connectors and terminals for copper conductors must be a compression or crimp type.

Connectors and terminals for aluminum conductors must be a compression type.

07-21-17

86-1.02J Standards, Poles, Pedestals, and Posts

Standards for signals, lighting, and flashing beacons, poles for closed circuit television, pedestals for cabinets, posts for extinguishable message sign and posts for pedestrian push button assemblies must comply with section 56-3.

86-1.02K Luminaires

86-1.02K(1) General

Luminaire must be either LED or low-pressure-sodium type.

86-1.02K(2) LED Luminaires

LED luminaire must be on the Authorized Material List for LED luminaires and must:

1. Be self-contained, not requiring assembly.
2. Comply with UL 1598 for luminaires in wet locations.
3. Have a power supply with:
   3.1. ANSI/IEC rating of at least IP65.
   3.2. 2 leads to accept standard 0-10 V(dc).
   3.3. Dimming control compatible with IEC 60929, Annex E. If the control leads are open or the analog control signal is lost, the circuit must default to 100-percent power.
   3.4. Case temperature self rise of 77 degrees F or less above ambient temperature in free air with no additional heat sinks.
4. Weigh no more than 35 lb.
5. Have a minimum operating life of 63,000 hours when operated for an average time of 11.5 hours at an average temperature of 70 degrees F.
6. Be designed to operate over a temperature range from -40 to 130 degrees F.
7. Be operationally compatible with photoelectric controls.
8. Have a correlated color temperature range from 3,500 to 6,500 K and a color rendering index of 65 or greater.
9. Have a maximum-effective projected area of 1.4 sq ft when viewed from either side or end.
10. Have a housing color that matches a color no. 26152 to 26440, 36231 to 36375, or 36440 of FED-STD-595.
11. Have an ANSI C136.41-compliant, locking-type, photocontrol receptacle with dimming connections and a watertight shorting cap.
12. Comply with LM-79, LM-80 and California Test 611.

The individual LEDs must be connected such that a catastrophic loss or a failure of 1 LED does not result in the loss of more than 20 percent of the luminous output of the luminaire.

The luminaire must be permanently marked inside the unit and outside of its packaging box. Marking consists of:

1. Manufacturer's name or trademark
2. Month and year of manufacture
3. Model, serial, and lot numbers
4. Rated voltage, wattage, and power in VA

An LED luminaire's onboard circuitry must include a surge protection device to withstand high-repetition noise transients caused by utility line switching, nearby lightning strikes, and other interferences. The device must protect the luminaire from damage and failure due to transient voltages and currents as defined in Tables 1 and 4 of ANSI/IEEE C64.41.2 for location category C-High. The surge protection device must comply with UL 1449 and ANSI/IEEE C62.45 based on ANSI/IEEE C62.41.2 definitions for standard and optional waveforms for location category C-High.

An LED luminaire and its associated onboard circuitry must comply with the Class A emission limits under 47 CFR 15(B) for the emission of electronic noise.

The fluctuations of line voltage must have no visible effect on the luminous output.

The operating voltage may range from 120 to 480 V(ac), 60 ± 3 Hz. Luminaire must operate over the entire voltage range or the voltage range must be selected from one of the following:

1. Luminaire must operate over a voltage range from 95 to 277 V(ac). The operating voltages for this option are 120 V(ac) and 240 V(ac).
2. Luminaire must operate over a voltage range from 347 to 480 V(ac). The operating voltage for this option is 480 V(ac).

LED luminaire must have a power factor of 0.90 or greater. The total harmonic distortion, current, and voltage induced into a power line by a luminaire must not exceed 20 percent. The L70 of the luminaire must be the minimum operating life or greater. Illuminance measurements must be calibrated to standard photopic calibrations.

The maximum power consumption and maintained illuminance of the LED luminaires must comply with the isofootcandle curves as shown.

LED luminaire must not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical and 2.5 percent of the rated lumens to project above 90 degrees from vertical.

Luminaire must have passive thermal management with enough capacity to ensure proper heat dissipation and functioning of the luminaire over its minimum operating life. The maximum junction temperature for the minimum operating life must not exceed 221 degrees F.

The junction-to-ambient thermal resistance must be 95 degrees F per watt or less. The use of fans or other mechanical devices is not allowed for cooling the luminaire. The heat sink must be made of aluminum or other material of equal or lower thermal resistance. The luminaire must contain circuitry that automatically reduces the power to the LEDs so the maximum junction temperature is not exceeded when the ambient temperature is 100 degrees F or greater.

The luminaire's housing must be fabricated from materials designed to withstand a 3,000-hour salt spray test under ASTM B117. All aluminum used in housings and brackets must be made of a marine-grade alloy with less than 0.2 percent copper. All exposed aluminum must be anodized. A chromate conversion undercoating must be used underneath a thermoplastic polyester powder coat.

The housing must be designed to prevent the buildup of water on its top surface. Exposed heat sink fins must be oriented to allow water to run off the luminaire and carry dust and other accumulated debris away from the unit. The optical assembly of the luminaire must be protected against dust and moisture intrusion to at least an UL 60529 rating of IP66. The power supply enclosure must be protected to at least an UL 60529 rating of IP43.

The housing must have a slip fitter capable of being mounted on a 2-inch-diameter pipe tenon. Slip fitter must:

1. Fit on mast arms with outside diameters from 1-5/8 to 2-3/8 inches
2. Be adjustable to a minimum of ±5 degrees from the axis of the tenon in a minimum of 5 steps: +5, +2.5, 0, -2.5, -5
3. Have clamping brackets that:
   3.1. Are made of corrosion-resistant materials or treated to prevent galvanic reactions
   3.2. Do not bottom out on the housing bosses when adjusted within the designed angular range
   3.3. Do not permanently set in excess of 1/32 inch when tightened

Each refractor or lens must be made of UV-inhibiting high-impact plastic, such as acrylic or polycarbonate, or heat- and impact-resistant glass. The refractor or lens must be resistant to scratching. Polymeric materials, except for the lenses of enclosures containing either the power supply or electronic components of the luminaire, must be made of UL94 V-0 flame-retardant materials.

An LED luminaire and its internal components must be able to withstand mechanical shock and vibration.

If the components are mounted on a down-opening door, the door must be hinged and secured to the luminaire's housing separately from the refractor or flat lens frame. The door must be secured to the housing to prevent accidental opening. A safety cable must mechanically connect the door to the housing.

An LED luminaire must have a barrier-type terminal block secured to the housing to connect field wires. The terminal screws must be captive and equipped with wire grips for conductors up to no. 6.

The conductors and terminals must be identified and marked.

86-1.02K(3) Low-Pressure Sodium Luminaires

A low-pressure sodium luminaire must be an enclosed cutoff or semi-cutoff type and be self-contained, not requiring assembly.

The housing must be either (1) a minimum 1/16-inch-thick, corrosion-resistant, die-cast aluminum sheet and plate with concealed continuous welds or (2) a minimum 3/32-inch-thick, acrylonitrile-butadiene-styrene sheet material on a cast aluminum frame. The housing must provide mounting for all electrical components and a slip fitter. The housing must be divided into optical and power compartments that are individually accessible for service and maintenance.

The painted exterior surface of the luminaire must be finished with a fused coating of electrostatically applied polyester powder paint or other UV-inhibiting film. The color must be aluminum gray.

A sealing ring must be installed in the pipe tenon opening to prevent the entry of water and insects into the power and optical compartments. The ring must be made of high-temperature neoprene or equal material.

The power unit assembly must be accessible through a weather-tight, hinged cover secured to the housing with spring latches or captive screws.

The luminaire's hardware must be stainless steel or cadmium plated. Removable components must be secured with machine screws or bolts instead of sheet metal screws.

A semi-cutoff luminaire or a molded refractor-style cutoff luminaire must include a refractor. Other cutoff luminaires must include a flat lens. The refractor assembly and flat lens assembly must be designed to rigidly maintain their shape and be hinged and secured to the housing with spring latches.

The refractor must be either a 1-piece injection-molded polycarbonate with a minimum thickness of 3/32 inch or a 1-piece injection-molded acrylic with a minimum thickness of 1/8 inch. Alternate methods of manufacturing the refractor may be authorized provided minimum specified thicknesses are maintained.

The flat lens must be a 1-piece polycarbonate with a minimum thickness of 3/32 inch, mounted to a metal frame.

The lamp socket must be made of high-temperature, flame-retardant, thermoset material with self-wiping contacts or an equal. The socket must be rated for 660 W and 1,000 V(ac). The position of the socket and support must maintain the lamp in the correct relationship with the reflector and refractor for the designed light distribution pattern. The reflector may be an integral part of the housing.

The luminaire must comply with the isofootcandle curves as shown.

Low-pressure sodium lamp must:

1. Be a 180 W, single-ended, bayonet-base, tubular, gas-discharge lamp
2. Maintain a minimum of 93 percent of its initial lumens over its rated life
3. Reach 80 percent of its light output within 10 minutes
4. Restrike within 1 minute after a power outage or voltage drop at the lamp socket
5. Have ANSI L74/E designation

The lamp operating position must be at ±20 degrees from the horizontal.

Lamp must comply with the minimum performance requirements shown in the following table:

Minimum Performance Requirements

Quality characteristic	Requirement
Initial lumens (lm)	33,000
Rated average life at 10 h/start (h)	18,000

The low-pressure sodium lamp ballast must be an autotransformer or high-reactance type. The power factor must be not less than 90 percent when the ballast is operated at the nominal line voltage with a nominally-rated reference lamp. The lamp wattage regulation spread must not vary by more than ±6 percent for ±10 percent input voltage variation from nominal through life.

At the line voltage, the ballast must have a lamp current crest factor not exceeding 1.8 and ballast loss not exceeding 24 percent for a 180 W ballast.

The ballast must include a multi-circuit connector for quick disconnection.

86-1.02K(4) Reserved

86-1.02L Reserved

86-1.02M Photoelectric Controls

Photoelectric control types are as shown in the following table:

Photoelectric Control Types

Control type	Description
I	Pole-mounted photoelectric unit. Test switch housed in an enclosure.
II	Pole-mounted photoelectric unit. Contactor and test switch located in a service equipment enclosure.
III	Pole-mounted photoelectric unit. Contactor and a test switch housed in an enclosure.
IV	A photoelectric unit that plugs into a NEMA twist-lock receptacle, integral with the luminaire.
V	A photoelectric unit, contactor, and test switch located in a service equipment enclosure.

The pole-mounted adaptor for Type I, II, and III photoelectric controls must include a terminal block and cable supports or clamps to support the wires.

The enclosure for Type I and III photoelectric controls must be a NEMA 3R type. The enclosure must have a factory-applied, rust-resistant prime coat and finish coat. The enclosure must be hot-dip galvanized or painted to match the color of the lighting standard.

Photoelectric unit must:

1. Have a screen to prevent artificial light from causing cycling.
2. Have a rating of 60 Hz, 105-130 V(ac), 210-240 V(ac), or 105-240 V(ac).
3. Operate at a temperature range from -20 to 55 degrees C.
4. Consume less than 10 W.
5. Be a 3-prong, twist-lock type with a NEMA IP 65 rating, ANSI C136.10-compliant
6. Have a fail-on state
7. Fit into a NEMA-type receptacle
8. Turn on from 1 to 5 footcandles and turn off from 1.5 to 5 times the turn-on level. Measurements must be made by procedures in *EEI-NEMA Standards for Physical and Electrical Interchangeability of Light-Sensitive Control Devices Used in the Control of Roadway Lighting.*

Type I, II, III, and V photoelectric controls must have a test switch to allow manual operation of the lighting circuit. Switch must be:

1. Single-hole mounting, toggle type
2. Single pole and single throw
3. Labeled *Auto-Test* on a nameplate

Photoelectric control's contactor must be:

1. Normally open
2. Mechanical-armature type with contacts of fine silver, silver alloy, or equal or better material
3. Installed to provide a minimum space of 2-1/2 inches between the contactor terminals and the enclosure's sides

The terminal blocks must be rated at 25 A, 600 V(ac), molded from phenolic or nylon material, and be the barrier type with plated-brass screw terminals and integral marking strips.

86-1.02N Fused Splice Connectors

The fused splice connector for 240 and 480 V(ac) circuits must simultaneously disconnect both ungrounded conductors. The connector must not have exposed metal parts except for the head of the stainless steel assembly screw. The head of the assembly screw must be recessed a minimum of 1/32 inch below the top of the plastic boss that surrounds the head.

The connector must protect the fuse from water or weather damage. Contact between the fuse and fuse holder must be spring loaded.

Fuses must:

1. Be standard, midget, ferrule type

2. Have a nontime-delay feature
3. Be 3/32 by 1-1/2 inches

86-1.02O Grounding Electrodes

Grounding electrode must be:

1. 1 piece
2. Minimum 10-foot length of one of the following:
   2.1. Galvanized steel rod or pipe not less than 3/4 inch in diameter
   2.2. Copper clad steel rod not less than 5/8 inch in diameter

86-1.02P Enclosures

86-1.02P(1) General

The enclosures must be rated NEMA 3R and include a dead front panel and a hasp with a 7/16-inch-diameter hole for a padlock.

The enclosure's machine screws and bolts must not protrude outside the cabinet wall.

The fasteners on the exterior of an enclosure must be vandal resistant and not be removable. The exterior screws, nuts, bolts, and washers must be stainless steel.

86-1.02P(2) Service Equipment Enclosures

A service equipment enclosure must be factory wired and manufactured from steel and galvanized or have factory-applied, rust-resistant prime and finish coats, except Types II and III.

Type II and III service equipment enclosures must:

1. Be made of 0.125-inch minimum thickness 5052-H32 aluminum sheet complying with ASTM B209.
2. Be manufactured using gas metal arc welding with bare aluminum welding electrodes. The electrodes must comply with AWS A5.10 Class ER5356.
3. Be manufactured using welding procedures, welders, and welding operators that comply with the requirements for welding procedures, welders, and welding operators in in AWS B2.1, "Specification for Welding Procedure and Performance Qualification."
4. Have full-seal weld exterior seams.
5. Exterior welds must be ground smooth and edges filed to a radius of at least 0.03 inch.
6. Have a surface finish that complies with MIL-A-8625 for a Type II, Class I coating, except the anodic coating must have a minimum thickness of 0.0007 inch and a minimum coating weight of 0.001 oz/sq in.

If a Type III enclosure houses a transformer of more than 1 kVA, the enclosure must have effective screened ventilation louvers of no less than 50 sq. in for each louver. The framed screen must be stainless no. 304 with a no. 10 size mesh and secured with at least 4 bolts.

The dead front panel on a Type III service equipment enclosure must have a continuous stainless steel or aluminum piano hinge. The panel must be secured with a latch or captive screws. No live part must be mounted on the panel.

The enclosure must be watertight and marked as specified in NEC to warn of potential electric-arc flash hazards.

Internal conductors for the photoelectric control unit must be 600 V(ac), 14 AWG (THHN) stranded machine tool wire. Where subject to flexing, 19 stranded wire must be used.

The meter area must be have a sealable, lockable, weather-tight cover that can be removed without the use of tools.

For Type III-A, III-B, and III-C enclosures, the meter socket must be a 5-clip type, and the landing lug must be suitable for multiple conductors.

For a Type III-D enclosure, the meter socket must be a 7-clip type, and the landing lug must be suitable for multiple conductors. The pedestal must comply with the Electric Utility Service Equipment Requirements Committee drawing no. 308 or 309.

Landing lugs must be (1) sized for the incoming service utility conductors, (2) compatible with either copper or aluminum conductors, and (3) made of copper or tin-plated aluminum. Live parts of the electrical equipment must be guarded against accidental contact.

The main and neutral busses of the enclosure must be made of tin-plated copper, be rated for 125 A, and be suitable for copper or aluminum conductors.

Each service equipment enclosure must have up to 2 main circuit breakers that will simultaneously disconnect ungrounded service-entrance conductors.

Circuit breaker for a service equipment enclosure must:

1. Be quick-break on either automatic or manual operation
2. Be trip indicating
3. Be internal-trip type
4. Be UL listed or NRTL certified and comply with UL 489 or equal
5. Be clearly marked with the frame size
6. Have an operating mechanism that is enclosed and trip-free from the operating handle on overload
7. Have the trip rating clearly marked on the operating handle
8. Have an interior made of copper

Circuit breakers used as disconnects must have a minimum interrupting capacity of 10,000 A, rms.

The interior of the enclosure must accept plug-in circuit breakers. A minimum of 6 standard single-pole circuit breakers, 3/4" nominal, must be provided for branch circuits.

Identify each circuit breaker and component by description using an engraved phenolic nameplate attached with stainless steel rivets or screws.

Nameplate must be installed:

1. Adjacent to the breaker on the dead front panel. The characters must be a minimum of 1/8 inch high.
2. Adjacent to the component on the back panel. The characters must be a minimum of 1/8 inch high.
3. At the top exterior of the door panel. The nameplate must include the system number, voltage, and number of phases engraved in minimum 3/16-inch-high characters.

A plastic-laminated wiring diagram must be attached inside the enclosure with brass eyelets by a UL-listed or NRTL-certified method.

86-1.02P(3) Lighting and Sign Illumination Enclosures

A lighting and sign illumination enclosure must be manufactured from steel and either galvanized, cadmium plated, or powder coated.

86-1.02Q Cabinets

86-1.02Q(1) General

Cabinets must be factory wired except for battery backup system cabinets.

The fasteners on the exterior of a cabinet, except for battery backup system cabinets, must be removable and vandal resistant. The exterior screws, nuts, bolts, and washers must be stainless steel.

Terminal blocks, circuit breakers, and a power supply must be UL approved.

86-1.02Q(2) Department-Furnished Controller Cabinets

A Department-furnished controller assembly consists of a Model 170E or 2070E controller unit, a wired controller cabinet, and all auxiliary equipment required to operate the system. The Department does not furnish anchor bolts.

86-1.02Q(3) Controller Cabinets

The controller cabinet must be a Model 334L, comply with TEES, and be on the Authorized Material List for traffic signal control equipment. The cabinet must have 3 drawer shelves. Each shelf must be attached to the tops of 2 supporting angles with 4 screws.

86-1.02Q(4) Telephone Demarcation Cabinets

86-1.02Q(4)(a) General

07-21-17

The doors of a telephone demarcation cabinet must be attached using stainless steel piano hinges.

04-15-16

86-1.02Q(4)(b) Type A Telephone Demarcation Cabinets

Reserved

86-1.02Q(4)(c) Type B Telephone Demarcation Cabinets

A Type B telephone demarcation cabinet consists of a mounting panel, outlets, circuit breaker, fan, dead front plates, and fuse.

The mounting panel must be made of 3/4-inch-thick ACX-grade plywood.

The mounting panel must be fastened to the cabinet with nuts, lock washers, and flat washers to 10 welded studs.

The cabinet must be made of 0.125-inch-thick anodized aluminum.

The cabinet door must be hung and secured with drawn latches, lockable with a padlock. The padlock latches must each have a minimum 7/16-inch-diameter hole.

Ventilation louvers must be located on the door.

The fan must be located in a ventilator housing and be controlled thermostatically. The thermostat control must have a range from 80 to 130 degrees F.

The thermostat and fan circuit must be protected with a fuse rated for 175 percent of the motor capacity. The fan capacity must be a minimum 25 cfm.

86-1.02Q(4)(d) Type C Telephone Demarcation Cabinets

Reserved

86-1.02Q(5) Battery Backup System Cabinets

The cabinet for a battery backup system must comply with TEES and be on the Authorized Material List for traffic signal control equipment.

86-1.02R Signal Heads

86-1.02R(1) General

A signal head consists of a signal mounting assembly, backplate, and signal face.

The head must have a terminal block attached to the back of one housing. The terminal block must have enough positions to accommodate all indications. Each position must be permanently labeled for the indications used.

The metal signal heads must not fracture or deflect more than half the lens diameter when tested under California Test 666.

The plastic signal heads must not fracture or deflect when tested under California Test 605.

The deflection must not be more than 10 degrees in either the vertical or horizontal plane after the wind load has been removed from the front of the signal face or more than 6 degrees in either the vertical or horizontal plane after the wind load has been removed from the back of the signal face.

86-1.02R(2) Signal Mounting Assemblies

Signal mounting assembly must include:

1. 1-1/2-inch-diameter steel pipe or galvanized conduit
2. Pipe fitting made of ductile iron, galvanized steel, bronze, or aluminum alloy, Type AC-84B, no. 380
3. Mast arm and post-top slip fitters and terminal compartments made of cast bronze or hot-dip galvanized ductile iron

The horizontal distance between the vertical centerlines of the terminal compartment or slip fitter and of each signal face must not exceed 11 inches except where required for proper signal face alignment or to allow programming of programmed visibility signal sections.

The mounting assembly must be watertight and free of sharp edges or protrusions that might damage conductor insulation. The assembly must have positive-locking serrated fittings that prevent signal faces from rotating when the fittings are mated with similar fittings on the faces.

Each terminal compartment must be fitted with a terminal block having a minimum of 12 positions, each with 2 screw-type terminals. Each terminal must accommodate at least five no. 14 conductors. The terminal compartment must have a cover for easy access to the terminal block.

86-1.02R(3) Backplates

The backplate material must be a homogeneous black color with a lusterless finish.

A metal backplate must be made of a minimum 1/16-inch-thick 3001-14 aluminum.

A plastic backplate must have a minimum thickness of 1/16 inch and be formed from sheet plastic or assembled from extruded, molded, or cast plastic sections. Sections must be factory joined using one of the following:

1. Appropriate solvent cement.
2. Aluminum rivets and washers painted or permanently colored to match the backplate.
3. No. 10 machine screws with flat washers, lock washers, and nuts painted to match the backplate.

Each plastic backplate must be secured to the plastic signal face such that it resists removal or permanent deformation.

86-1.02R(4) Signal Faces

Signal face consists of signal sections with signal housings, LED modules, and visors.

Signal face must:

1. Be adjustable and allow for 360-degree rotation about the vertical axis
2. Comply with ITE publications ST-052-E, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement* and ST-054, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement*
3. Be sealed with a neoprene gasket at the top opening

A metal signal face must have a metal backplate and visor.

A plastic signal face must have a plastic backplate and visor.

If a signal face is supported by a Type MAS slip fitter, spacers are required between the 2 sections. The spacers must be made of the same material as the housing. The vertical dimension of the spacers must allow proper seating of the serrations between the slip fitter and the 2 sections. The 2 sections must be joined with at least two no. 10 minimum machine screws through holes near the front of the housing and the spacers and matching holes in a reinforcing plate installed in the housing.

86-1.02R(4)(a) Signal Sections

86-1.02R(4)(a)(i) General

Signal section must have:

1 Opening at the top and bottom for a 1-1/2-inch pipe
2. Maximum height of 10-1/4 inches for an 8-inch section and 14-3/4 inches for a 12-inch section
3. Hinge pins, door-latching devices, and other exposed hardware manufactured of Type 304/304L or 305 stainless steel
4. Interior screws and fittings manufactured of stainless steel or steel with a corrosion-resistant plating or coating
5. Gaskets made of a material that is not degraded if installed in a section with metal or plastic housing

Sections must be capable of being joined together to form a signal face in any combination. This interchangeability is not required between metal and plastic sections.

Each section must be joined to an adjacent section by one of the following:

1. Minimum of 3 machine screws for 8-inch sections and 4 machine screws for 12-inch sections, installed through holes near the front and back of the housing. Each screw must be a no. 10 and have a nut, flat washer, and lock washer.
2. 2 machine screws, each with a nut, flat washer, and lock washer, installed through holes near the front of the housing and a fastener through the 1-1/2-inch pipe opening. The fastener must have 2 large, flat washers to distribute the load around the pipe's opening and 3 carriage bolts, each with a nut and lock washer. The minimum screw size must be no. 10, and the carriage bolt size must be 1/4 inch.

The holes for the machine screws must be either cast or drilled during signal section fabrication. Each hole must be surrounded by a minimum 1/8-inch-wide boss to allow contact between signal sections about the axis of the hole.

A serrated nylon washer must be inserted between each plastic signal section and the metal mounting assembly. Each serrated nylon washer must be from 3/16 to 1/4 inch thick. The serrations must match those on the signal section and the mounting assembly.

86-1.02R(4)(a)(ii) Programmed Visibility Signal Sections

Programmed visibility signal section must have:

1. Nominal 12-inch-diameter circular or arrow indication
2. Cap visor
3. Adjustable connection that:
   3.1. Provides incremental tilting from 0 to 10 degrees above or below the horizontal
   3.2. Maintains a common vertical axis through couplers and mountings

The terminal connection must allow external adjustment about the mounting axis in 5-degree increments.

The visibility of each signal section must be capable of adjustment or programming within the section.

The adjustment for the section must be preset at 4 degrees below the horizontal.

86-1.02R(4)(a)(iii) Signal Housings

The signal housing must:

1. Be die-cast aluminum, permanent mold-cast aluminum, or if specified, structural plastic
2. Comply with ITE publications ST-052-E, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement* and ST-054, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement* if made of die-cast or permanent mold-cast aluminum
3. Have a 1-piece, hinged, square-shaped door that is:
   3.1. Designed to allow access for replacement of modules without the use of tools
   3.2. Secured such that it remains closed during loading tests
4. Have a watertight module or lens mounted in the door
5. Have a terminal block attached to the back, with the terminals permanently labeled for conductors to facilitate field wiring

Each housing must have reinforcement plates. Reinforcement plates must be either sheet aluminum, galvanized steel, or cast aluminum. Each plate must have a minimum thickness of 0.11 inch and a hole concentric with a 1-1/2-inch pipe-mounting hole in the housing. Reinforcement plates must be placed as specified in the following table:

Reinforcement Plate Placement

Material	Placement
Sheet aluminum	Inside and outside of housing
Galvanized steel	Inside of housing
Cast aluminum	Outside of housing

Reinforcement plates placed outside of the housing must be finished to match the signal housing color and be designed to allow a proper serrated coupling between the signal face and the mounting hardware. A minimum of three no. 10 machine screws must be installed through holes in each plate and matching holes in the housing. Each screw must have a round or binder head, a nut, and a lock washer.

A metal housing must have a metal visor.

Plastic housing must:

1. Be molded in a single piece or fabricated from 2 or more pieces joined into a single piece
2. Be a black color throughout, including the door, matching color no. 17038, 27038, or 37038 of FED-STD-595
3. Have UV stability
4. Be self-extinguishing

If reinforcing webs are used to connect the back of the housing to the top, bottom, and sides of the adjacent housing, reinforcement plates are not required.

The exterior of the housing must be painted as specified in sections 78-4.08 and 59.

86-1.02R(4)(b) LED Signal Modules

An LED signal module must be on the Authorized Material List for LED traffic signal modules.

An LED signal module must comply with ITE publications ST-052-E, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement* and ST-054, *Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement*, except:

1. Maximum module weight must be 4 lb
2. Module must be a sealed unit with:
   - 2.1. 2 color-coded conductors for the power connection except lane control modules must use 3 color-coded conductors
   - 2.2. Printed circuit board that complies with TEES, chapter 1, section 6
   - 2.3. Lens that is:
     - 2.3.1. Convex or flat with a smooth outer surface
     - 2.3.2. Made of UV-stabilized plastic or glass
   - 2.4. 1-piece EPDM gasket
3. Module must include 3-foot-long conductors with attached quick-disconnect terminals
4. Identification must include:
   - 4.1. Month and year of manufacture
   - 4.2. 1-inch-diameter symbol of the module type with the module color written adjacent to the symbol in 0.50-inch-high letters
5 LED must be the ultra-bright type rated for 100,000 hours of continuous operation
6. Module must have an integral power supply

Individual LEDs must be wired such that a loss or failure of 1 LED will not result in a loss of more than 5 percent of the module's light output. Failure of an individual LED in a string must not result in a loss of an entire string or other indication.

The symbol for a 12-inch U-turn section must be a 15/16-inch-wide inverted *U* with an arrow on the left end.

A lane control section must be a combination module with a red *X* and green arrow. The conductor function and color code must be as shown in the following table:

Conductor Function and Color Code

Function	Color
Neutral	White
Red *X*	Red
Green arrow	Brown

The minimum power consumption for an LED signal module must be 5 W.

The maximum power consumption for an LED signal module must be as shown in the following table:

Maximum Power Consumption

LED signal module type	Power consumption (W)					
	Red		Yellow		Green	
	25 °C	74 °C	25 °C	74 °C	25 °C	74 °C
8-inch circular	8	13	13	16	12	12
12-inch circular	11	17	22	25	15	15
12-inch arrow	9	12	10	12	11	11
12-inch U-turn	9	12	10	12	11	11
Bicycle	11	17	22	25	15	15
Programmed visibility	11	17	22	25	15	15
Lane control (*X*)	9	12	--	--	--	--
Lane control (*Arrow*)	--	--	--	--	11	11

Red and green LED signal modules operating over a temperature range from -40 to 74 degrees C and yellow LED signal modules operating at 25 degrees C must maintain the minimum illumination values for 48 months as shown in the following tables:

Minimum Maintained Intensities for Circular Indications

Angle (v,h)	Intensities (cd)					
	8-inch			12-inch		
	Red	Yellow	Green	Red	Yellow	Green
2.5, ±2.5	133	267	267	339	678	678
2.5, ±7.5	97	194	194	251	501	501
2.5, ±12.5	57	113	113	141	283	283
2.5, ±17.5	25	48	48	77	154	154
7.5, ±2.5	101	202	202	226	452	452
7.5, ±7.5	89	178	178	202	404	404
7.5, ±12.5	65	129	129	145	291	291
7.5, ±17.5	41	81	81	89	178	178
7.5, ±22.5	18	37	37	38	77	77
7.5, ±27.5	10	20	20	16	32	32
12.5, ±2.5	37	73	73	50	101	101
12.5, ±7.5	32	65	65	48	97	97
12.5, ±12.5	28	57	57	44	89	89
12.5, ±17.5	20	41	41	34	69	69
12.5, ±22.5	12	25	25	22	44	44
12.5, ±27.5	9	16	16	16	32	32
17.5, ±2.5	16	32	32	22	44	44
17.5, ±7.5	14	28	28	22	44	44
17.5, ±12.5	10	20	20	22	44	44
17.5, ±17.5	9	16	16	22	44	44
17.5, ±22.5	6	12	12	20	41	41
17.5, ±27.5	4	9	9	16	32	32

Minimum Maintained Luminance for Indications

Indication type	Luminance (fL)		
	Red	Yellow	Green
Arrow	1,610	3,210	3,210
U-turn	1,610	3,210	3,210
Bicycle	1,610	1,610	1,610
Lane control (*X*)	1,610	--	--
Lane control (*Arrow*)	--	--	1,610

Minimum Maintained Luminance for Programmed Visibility Indications

Indication type	Luminance (cd)		
	Red	Yellow	Green
PV at angle v=2.5, h=±2.5	314	314	314

Conductors must be prewired to the terminal block.

86-1.02R(4)(c) Visors and Directional Louvers

The visor must be a tunnel type.

The visor must have a downward tilt from 3 to 7 degrees with a minimum length of 9-1/2 inches for nominal 12-inch round lenses and 7 inches for nominal 8-inch round lenses.

A metal visor must be formed from minimum 0.050-inch-thick aluminum alloy sheet.

A plastic visor must be either formed from sheet plastic or blow-molded. The plastic must be a black homogeneous color with a lusterless finish. A visor must withstand a wind load applied to its side for 24 hours without permanent deformation or removal from its door when tested under California Test 605 for plastic visors and California Test 666 for metal visors.

If directional louvers are used, the louvers must fit into full-circular signal visors. Louvers must consist of one of the following:

1. Outside cylinder constructed of sheet steel with a minimum nominal thickness of 0.030 inch and vanes constructed of sheet steel with a minimum nominal thickness of 0.016 inch.
2. Outside cylinder and vanes constructed of 5052-H32 aluminum alloy of equal thickness.

86-1.02S Pedestrian Signal Heads

86-1.02S(1) General

A pedestrian signal head consists of a pedestrian signal mounting assembly and a pedestrian signal face comprising of a pedestrian signal housing, an LED countdown pedestrian signal face module, and a front screen.

86-1.02S(2) Pedestrian Signal Mounting Assemblies

A pedestrian signal mounting assembly must comply with the specifications for a signal mounting assembly in section 86-1.02R, except mast arm slip fitters are not required.

86-1.02S(3) Pedestrian Signal Faces

86-1.02S(3)(a) General

Each pedestrian signal face must include a light-duty terminal block rated at 5 A and have 12 positions with no. 6-by-1/8-inch binder head screws. Each position must have 1 screw-type terminal.

The wiring and terminal block must comply with ITE publication ST-055-E*, Pedestrian Traffic Control Signal Indicators: Light Emitting Diode (LED) Signal Modules*.

86-1.02S(3)(b) Pedestrian Signal Housings

Pedestrian signal housing must comply with the specifications for a signal housing in 86-1.02R(4)(a)(iii), except the maximum overall dimensions must be 18-1/2 inches wide, 19 inches high, and 11-1/2 inches deep and without:

1. Visor
2. Watertight module or lens mounted in the door
3. Reinforcement plates

The housing must have a terminal block attached to the back. The terminal block must have enough positions to accommodate all indications. Each position must be permanently labeled for the indications used.

86-1.02S(3)(c) LED Countdown Pedestrian Signal Face Modules

An LED countdown PSF module must comply with ITE publication ST-055-E, *Pedestrian Traffic Control Signal Indicators: Light Emitting Diode (LED) Signal Modules*, except the material must comply with ASTM D3935 and the module must have:

1. Ultra-bright-type LED rated for 100,000 hours of continuous operation.
2. Lot number and month and year of manufacture permanently marked on the back of the module
3. Prominent and permanent vertical markings for accurate indexing and orientation within the pedestrian signal housing if a specific mounting orientation is required. Markings must be a minimum of 1 inch in height and include an up arrow and the word *up* or *top.*
4. Circuit board complying with TEES, chapter 1, section 6.

Individual LEDs must be wired such that a loss or failure of 1 LED will not result in a loss of more than 5 percent of the module's light output. Failure of an individual LED in a string must not result in a loss of an entire string or other indication.

Each symbol must be at least 9 inches high and 5-1/4 inches wide. The 2-digit countdown timer, *Upraised Hand*, and *Walking Person* indications must be electronically isolated from each other. The 3 indications must not share a power supply or interconnect circuitry.

The module must operate over the specified ambient temperature and voltage range and be readable both day and night at distances up to the full width of the area to be crossed. Upon initial testing at 25 degrees C, the module must have at least the luminance values shown in the following table:

Luminance Values

PSF module symbol	Luminance
Upraised hand and 2-digit countdown timer (fL)	1,094
Walking person (fL)	1,547

The module must not exceed the power consumption requirements shown in the following table:

Maximum Power Consumption Requirements

PSF module display	At 24 ºC	At 74 ºC
Upraised Hand	10.0 W	12.0 W
Walking Person	9.0 W	12.0 W
2-digit countdown timer	6.0 W	8.0 W

07-21-17

If the pedestrian change interval is interrupted, then the 2-digit countdown timer and display must reset to the full pedestrian change interval before being initiated the next time. The 2-digit countdown display on the PSF module must go dark within a second after displaying "0".

04-15-16

86-1.02S(3)(d) Front Screen

Pedestrian signal face must have a front screen that is one of the following types:

1. 3/8-inch-thick aluminum honeycomb screen with 0.2-inch-wide cells or a 1/2-inch-thick plastic screen with 3/8-inch-wide squares with 1/16-inch wall thickness that:
   1.1. Is installed so it tilts downward at an angle of 15 ± 2 degrees from the top and completely covers the message plate.
   1.2. Includes a clear front cover made of either a minimum 1/8-inch-thick acrylic plastic sheet or a minimum 1/16-inch-thick polycarbonate plastic.
   1.3. Is held firmly in place, including the cover, with stainless steel or aluminum clips or stainless steel metal screws.
2. Polycarbonate screen that:
   2.1. Has a nominal thickness of 1/32 inch.
   2.2. Is a 1-1/2-inch-deep eggcrate or Z-crate type.
   2.3. Is mounted in a frame constructed of aluminum alloy or polycarbonate with a minimum thickness of 0.040 inch.
   2.4. Is held in place with stainless steel screws.

The screen and frame of a pedestrian signal face must be made of either (1) plastic that is a flat black color or (2) anodized aluminum that is a flat black color or finished with lusterless, black, exterior-grade latex paint formulated for application to metal surfaces.

86-1.02T Accessible Pedestrian Signals

Accessible pedestrian signal must comply with the *California MUTCD*, chapter 4E, and have:

07-21-17

1. Audible speech message that plays when the push button is actuated. The accessible pedestrian signal must have at least 5 audible message options.

04-15-16

2. Push button locator tone that clicks or beeps.

04-20-18

3. Feature that activates the pedestrian phase during any failure without causing the pedestrian phase to be on RECALL.

04-15-16

An accessible pedestrian signal must function with the Department-furnished Model 170E/2070E controller assembly.

No part of the accessible pedestrian signal must be installed inside the controller cabinet.
Power for the accessible pedestrian signal must be from the pedestrian signal housing terminal block.

The housing for the signal assembly must be made of corrosion-resistant material. Theft-proof bolts used for mounting the housing to the standard must be stainless steel with a content of 17 percent chromium and 8 percent nickel. The housing must be shaped to fit the pole's curvature.

The color of a metallic housing must match color no. 33538 of FED-STD-595.

The color of a plastic housing must match color no. 17038, 27038, or 37038 of FED-STD-595.

Accessible pedestrian signal must:

1. Have electronic switches, a potentiometer, or an access port for a device for controlling and programming the volume level and messaging
2. Be weatherproof and shockproof

Enclosure for the accessible pedestrian signal must:

1. Weigh less than 7 lb
2. Measure less than 16 by 6 by 5 inches
3. Have a wiring hole with a diameter not exceeding 1-1/8 inches
5. Have a switch for a push button
6. Have a vibrotactile device on the push button or on the arrow
7. Have an internal weatherproof speaker and microphone that senses the ambient sound level

The separation between adjacent holes used for conductors and mounting must be at least twice the diameter of the larger hole.

The speaker grills must be located on the surface of the enclosure. The speakers must not interfere with the housing or its mounting hardware.

04-20-18

The cable between the accessible pedestrian signal assembly and the pedestrian signal head must have a:

1. Minimum four no. 18 stranded or larger tinned copper conductors with a minimum insulation thickness of 15 mils
2. Cable jacket with a minimum thickness of 20 mils and rated for a minimum:
   2.1. 300 V(ac)
   2.2. 80 degrees C
3. Nominal outside diameter less than 350 mils
4. Conductor color code of black, white, red and green

04-15-16

86-1.02U Push Button Assemblies

The housing for a push button assembly must be made of die-cast aluminum, permanent mold-cast aluminum, or UV-stabilized self-extinguishing structural plastic. The plastic housing must have a color throughout that matches color no. 17038, 27038, or 37038 of FED-STD-595.

If the push button is to be attached to a pole, the housing must be shaped to fit the pole's curvature.

The assembly must be waterproof and shockproof.

The push button's switch must be a single-pole, double-throw switching unit with screw-type terminals rated 15 A at 125 V(ac).

Switch for the push button must have:

1. Plunger actuator and a U frame to allow recessed mounting in the push button housing
2. Operating force of 3.5 lb
3. Maximum pretravel of 5/64 inch
4. Minimum overtravel of 1/32 inch
5. Differential travel from 0.002 to 0.04 inch
6. Minimum 2-inch diameter actuator

86-1.02V Reserved

86-1.02W Loop Detector Sealants

86-1.02W(1) General

Sealant for filling loop detector slots must be one of the following:

1. Asphaltic emulsion
2. Elastomeric sealant
3. Epoxy sealant for inductive loops
4. Hot-melt rubberized asphalt

86-1.02W(2) Asphaltic Emulsion Sealant

Asphaltic emulsion sealant must comply with the State Specification 8040-41A-15.

86-1.02W(3) Elastomeric Sealant

Elastomeric sealant must be a polyurethane material that cures only in the presence of moisture if used within the stated shelf life. The sealant must be suitable for use in both asphalt concrete and concrete pavement.

The cured elastomeric sealant must comply with the requirements shown in the following table:

Cured Elastomeric Sealant Requirements

Quality characteristic	Test method	Requirement
Hardness	ASTM D2240[a]	65–85
Tensile strength (min, MPa)	ASTM D412[b]	3.45
Elongation (min, %)		400
Flex at -40 °C[c]	--	No cracks
Weathering resistance	ASTM D822[d]	Slight chalking
Salt spray resistance:	ASTM B117[e]	
Tensile strength (min, MPa)		3.45
Elongation (min, %)		400
Dielectric constant (%)	ASTM D150[f]	<25

[a]Indentation at 25 °C and 50% relative humidity (Rex. Type A, Model 1700 only)
[b]Die C pulled at 508 mm/minute
[c]0.6-mm free film bend (180°) over 13-mm mandrel
[d]Weatherometer 350 h, cured 7 days at 25 °C and 50% relative humidity
[e]28 days at 38 °C with 5% NaCl, Die C, and pulled at 508 mm/minute)
[f]Change over a temperature range from -30 to 50 °C

86-1.02W(4) Hot-Melt Rubberized Asphalt Sealant

Hot-melt rubberized asphalt sealant must:

1. Be in solid form at room temperature and fluid at an application temperature range from 190 to 205 degrees C
2. Not produce toxic fumes
3. Be suitable for use in both asphalt concrete and concrete pavement
4. Be packaged in containers clearly marked *Detector Loop Sealant* with the manufacturer's batch and lot number.

The cured hot-melt rubberized asphalt sealant must comply with the requirements shown in the following table:

Cured Hot-Melt Rubberized Asphalt Sealant Requirements

Quality characteristic	Test method	Requirement
Cone penetration (max, 1/10 mm)	ASTM D5329, sec. 6[a]	35
Flow (max, mm)	ASTM D5329, sec. 8[b]	5
Resilience (min, %)	ASTM D5329, sec. 12[c]	25
Softening point (min, °C)	ASTM D36	82
Ductility (min, cm)	ASTM D113[d]	30
Flash point, Cleveland Open Cup (min, °C)	ASTM D92	288
Viscosity (Pa·s)	ASTM D4402[e]	2.5–3.5

[a]At 25 °C, 150 g, 5 s
[b]At 60 °C
[c]At 25 °C
[d]At 25 °C, 5 cm/minute
[e]Brookfield Thermosel, no. 27 spindle, 20 rpm, 190 °C

07-21-17

86-1.02X Electronic Markers and Locators

04-20-18

The electronic marker must be discrete or cast inside the pull box cover.

An electronic marker must:

1. Be passive
2. Be energized solely by electromagnetic energy received from the interrogating electronic marker locator
3. Operate over a temperature range from -4 to 122 degrees F

4. Operate at a frequency range between 30 kHz to 300 kHz and comply with FCC part 15
5. Have a watertight and moisture-resistant housing

In addition, a discrete electronic marker must:

1. Have a maximum diameter of 6 inches
2. Weigh a maximum of 2 lb
3. Be colored red for power and orange for communication circuits
4. Be self-leveling or omnidirectional

The electronic marker locator must:

1. Be compatible with the electronic marker
2. Detect the electronic marker in pull boxes buried under dirt, sand, or snow
3. Detect the electronic marker from a maximum distance of 5 feet vertically with a 6-inch offset
4. Have a headphone jack
5. Have a battery level indicator
6. Have a large character display
7. Have a numeric and audible signal strength indicator
8. Have a speaker volume adjustment

04-15-16

86-1.02Y Transformers

A transformer must be single-phase and may be a nonsubmersible or submersible type.

A transformer must be a dry type designed for operation on a 60 Hz supply. The transformer must have a decal showing a connection diagram. The diagram must show either color coding or wire tagging with primary (H1, H2) or secondary (X1, X2) markers and the primary and secondary voltage and volt-ampere rating. A transformer must comply with the electrical requirements shown in the following table:

Transformer Electrical Requirements

Quality characteristic	Requirement
Rating (V(ac))	120/480, 120/240, 240/480, or 480/120
Efficiency (%)	> 95
Secondary voltage regulation and tolerance from half load to full load (%)	±3

Secondary 240 and 480 V(ac) windings must be center tapped.

The transformer must withstand the application of 2,200 V(ac) from core to coils and from coil to coil for a 1-minute period when tested immediately after operation of the transformer at full load for 24 hours.

The external leads for the secondary connections must be no. 10 Type USE rated for 600 V(ac).

The transformer's leads must extend a minimum of 12 inches from the case.

The transformer's insulation must be NEMA 185 C or better.

Each transformer must:

1. Include metal half-shell coil protection.
2. Have moisture-resistant, synthetic-varnish-impregnated windings.
3. Be waterproof and suitable for outdoor operation.

Each submersible transformer must:

1. Include a handle and a hanger.
2. Be securely encased in a rugged, corrosion-resistant, watertight case.
3. Have leads that extend out through 1 or more sealed hubs.

4. Be manufactured to withstand a 5-day test with 12-hour on and off periods submerged in 2 feet of salt water that is 2 percent salt by weight. The operating periods must be at full load.

86-1.02Z Batteries

Battery must:

1. Be deep-cycle, sealed, prismatic, lead-calcium-based, absorbed-glass-mat, valve-regulated, lead-acid type
2. Be rated for 12 V
3. Be rated for a temperature range from -25 to 60 degrees C
4. Be group size 24
5. Be commercially available and stocked locally
6. Be marked with a date code, maximum recharge data, and recharge cycles
7. Be new and fully charged when furnished
8. Be free from damage or deformities
9. Have a carrying handle
10. Have 2 top-mounted, threaded-stud posts that include all washers and nuts
11. Include insulating rubber covers for protecting the lugs, posts, and wiring: red for the positive terminal and black for the negative terminal

If a battery is used for a battery backup system, it must accommodate 3/8-inch ring lugs of a Department-furnished battery harness.

86-1.03 CONSTRUCTION

Not Used

86-1.04 PAYMENT

Not Used

Replace section 87 with:

04-15-16

87 ELECTRICAL SYSTEMS

04-20-18

87-1 GENERAL

87-1.01 GENERAL

87-1.01A Summary

Section 87 includes general specifications for constructing and installing electrical systems.

The Department deducts the cost for maintenance performed by the Department on new or portions of existing systems modified under the Contract.

87-1.01B Definitions

Reserved

87-1.01C Submittals

Reserved

87-1.01D Quality Assurance

87-1.01D(1) General

Reserved

04-20-18

87-1.01D(2) Quality Control

87-1.01D(2)(a) General

Before shipping the material to the job site, submit to METS test samples of:

1. Accessible pedestrian signals
2. LED countdown pedestrian signal face modules

3. LED signal modules
4. LED luminaires

Submit a sample size as shown in the following table:

Electrical Material Sampling

Contract quantity	Test sample size
1–8	1
9–15	2
16–25	3
26–90	5
91–150	8
151–280	13
281–500	20
501–1200	32

Before starting operation of an electrical system, perform a conductor test in the presence of the Engineer.

Conductor test consists of testing each conductor and the conductors in cables for:

1. Continuity.
2. Grounds.
3. Insulation resistance at 500 V(dc) between the circuit and ground. A minimum insulation resistance of 100 MΩ on circuits must be attained.

Start the operational test of the system on any day except Friday or the day before a holiday. The operational test for signals must start from 9:00 a.m. to 2:00 p.m. Notify the Engineer 48 hours before starting the test.

An operational test consists of a minimum of 5 business days of continuous, satisfactory operation of the system. If the system fails, correct the problem and retest the system. A shutdown of the system caused by traffic, a power interruption, or unsatisfactory performance of Department-furnished materials does not constitute discontinuity of the test.

87-1.01D(2)(b) Electronic Markers

Electronic marker test consists of placing the electronic marker in the pull box, temporarily marking the pull box location with a utility flag, and using a compatible electronic marker locator to perform the following location test in the presence of the Engineer:

1. Within a 10 foot radius of the electronic marker, slowly move the locator toward the marker to determine the exact location of the pull box
2. Repeat the test at four different points at 90 degree from each other on a horizontal plane, away from the marker location, as shown. Take the average of the four points to determine the detected location of the pull box.
3. Detected location of the pull box must be within 0.5 feet of the actual location.

87-1.01D(2)(c) Battery Backup System

Notify the Engineer 48 hours before testing the battery backup system.

Test the system in the presence of the Engineer by turning off the power to the signal system at the service equipment enclosure. The signal system must run continuously for 30 minutes. If the battery

backup system fails, correct the problem and retest the system for another 30 minutes. After successful completion of the test, turn the power on for the signal system.

87-1.01D(2)(d) Piezoelectric Axle Sensors

Piezoelectric axle sensors consists of testing each piezoelectric axle sensor for each lane of data collection as follows:

1. Capacitance must be 20 percent of the sensor's data sheet as provided by the manufacturer.
2. Dissipation factor must be less than 0.04 nF when measured in the 20 nF range.
3. Resistance must be greater than 20 Megaohms.
4. Minimum of 100 per-vehicle records must be collected for each lane. Collected data must have:
   - 4.1 Total volume of ±3 percent accuracy.
   - 4.2 Vehicle classification of 95 percent accuracy by type.

Collect data files from the on-site equipment using the central office host computer to verify the communication link is working.

04-15-16

87-1.02 MATERIALS

Not Used

87-1.03 CONSTRUCTION

87-1.03A General

The Engineer determines the final locations of electrical systems.

Verify the locations of electrical systems and the depths of existing detectors, conduits, and pull boxes.

Notify the Engineer before performing work on the existing system.

You may shut down the system for alteration or removal.

Where an existing Department underground facility is shown within 10 feet of any excavation, locate and field mark the facility before performing work that could damage or interfere with the existing facility.

If an existing facility is within 2 feet of an excavation, determine the exact location of the facility by excavating with hand tools before using any power-operated or power-driven excavating or boring equipment. A vacuum excavator may be used if authorized.

Notify the Engineer immediately if an existing facility is damaged by your activities.

If existing underground conduit is to be incorporated into a new system, clean it with a mandrel or cylindrical wire brush and blow it clean with compressed air.

Limit the shutdown of traffic signal systems to normal working hours. Notify the local traffic enforcement agency before shutting down the signal.

Place temporary W3-1 and R1-1 signs in each direction to direct traffic through the intersection during shutdown of the signal. Place two R1-1 signs for 2-lane approaches. The signs must comply with part 2 of the *California MUTCD*.

Cover signal faces when the system is shut down overnight. Cover temporary W3-1 and R1-1 signs when the system is turned on.

If you work on an existing lighting system and the roadway is to remain open to traffic, ensure the system is in operation by nightfall.

Replace detectors you damage within 72 hours, or the Department replaces them and deducts the cost.

Work performed on an existing system not described is change order work.

Do not use electrical power from existing highway facilities unless authorized.

Maintain a minimum 48-inch clearance for a pedestrian pathway when placing equipment.

Except for service installation or work on service equipment enclosures, do not work above ground until all materials are on hand to complete the electrical work at each location.

Bond all metal components to form a continuous grounded system as specified in NEC.

Ground metallic equipment mounted less than 8 feet above the ground surface on a wood pole.

If you damage any portion of a concrete curb, sidewalk, curb ramp, driveway, or gutter depression, replace the entire section between contraction or expansion joints under section 73.

Apply equipment identification characters.

Orient louvers, visors, and signal faces such that they are clearly visible to approaching traffic from the direction being controlled.

Test loops and the detector lead-in cable circuit for continuity, ground, and insulation resistance at the controller cabinet before connecting detector lead-in cable to the terminal block.

Perform an operational test of the systems.

Before starting the operational test for systems that impact traffic, the system must be ready for operation, and all signs, pavement delineation, and pavement markings must be in place at that location.

87-1.03B Conduit Installation

87-1.03B(1) General

The installation of conduit includes installing caps, bushings, and pull tape and terminating the conduit in pull boxes, foundations, poles, or a structure.

04-20-18

Notify the Engineer at least 4 business days before starting horizontal directional drilling method or jack and drill activities.

04-15-16

Limit the number of bends in a conduit run to no more than 360 degrees between pull points.

Use conduit to enclose conductors except where they are installed overhead or inside standards or posts.

You may use a larger size conduit than specified for the entire length between termination points. Do not use a reducing coupling.

Extend an existing conduit using the same material. Terminate conduits of different materials in a pull box.

Install 2 conduits between a controller cabinet and the adjacent pull box.

Use a minimum trade size of conduit of:

1. 1-1/2 inches from an electrolier to the adjacent pull box
2. 1 inch from a pedestrian push button post to the adjacent pull box
3. 2 inches from a signal standard to the adjacent pull box
4. 3 inches from a controller cabinet to the adjacent pull box
5. 2 inches from an overhead sign to the adjacent pull box
6. 2 inches from a service equipment enclosure to the adjacent pull box
7. 1-1/2 inches if unspecified

Use Type 1 conduit:

1. On all exposed surfaces
2. In concrete structures
3. Between a structure and the nearest pull box

Ream the ends of shop-cut and field-cut conduit to remove burrs and rough edges. Make the cuts square and true. Do not use slip joints and running threads to couple conduit. If a standard coupling cannot be

used for metal-type conduit, use a threaded union coupling. Tighten the couplings for metal conduit to maintain a good electrical connection.

04-20-18

Cap the ends of conduit to prevent debris from entering before installing the conductors or cables. Use a plastic cap for Type 1, 2, and 5 conduits and a standard pipe cap for all other types of conduit or bell.

04-15-16

For Type 1, 2, and 5 conduits, use threaded bushings and bond them using a jumper. For other types of conduit, use nonmetallic bushings.

Do not install new conduit through foundations.

Cut Type 2 conduit with pipe cutters; do not use hacksaws. Use standard conduit-threading dies for threading conduit. Tighten conduit into couplings or fittings using strap wrenches or approved groove joint pliers.

Cut Type 3 conduit with tools that do not deform the conduit. Use a solvent weld for connections.

Protect shop-cut threads from corrosion under the standards shown in the following table:

Shop-Cut Thread Corrosion Protection

Conduit	Standard
Types 1 and 2	ANSI C80.1
Type 5	ANSI C80.6

Apply 2 coats of unthinned, organic zinc-rich primer to metal conduit before painting. Use a primer on the Authorized Material List for organic zinc-rich primers. Do not use aerosol cans. Do not remove shop-installed conduit couplings.

For conduits, paint:

1. All exposed threads
2. Field-cut threads, before installing conduit couplings to metal conduit
3. Damaged surfaces on metal conduit

If a Type 2 conduit or conduit coupling coating is damaged:

1. Clean the conduit or fitting and paint it with 1 coat of rubber-resin-based adhesive under the manufacturer's instructions
2. Wrap the damaged coating with at least 1 layer of 2-inch-wide, 20 mils-minimum-thickness, PVC tape under ASTM D1000 with a minimum tape overlap of 1/2 inch

You may repair damaged spots of 1/4 inch or less in diameter in the thermoplastic coating by painting with a brushing-type compound supplied by the conduit manufacturer.

If factory bends are not used, bend the conduit to a radius no less than 6 times its inside diameter without crimping or flattening it. Comply with the bending requirements shown in the following table:

Conduit-Bending Requirements

Type	Requirement
1	Use equipment and methods under the conduit manufacturer's instructions.
2	Use a standard bending tool designed for use on thermoplastic-coated conduit. The conduit must be free of burrs and pits.
3	Use equipment and methods under the conduit manufacturer's instructions. Do not expose the conduit to a direct flame.
5	Use equipment and methods under the conduit manufacturer's instructions.

Install pull tape with at least 2 feet of slack in each end of the conduit that will remain empty. Attach the tape's ends to the conduit.

Install conduit terminating in a standard or pedestal from 2 to 3 inches above the foundation. Slope the conduit toward the handhole opening.

Terminate conduit installed through the bottom of a nonmetallic pull box 2 inches above the bottom and 2 inches from the wall closest to the direction of the run.

87-1.03B(2) Conduit Installation for Structures

87-1.03B(2)(a) General

Paint exposed Type 1 conduit the same color as the structure.

Install galvanized steel hangers, steel brackets, and other fittings to support conduit in or on a wall or bridge.

87-1.03B(2)(b) New Structures

Seal and make watertight the conduits which lead to soffits, wall-mounted luminaires, other lights, and fixtures located below the pull box grade.

If you place a conduit through the side of a nonmetallic pull box, terminate the conduit 2 inches from the wall and 2 inches above the bottom. Slope the conduit toward the top of the box to facilitate pulling conductors.

For ease of installation and if authorized, you may use Type 4 conduit instead of Type 1 conduit for the final 2 feet of conduit entering a pull box in a reinforced concrete structure.

Install an expansion fitting where a conduit crosses an expansion joint in a structure. Each expansion fitting for metal conduit must include a copper bonding jumper having the ampacity as specified in NEC.

Install an expansion-deflection fitting for an expansion joint with a 1-1/2-inch movement rating. The fitting must be watertight and include a molded neoprene sleeve, a bonding jumper, and 2 silicon bronze or zinc-plated iron hubs.

For an expansion joint with a movement rating greater than 1-1/2 inches, install the expansion-deflection fitting as shown.

For conduit installed inside of bridge structures, you must:

1. Install precast concrete cradles made of minor concrete and commercial-quality welded wire fabric. The minor concrete must contain a minimum of 590 lb of cementitious material per cubic yard. The cradles must be moist cured for a minimum of 3 days.
2. Bond precast concrete cradles to a wall or bridge superstructure with one of the following:
   2.1. Epoxy adhesive for bonding freshly-mixed concrete to hardened concrete.
   2.2. Rapid-set epoxy adhesive for pavement markers.
   2.3. Standard-set epoxy adhesive for pavement markers.
3. Use a pipe sleeve or form an opening for a conduit through a bridge superstructure. The sleeve or opening through a prestressed member or conventionally reinforced precast member must be:
   3.1. Oriented transverse to the member.
   3.2. Located through the web.
   3.3. No more than 4 inches in size.
4. Wrap the conduit with 2 layers of asphalt felt building paper and securely tape or wire the paper in place for a conduit passing through a bridge abutment wall. Fill the space around the conduit with mortar under section 51-1, except the proportion of cementitious material to sand must be 1 to 3. Fill the space around the conduits after prestressing is completed.

Thread and cap a conduit installed for future use in structures. Mark the location of the conduit's end in a structure, curb, or wall directly above the conduit with a *Y* that is 3 inches tall.

87-1.03B(2)(c) Existing Structures

Run surface-mounted conduit straight and true, horizontal or vertical on the wall, and parallel to walls on ceilings or similar surfaces. Support the conduit at a maximum of 5-foot intervals where needed to prevent vibration or deflection. Support the conduit using galvanized, malleable-iron, conduit clamps, and clamp backs secured with expansion anchorage devices complying with section 75-3.02C. Use the

largest diameter of galvanized, threaded studs that will pass through the mounting hole in the conduit clamp.

87-1.03B(3) Conduit Installation Underground

87-1.03B(3)(a) General

Install conduit to a depth of:

1. 14 inches for the trench-in-pavement method
2. 18 inches, minimum, under sidewalk and curbed paved median areas
3. 42 inches, minimum, below the bottom of the rail of railroad tracks
4. 30 inches, minimum, everywhere else below grade

Place conduit couplings at a minimum of 6 inches from the face of a foundation.

Place a minimum of 2 inches of sand bedding in a trench before installing Type 2 or Type 3 conduit and 4 inches of sand bedding over the conduit before placing additional backfill material.

If installing conduit within the limits of hazardous locations as specified in NEC for Class I, division 1, install and seal Type 1 or Type 2 conduit with explosion-proof sealing fittings.

87-1.03B(3)(b) Conduit Installation under Paved Surfaces

You may lay conduit on existing pavement within a new curbed median constructed on top.

07-21-17

Install conduit under existing pavement by either the horizontal directional drill method or jack and drill method. You may use the trench-in-pavement method for either of the following conditions:

1. If conduit is to be installed behind the curb under the sidewalk
2. If the delay to vehicles will be less than 5 minutes

04-15-16

Do not use the trench-in-pavement method for conduit installations under freeway lanes or freeway-to-freeway connector ramps.

04-20-18

87-1.03B(3)(c) High Density Polyethylene Conduit Installation

For sweeps, maintain a conduit bend radius of a minimum 10 times the outside diameter of the conduit.

Conduits must not protrude more than 2 inches inside the pull box and vaults, and must enter at an angle less than 20 degrees from either the vertical or horizontal axis.

Demonstrate a minimum of 2 test fusions to the Engineer prior to performing fusion operations on HDPE conduit to be installed.

Join HDPE conduit using the electro fusion method recommended by the conduit manufacturer. Do not expose conduit to direct flame. The electro-fusion must be performed by a person certified by the conduit manufacturer.

Place warning tape in the trench 6 inches below finished grade.

Backfill trench with slurry concrete pigmented matching FED-STD-595 under 19-3.02E. The size of the aggregate must be no larger than 3/8 inch. Provide adequate spacers, tie-downs and bracing to maintain conduits in place during backfill.

For trenches in paved areas, only the top 4 inch of concrete backfill must be pigmented.

Blow out all conduits with compressed air until all foreign material is removed, before installing innerducts.

Install innerducts in accordance with the manufacturer's installation procedures. Innerducts must be one continuous unit between splice vaults. Innerducts may be interrupted inside pull boxes located between splice vaults and cabinets.

Lubricate innerducts per manufacturer's instructions during installation.

Install a pull tape in conduits and innerducts to remain empty.

Seal the ends of conduit after cables or pull tape are installed.

04-15-16

87-1.03B(3)(d) Conduit Installation under Railroad Tracks

Install Type 1 or Type 2 conduit with a minimum diameter of 1-1/2 inches under railroad tracks. If you use the jacking or drilling method to install the conduit, construct the jacking pit a minimum of 13 feet from the tracks' centerline at the near side of the pit. Cover the jacking pit with planking if left overnight.

04-20-18

87-1.03B(4) Conduit Installation by Horizontal Directional Drilling Method

Install a conduit to a minimum depth of 4 feetand maximum depth of 6 feet. If you must install a conduit less than 4 feet in depth or greater than 6 feet in depth, the installation must be authorized.

The diameter of the bore hole must be no larger than 1.5 times the outside diameter of the conduit.

Water-based mineral slurry or wetting solution may be used to lubricate the boring tool and stabilize the soil surrounding the boring path.

Disposal of residue must comply with section 13-4.03D.

The horizontal directional drilling equipment must have directional control of the boring tool and have an electronic boring tool location detection system. During operation, the equipment must be able to determine the location of the tool both horizontally and vertically.

Do not use slurry cement backfill.

Use a mandrel to prove the conduit is free and clear of dirt, rocks, and other debris after installation.

07-21-17

87-1.03B(5) Conduit Installation by the Jack and Drill Method

04-15-16

Keep the jacking or drilling pit 2 feet away from the pavement's edge. Do not weaken the pavement or soften the subgrade with excessive use of water.

If an obstruction is encountered, obtain authorization to cut small holes in the pavement to locate or remove the obstruction.

You may install Type 2 or Type 3 conduit under the pavement if a hole larger than the conduit's diameter is predrilled. The predrilled hole must be less than one and half the conduit's diameter.

Remove the conduit used for drilling or jacking and install new conduit for the completed work.

87-1.03B(6) Conduit Installation by the Trenching-In-Pavement Method

Install conduit by the trenching-in-pavement method using a trench approximately 2 inches wider than the conduit's outside diameter but not exceeding 6 inches in width.

Where additional pavement is to be placed, you must complete the trenching before the final pavement layer is applied.

If the conduit shown is to be installed under the sidewalk, you may install it in the street within 3 feet of and parallel to the face of the curb. Install pull boxes behind the curb.

Cut the trench using a rock-cutting excavator. Minimize the shatter outside the removal area of the trench.

Dig the trench by hand to the required depth at pull boxes.

Place conduit in the trench.

Backfill the trench with minor concrete to the pavement's surface by the end of each work day. If the trench is in asphalt concrete pavement and no additional pavement is to be placed, backfill the top 0.10 foot of the trench with minor HMA within 3 days after trenching.

87-1.03C Installation of Pull Boxes

87-1.03C(1) General

Install pull boxes no more than 200 feet apart.

You may install larger pull boxes than specified or shown and additional pull boxes to facilitate the work except in structures.

Install a pull box on a bed of crushed rock and grout it before installing conductors. The grout must be from 0.5 to 1 inch thick and sloped toward the drain hole. Place a layer of roofing paper between the grout and the crushed rock sump. Make a 1-inch drain hole through the grout at the center of the pull box.

Set the pull box such that the top is 1-1/4 inches above the surrounding grade in unpaved areas and leveled with the finished grade in sidewalks and other paved areas.

Place the cover on the box when not working in it.

Grout around conduits that are installed through the sides of the pull box.

Bond and ground the metallic conduit before installing conductors and cables in the conduit.

Bond metallic conduits in a nonmetallic pull box using bonding bushings and bonding jumpers.

Do not install pull boxes in concrete pads, curb ramps, or driveways.

Reconstruct the sump of a pull box if disturbed by your activities. If the sump was grouted, remove and replace the grout.

87-1.03C(2) Nontraffic Pull Boxes

04-20-18

For buried pull boxes, install the electronic marker.

04-15-16

If you bury a nontraffic pull box, set the box such that the top is 6 to 8 inches below the surrounding grade. Place a 20-mil-thick plastic sheet made of HDPE or PVC virgin compounds to prevent water from entering the box.

Place mortar between a nontraffic pull box and a pull box extension.

Where a nontraffic pull box is in the vicinity of curb in an unpaved area, place the box adjacent to the back of the curb if practical.

07-21-17

Where a nontraffic pull box is adjacent to a post or standard, place the box within 5 feet downstream from traffic if practical.

04-15-16

If you replace the cover on a nontraffic pull box, anchor it to the box.

04-20-18

Perform the electronic marker test.

04-15-16

87-1.03C(3) Traffic Pull Boxes

Place minor concrete around and under a traffic pull box.

Bolt the steel cover to the box when not working in it.

Bond the steel cover to the conduit with a jumper and bolt it down after installing the conductors and cables.

87-1.03C(4) Structure Pull Boxes

Bond metallic conduit in a metal pull box in a structure using locknuts, inside and outside of the box, bonding bushings, and bonding jumpers connected to bonding wire running in the conduit system.

04-20-18

87-1.03C(5) Tamper-Resistant Pull Boxes

Install the tamper-resistant pull boxes under the manufacturer's instructions.

04-15-16
04-20-18

87-1.03D Battery Backup System Cabinets

Install the battery backup system cabinet to the right of the Model 332L cabinet.

If installation on the right side is not feasible, obtain authorization for installation on the left side.

Provide access for power conductors between the cabinets using:

1. 2-inch nylon-insulated, steel chase nipple
2. 2-inch steel sealing locknut
3. 2-inch nylon-insulated, steel bushing

Remove the jumper between the terminals labeled *BBS-1* and *BBS-2* in the 5 position terminal block in the controller cabinet before connecting the Department-furnished electronics assembly.

04-15-16

87-1.03E Excavating and Backfilling for Electrical Systems

87-1.03E(1) General

Notify the Engineer at least 72 hours before starting excavation activities.

Dispose of surplus excavated material.

Restrict closures for excavation on a street or highway to 1 lane at a time unless otherwise specified.

87-1.03E(2) Trenching

07-21-17

Dig a trench for the electrical conduits. Do not excavate until the installation of the conduit.

04-15-16

Place excavated material in a location that will not interfere with traffic or surface drainage.

07-21-17

After placing the conduit, backfill the trench with the excavated material.

04-15-16

Compact the backfill placed within the hinge points and in areas where pavement is to be constructed to a minimum relative compaction of 95 percent.

Restore the sidewalks, pavement, and landscaping at a location before starting excavation at another location.

87-1.03E(3) Concrete Pads, Foundations, and Pedestals

Construct foundations for standards, poles, metal pedestals, and posts under section 56-3.

Construct concrete pads, foundations, and pedestals for controller cabinets, telephone demarcation cabinets, and service equipment enclosures on firm ground.

Install anchor bolts using a template to provide proper spacing and alignment. Moisten the forms and ground before placing the concrete. Keep the forms in place until the concrete sets for at least 24 hours to prevent damage to the surface.

Use minor concrete for pads, foundations, and pedestals.

In unpaved areas, place the top of the foundation 6 inches above the surrounding grade, except place the top:

1. 1 foot 6 inches above the grade for Type M and 336L cabinets
2. 1 foot 8 inches above the grade for Type C telephone demarcation cabinets

3. 2 inches above the grade for Type G and Type A cabinets and Type III service equipment enclosures

The pad must be 2 inches above the surrounding grade.

In and adjacent to the sidewalk and other paved areas, place the top of the foundation 4 inches above the surrounding grade, except place the top:

1. 1 foot 6 inches above the grade for Type M and 336L cabinets
2. 1 foot 8 inches above the grade for Type C telephone demarcation cabinets
3. Level with the finished grade for Type G and Type A cabinets and Type III service equipment enclosures

The pad must be level with the finished grade.

Apply an ordinary surface finish under section 51-1.03F.

Allow the foundation to cure for at least 7 days before installing any equipment.

87-1.03F Conductors and Cable Installations

87-1.03F(1) General

The installation of conductors and cables includes splicing conductors and attaching the terminals and connectors to the conductors.

Clean the conduit and pull all conductors and cables as a unit.

If new conductors or cables are to be added in an existing conduit:

1 Remove the content
2. Clean the conduit
3. Pull both old and new conductors and cables as a unit

Wrap conductors and secure cables to the end of the conduit in a pull box.

Seal the ends of conduits with a sealing compound after installing conductors or cables.

Neatly arrange conductors and cables inside pull boxes and cabinets. Tie the conductors and cables together with self-clinching nylon cable ties or enclose them in a plastic tubing or raceway.

Identify conductors and cables by direct labeling, tags, or bands fastened in such a way that they will not move. Use mechanical methods for labeling.

Provide band symbol identification on each conductor or each group of conductors comprising a signal phase in each pull box and near the end of terminated conductors.

Tape the ends of unused conductors and cables in pull boxes to form a watertight seal.

Do not connect the push-button or accessible pedestrian signal neutral conductor to the signal neutral conductor.

04-20-18

Install a continuous tracer throughout the length of the trench.

04-15-16

87-1.03F(2) Cables

87-1.03F(2)(a) General

Reserved

04-20-18

87-1.03F(2)(b) Communication Cables

87-1.03F(2)(b)(i) General

Terminate the ends of the communication cables as shown.

87-1.03F(2)(b)(ii) Category 5E and 6 Cables

Do not splice category 5E and 6 cables between components.

Provide a minimum of 3 feet of slack at each pull box and vault and minimum of 6 feet of slack at the cabinet.

87-1.03F(2)(b)(iii) Telephone Cables

Do not splice telephone cables between the telephone demarcation point and the controller cabinet.

Provide a minimum of 6 feet of slack at each cabinet, including the telephone demarcation cabinet.

04-15-16

87-1.03F(2)(c) Copper Cables

87-1.03F(2)(c)(i) General

Reserved

87-1.03F(2)(c)(ii) Detector Lead-in Cables

Install a Type B or C detector lead-in cable in conduit.

Waterproof the ends of the lead-in cable before installing it in the conduit to prevent moisture from entering the cable.

Splice loop conductors for each direction of travel for the same phase, terminating in the same pull box, to a separate lead-in cable running from the pull box adjacent to the loop detector to a sensor unit mounted in the controller cabinet. Install the lead-in cable without splices except at the pull box when connecting to loop wire.

Verify in the presence of the Engineer that the loops are operational before making the final splices between loop conductors and the lead-in cable.

Identify and tag each lead-in cable with the detector designation at the cabinet and pull box adjacent to the loops.

87-1.03F(2)(c)(iii) Conductors Signal Cables

Do not splice signal cables except for a 28-conductor cable.

Provide identification at the ends of terminated conductors in a cable as shown.

Provide identification for each cable in each pull box showing the signal standard to which it is connected except for the 28-conductor cable.

Connect conductors in a 12-conductor cable as shown in the following table:

12CSC Color Code and Functional Connection

Color code	Termination	Phase
Red	Red signal	2, 4, 6, or 8
Yellow	Yellow signal	2, 4, 6, or 8
Brown	Green signal	2, 4, 6, or 8
Red/black stripe	Red signal	1, 3, 5, or 7
Yellow/black stripe	Yellow signal	1, 3, 5, or 7
Brown/black stripe	Green signal	1, 3, 5, or 7
Black/red stripe	Spare or as required for red or *DONT WALK*	--
Black/white stripe	Spare or as required for yellow	--
Black	Spare or as required for green or *WALK*	--
Red/white stripe	Pedestrian signal *DONT WALK*	--
Brown/white stripe	Pedestrian signal *WALK*	--
White	Terminal block	Neutral

Provide identification for each 28-conductor cable C1 or C2 in each pull box. The cable labeled *C1* must be used for signal phases 1, 2, 3, and 4. The cable labeled *C2* must be used for signal phases 5, 6, 7, and 8.

Connect conductors in a 28-conductor cable as shown in the following table:

28CSC Color Code and Functional Connection

Color code	Termination	Phase
Red/black stripe	Red signal	2 or 6
Yellow/black stripe	Yellow signal	2 or 6
Brown/black stripe	Green signal	2 or 6
Red/orange stripe	Red signal	4 or 8
Yellow/orange stripe	Yellow signal	4 or 8
Brown/orange stripe	Green signal	4 or 8
Red/silver stripe	Red signal	1 or 5
Yellow/silver stripe	Yellow signal	1 or 5
Brown/silver stripe	Green signal	1 or 5
Red/purple stripe	Red signal	3 or 7
Yellow/purple stripe	Yellow signal	3 or 7
Brown/purple stripe	Green signal	3 or 7
Red/2 black stripes	Pedestrian signal *DONT WALK*	2 or 6
Brown/2 black stripes	Pedestrian signal *WALK*	2 or 6
Red/2 orange stripes	Pedestrian signal *DONT WALK*	4 or 8
Brown/2 orange stripes	Pedestrian signal *WALK*	4 or 8
Red/2 silver stripes	Overlap A, C	OLA[a], OLC[a]
Brown/2 silver stripes	Overlap A, C	OLA[c], OLC[c]
Red/2 purple stripes	Overlap B, D	OLB[a], OLD[a]
Brown/2 purple stripes	Overlap B, D	OLB[c], OLD[c]
Blue/black stripe	Pedestrian push button	2 or 6
Blue/orange stripe	Pedestrian push button	4 or 8
Blue/silver stripe	Overlap A, C	OLA[b], OLC[b]
Blue/purple stripe	Overlap B, D	OLB[b], OLD[b]
White/black stripe	Pedestrian push button common	--
Black/red stripe	Railroad preemption	--
Black	Spare	--
White	Terminal block	Neutral

OL = Overlap; A, B, C, and D = Overlapping phase designation
[a]For red phase designation
[b]For yellow phase designation
[c]For green phase designation

Use the neutral conductor only with the phases associated with that cable. Do not intermix neutral conductors from different cables except at the signal controller.

87-1.03F(2)(c)(iv) Signal Interconnect Cable

For a signal interconnect cable, provide a minimum of 6 feet of slack inside each controller cabinet.

Do not splice the cable unless authorized.

If splices are authorized, insulate the conductor splices with heat-shrink tubing and overlap the insulation at least 0.6 inch. Cover the splice area of the cable with heat-shrink tubing and overlap the cable jacket at least 1-1/2 inches. Provide a minimum of 3 feet of slack at each splice.

87-1.03F(3) Conductors

87-1.03F(3)(a) General

Do not run conductors to a terminal block on a standard unless they are to be connected to a signal head mounted on that standard.

Provide 3 spare conductors in all conduits containing ramp metering and traffic signal conductors.

Install a separate conductor for each terminal of a push button assembly and accessible pedestrian signal.

Provide conductor slack to comply with the requirements shown in the following table:

Conductor Slack Requirements

Location	Slack (feet)
Signal standard	1
Lighting standard	1
Signal and lighting standard	1
Pull box	3
Splice	3
Standards with slip base	0

87-1.03F(3)(b) Reserved

87-1.03F(3)(c) Copper Conductors

87-1.03F(3)(c)(i) General

07-21-17

Install a minimum no. 8 grounding copper conductor in conduit and connect it to all-metal components.

04-15-16

Where conductors from different service points occupy the same conduit or standard, enclose the conductors from one of the services in flexible or rigid metal conduit.

87-1.03F(3)(c)(ii) Inductive Loop Conductors

Install a Type 1 or 2 inductive loop conductor except use Type 2 for Type E loop detectors.

Install the conductor without splices except at the pull box.

87-1.03F(4) Manual Installation Method

Use an inert lubricant for placing conductors and cables in conduit.

Pull the conductors and cables into the conduit by hand using pull tape.

04-20-18

87-1.03F(5) Direct Burial Aluminum Cable Installation Method

Install direct burial aluminum cable at a minimum 30 inches below grade in unpaved areas or at a minimum 18 inches below finished grade in paved areas.

Do not splice the direct burial aluminum cable between pull boxes and enclosures.

Fill trench with slurry cement backfill to between 4to 6 inches below finished grade under section 19-3.02E.

Fill the remaining trench to finished grade with native material. In paved area, fill the remaining trench to finished grade with the same material of the paved area.

04-15-16

87-1.03G Equipment Identification Characters

The Engineer provides you with a list of the equipment identification characters.

Stencil the characters or apply the reflective self-adhesive labels to a clean surface.

Treat the edges of self-adhesive characters with an edge sealant.

Place the characters on the side facing traffic on:

1. Front doors of cabinets and service equipment enclosures.
2. Wood poles, fastened with 1-1/4-inch aluminum nails, for pole mounted enclosures
3. Adjacent bent or abutment at approximately the same station as an illuminated sign or soffit luminaire
4. Underside of the structure adjacent to the illuminated sign or soffit luminaire if no bent or abutment exists nearby
5. Posts of overhead signs
6. Standards

Before placing new characters on existing or relocated equipment, remove the existing characters.

04-20-18

For luminaires, place equipment identification character labels outside the unit on the side facing the road. Equipment identification characters consist of:

1. R1 for Roadway 1, R2 for Roadway 2, R3 for Roadway 3, and R4 for Roadway 4
2. Rated wattage

04-15-16

87-1.03H Conductor and Cables Splices

87-1.03H(1) General

You may splice:

1. Grounded conductors in a pull box
2. Accessible pedestrian signal and push bottom conductors in a pull box
3. Ungrounded signal conductors in a pull box if signals are modified
4. Ungrounded signal conductors to a terminal compartment or a signal head on a standard with conductors of the same phase in the pull box adjacent to the standard
5. Ungrounded lighting circuit conductors in a pull box if lighting circuits are modified

07-21-17

Solder all copper conductor splices using the hot iron, pouring, or dipping method. Do not perform open-flame soldering.

04-20-18

Do not solder aluminum conductors.

04-15-16

87-1.03H(2) Splice Insulation Methods

Insulate splices in a multiconductor cable to form a watertight joint and to prevent moisture absorption by the cable.

Use heat-shrink tubing or Method B to insulate a splice.

Use heat-shrink tubing as follows:

1. Cover the splice area completely with an electrical insulating coating and allow it to dry.
2. Place mastic around each conductor before placing them inside the tubing. Use the type of mastic specified in the tubing manufacturer's instructions.
3. Heat the area under the manufacturer's instructions. Do not perform open-flame heating. After contraction, each end of the heat-shrink tubing or the open end of the tubing's end cap must overlap the conductor insulation at least 1-1/2 inches.
4. Cover the entire splice with an electrical insulating coating and allow it to dry.

Use Method B as follows:

1. Cover the splice area completely with an electrical insulating coating and allow it to dry.

04-20-18

2. Apply 3 layers of half-lapped, minimum 60-mils, PVC tape.

04-15-16

3. Apply 2 layers of 120-mils, butyl-rubber, stretchable tape with liner.

04-20-18

4. Apply 3 layers of half-lapped, minimum 6-mils, PVC, pressure-sensitive, adhesive tape.

04-15-16

5. Cover the entire splice with an electrical insulating coating and allow it to dry.

87-1.03I Connectors and Terminals

Apply connectors and terminals to cables and conductors using a crimping compression tool under the manufacturer's instructions. The tool must prevent opening of the handles until the crimp is completed.

Install crimp-style terminal lugs on stranded conductors smaller than no. 14.

07-21-17

Solder no. 8 and smaller copper conductors to connectors and terminal lugs.

04-15-16

87-1.03J Standards, Poles, Pedestals, and Posts

Install standards, poles, pedestals, and posts under section 56-3.

Ground standards with a handhole by attaching a bonding jumper from the bolt or lug inside the standard to a metal conduit or to the grounding wire in the adjacent pull box. The bonding jumper must be visible when the handhole cover is removed.

Ground standards without a handhole or standards with a slip base by attaching a bonding jumper to all anchor bolts using ground clamps and connecting it to a metal conduit or to the grounding wire in the adjacent pull box. The bonding jumper must be visible after mortar has been placed on the foundation.

04-20-18

87-1.03K Piezoelectric Axle Sensors

Obtain authorization for exact locations for installation of the piezoelectric axle sensors.

Cut slots for axle sensors and screened transmission cables under section 87-1.03V(2).

Install the piezoelectric axle sensors in a channel under the manufacturer's instructions. Fill the channel with epoxy grout under section 95-1.02H. The grout must not exceed 165 degrees F while curing. Do not reopen the lane to traffic until the epoxy sets.

Perform the conductor test.

Connect the field wiring to the terminal blocks in the controller cabinet.

Perform the piezoelectric axle sensor test.

Perform the operational test. Failure of the system to record and store data as required for an accumulated time exceeding 3 hours during the 5-day period is cause for the operational test to be rejected and repeated.

04-15-16

87-1.03L Utility Service

87-1.03L(1) General

Install the service equipment early enough to allow the utility to complete its work before completion of the electrical work.

At least 15 days before permanent electrical and telecommunication service is required, request the service connections for permanent installations. The Department arranges with the utilities for completion of the connections and pays all costs and fees required by the utilities.

87-1.03L(2) Electric Service

87-1.03L(2)(a) General

If service equipment is to be installed on a utility-owned pole, furnish and install the conduit, conductors, pull boxes, and other necessary material to complete the service installation. The service utility decides the position of the riser and equipment on the pole.

87-1.03L(2)(b) Electric Service for Irrigation

Establishing electric service for irrigation includes installing conduit, conductors, and pull boxes and making connections from the service point to the irrigation controllers.

87-1.03L(2)(c) Electric Service for Booster Pumps

Establishing electric service for a booster pump includes installing conduit, conductors, and pull boxes and making connections from the service point to the booster pump enclosure.

87-1.03L(3) Telecommunications Service

Establishing telecommunication service includes installing conduit, conductors, and pull boxes and making connections from the service point to the telephone demarcation cabinet.

87-1.03M Photoelectric Controls

Mount the photoelectric unit on the top of the pole for Type I, II, and III photoelectric controls. Use mounting brackets where pole-top mounting is not possible. Orient the photoelectric unit to face north.

Mount the enclosure at a height of 6 feet above finished grade on the same standard as the photoelectric unit.

Install a minimum 100 VA, 480/120 V(ac) transformer in the contactor enclosure to provide 120 V(ac) for the photoelectric control unit when switching 480 V(ac), 60 Hz circuits.

87-1.03N Fused Splice Connectors

04-20-18

Install a fuse splice connector with a fuse:

1. In each ungrounded conductor for luminaires
2 On primary side of transformer when a transformer is installed

07-21-17

The connector must be located in the pull box adjacent to the standard.

04-15-16

Crimp the connector terminals onto the ungrounded conductors using a tool under the manufacturer's instructions. Insulate the terminals and make them watertight.

87-1.03O Grounding Electrodes

Install a grounding electrode for each cabinet, service equipment enclosure, and transformer.

Attach a grounding conductor from the electrode using either a ground clamp or exothermic weld. Connect the other end of the conductor to the cabinet, service equipment enclosure, and transformer.

87-1.03P Service Equipment Enclosures

Installing a service equipment enclosure includes constructing the foundation and pad and installing conduit, adjacent pull boxes, and grounding electrode.

Locate the foundation such that the minimum clearance around the front and back of the enclosure complies with NEC, article 110.26, "Spaces About Electrical Equipment, (600 V, nominal or less)."

Bond and ground metal conduit as specified in NEC and by the service utility except the grounding electrode conductor must be no. 6 or larger.

If circuit breakers and components do not have a description on engraved phenolic nameplates, install them using stainless steel rivets or screws under section 86-1.02P(2).

87-1.03Q Cabinets

87-1.03Q(1) General

Installing a cabinet includes constructing the foundation and pad and installing conduit, adjacent pull boxes, and grounding electrode.

Apply a mastic or caulking compound before installing the cabinet on the foundation to seal the openings.

Connect the field wiring to the terminal blocks in the cabinet. Neatly arrange and lace or enclose the conductors in plastic tubing or raceway. Terminate the conductors with properly sized captive or spring spade terminals. Apply a crimp-style connector and solder them.

Install and solder a spade-type terminal on no. 12 and smaller field conductors and a spade-type or ring-type terminal on conductors larger than no. 12.

87-1.03Q(2) Department-Furnished Controller Cabinets

Arrange for the delivery of Department-furnished controller cabinets.

87-1.03Q(3) Reserved

87-1.03Q(4) Telephone Demarcation Cabinets

Installing a telephone demarcation cabinet includes installing conduit, cable, and pull boxes to the controller cabinet.

Install the cabinet with the back toward the nearest lane of traffic.

87-1.03R Signal Heads

87-1.03R(1) General

Installing a signal head includes mounting the heads on standards and mast arms, installing backplates and visors, and wiring conductors to the terminal blocks.

Keep the heads covered or direct them away from traffic until the system is ready for operation.

87-1.03R(2) Signal Faces

Use the same brand and material for the signal faces at each location.

Program the programmable visibility signal faces under the manufacturer's instructions. The indication must be visible only in those areas or lanes to be controlled.

87-1.03R(3) Backplates

Install backplates using at least six 10-24 or 10-32 self-tapping and locking stainless steel machine screws and flat washers.

If a plastic backplate requires field assembly, attach each joint using at least four no.10 machine screws. Each machine screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and either a locking nut with an integral or captive flat washer or a nut, flat washer, and lock washer. Machine screws, nuts, and washers must be stainless steel or steel with a zinc or black oxide finish.

If a metal backplate has 2 or more sections, fasten the sections with rivets or aluminum bolts peened after assembly to avoid loosening.

Install the backplate such that the background light is not visible between the backplate and the signal face or between sections.

87-1.03R(4) Signal Mounting Assemblies

Install a signal mounting assembly such that its members are arranged symmetrically and plumb or level. Orient each mounting assembly to allow maximum horizontal clearance to the adjacent roadway.

For a bracket-mounted assembly, bolt the terminal compartment or pole plate to the pole or standard.

In addition to the terminal compartment mounting, attach the upper pipe fitting of Type SV-1-T with 5 sections or a SV-2-TD to the standard or pole using the mounting detail for signal heads without a terminal compartment.

Use a 4-1/2-inch slip fitter and set screws to mount an assembly on a post top.

After installing the assembly, clean and paint the exposed threads of the galvanized conduit brackets and bracket areas damaged by the wrench or vise jaws. Use a wire brush to clean and apply 2 coats of unthinned, organic zinc-rich primer. Do not use an aerosol can to apply the primer.

Install the conductors in the terminal compartment and secure the cover.

87-1.03S Pedestrian Signal Heads

Installing a pedestrian signal head includes mounting the heads on standards and wiring conductors to the terminal blocks.

Install the pedestrian signal mounting assembly under section 87-1.03R(4).

Use the same brand and material for the pedestrian signal faces at each location.

Install a pedestrian signal face such that its members are arranged symmetrically and plumb or level.

87-1.03T Accessible Pedestrian Signals

Use the same brand for the accessible pedestrian signals at each location.

Install an accessible pedestrian signal and the R10 series sign on the crosswalk side of the standard.

Attach the accessible pedestrian signal to the standard with self-tapping screws.

Attach the sign to the standard using 2 straps and saddle brackets.

Point the arrow on the accessible pedestrian signal in the same direction as the corresponding crosswalk.

Furnish the equipment and hardware to set up and calibrate the accessible pedestrian signal.

Arrange to have a manufacturer's representative at the job site to program the accessible pedestrian signal with an audible message or tone.

87-1.03U Push Button Assemblies

Install the push button assembly and the R10 series sign on the crosswalk side of the standard.

Attach the sign to the assembly for Type B assemblies.

Attach the sign to the standard using 2 straps and saddle brackets for Type C assemblies.

You may use straps and saddle brackets to secure the push button to the standard.

Use a slip fitter to secure the assembly on top of a 2-1/2-inch-diameter post.

87-1.03V Detectors

87-1.03V(1) General

Installing a detector includes installing inductive loop conductors, sealant, conduit, and pull boxes.

Center the detectors in the traffic lanes.

Do not splice the detector conductor.

87-1.03V(2) Inductive Loop Detectors

Mark the location of the inductive loop detectors such that the distance between the side of the loop and a lead-in saw cut from an adjacent detector is at least 2 feet. The distance between lead-in saw cuts must be at least 6 inches.

Saw cut the slots under section 13-4.03E(7). The bottoms of the slots must be smooth with no sharp edges. For Type E detector loops, saw the slots such that the sides are vertical.

Wash the slots clean using water and blow dry them with compressed air to remove all moisture and debris.

Identify the start of the conductor.

Waterproof the ends of a Type 2 loop conductor before installing it in the conduit to prevent moisture from entering the cable.

Install the loop conductor in the slots and lead-in saw cuts using a 3/16- to 1/4-inch-thick wood paddle. Hold the conductors in place at the bottom of the slot with wood paddles during placement of the sealant.

Wind adjacent loops on the same sensor unit channel in opposite directions.

Twist the conductors for each loop into a pair consisting of a minimum of 2 turns per foot before placing them in the lead-in saw cut and the conduit leading to the pull box. Do not install more than 2 twisted pairs of conductors per lead-in saw cut.

Provide 5 feet of slack in the pull box.

Test each loop for continuity, circuit resistance, and insulation resistance before filling the slots with sealant.

Remove excess sealant from the adjacent road surface before it sets. Do not use solvents to remove the excess.

Identify the loop conductor pair in the pull box, marking the start with the letter *S* and the end with the letter *F*. Band conductors in pairs by lane in the pull box adjacent to the loops and in the cabinet. Identify each pair with the detector designation and loop number.

Install the conductors in a compacted layer of HMA immediately below the uppermost layer if more than one layer will be placed. Install the loop conductors before placing the uppermost layer of HMA. Fill the slot with a sealant flush to the surface.

Install the conductors in the existing pavement if one layer of HMA is to be placed. Install the loop conductors before placing the layer of HMA. Fill the slot with a sealant flush to the surface.

87-1.03V(3) Preformed Inductive Loop Detectors

04-20-18

Install a preformed inductive loop detector consisting of 4 turns in the loop and a lead-in conductor pair twisted at least 2 turns per foot all encased in conduit and sealed to prevent water penetration. The detector must be 6-foot square unless shown otherwise.

Construct the loop detector using a minimum 3/8-inch Schedule 40 or Schedule 80 PVC or polypropylene conduit and no. 16 or larger conductor with Type THWN insulation.

04-15-16

In new roadways, place the detector in the base course with the top of the conduit flush with the top of the base. Cover with HMA or concrete pavement. Protect the detector from damage before and during pavement placement.

In new reinforced concrete bridge decks, secure the detector to the top of the uppermost layer of reinforcing steel using nylon wire ties. Hold the detector parallel to the bridge deck using PVC or polypropylene spacers where necessary. Place conduit for lead-in conductors between the uppermost 2 layers of reinforcing steel.

Do not install detectors in existing bridge decks unless authorized.

Install a detector in existing pavement before placement of concrete or HMA as follows:

04-20-18

1. Saw cut slots at least 1-1/4 inches wide into the pavement.

04-15-16

2. Place the detector in the slots. The top of the conduit must be at least 2 inches below the top of the pavement.
3. Test each loop circuit for continuity, circuit resistance, and insulation resistance.
4. Fill saw cuts with elastomeric or hot melt rubberized asphalt sealant for asphalt concrete pavement and with epoxy sealant or hot melt rubberized asphalt sealant for concrete pavement.

87-1.03W Sealants

87-1.03W(1) General

Reserved

87-1.03W(2) Elastomeric Sealant

Apply an elastomeric sealant with a pressure feed applicator.

87-1.03W(3) Asphaltic Emulsion Sealant

Asphaltic emulsion sealant must:

1. Be used for filling slots in asphalt concrete pavement of a maximum width of 5/8 inch
2. Not be used on concrete pavement or where the slope causes the material to run from the slot
3. Be thinned under the manufacturer's instructions
4. Be placed when the air temperature is at least 45 degrees F

87-1.03W(4) Hot-Melt Rubberized Asphalt Sealant

Melt the sealant in a jacketed, double-boiler-type, melting unit. The temperature of the heat transfer medium must not exceed 475 degrees F.

Apply the sealant with a pressure feed applicator or a pour pot when the surface temperature of the pavement is greater than 40 degrees F.

87-1.03X Reserved

87-1.03Y Transformers

Installing a transformer includes placing the transformer inside a pull box, a cabinet, or an enclosure.

Wire the transformer for the appropriate voltage.

Ground the secondary circuit of the transformer as specified in the NEC.

87-1.03Z Reserved

87-1.04 PAYMENT

Not Used

87-2 LIGHTING SYSTEMS

87-2.01 GENERAL

87-2.01A Summary

Section 87-2 includes specifications for constructing lighting systems.

Lighting system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Luminaires
7. Service equipment enclosure
8. Photoelectric control
9. Fuse splice connectors
10. High mast lighting assemblies

The components of a lighting system are shown on the project plans.

87-2.01B Definitions

Reserved

87-2.01C Submittals

Submit a certificate of compliance and test data for the high mast lighting luminaires.

87-2.01D Quality Assurance

Reserved

87-2.02 MATERIALS

87-2.02A General

Reserved

87-2.02B High Mast Lighting Assemblies

A high mast lighting assembly includes the foundation, pole, lowering device system, luminaires, and control pedestal.

Each luminaire in a high mast lighting assembly must include a housing, an optical system, and a ballast.

The housing must be made of aluminum.

A painted or powder-coated housing for a high mast lighting luminaire must be able to withstand a 1,000-hour salt spray test as specified in ASTM B117.

The optical system, consisting of the reflector, refractor or lens, lamp socket, and lamp, must be in a sealed chamber. The chamber must be sealed by a gasket between the reflector and refractor or lens and a gasket between the reflector and lamp socket. The chamber must have a separate filter or filtering gasket for flow of air.

An asymmetrical luminaire must have a refractor or reflector that is rotatable 360 degrees around a vertical axis to orient the distribution of light.

The luminaire must have a slip fitter for mounting on a 2-inch horizontal pipe tenon and must be adjustable ±3 degrees from the axis of the tenon.

The reflector must have a specular surface made of silvered glass or aluminum protected by either an anodized finish or a silicate film. The reflector must be shaped such that a minimum of light is reflected through the arc tube of the lamp.

The refractor and lens must be made of heat-resistant glass.

The lamp socket must be a porcelain-enclosed, mogul-multiple type. The shell must contain integral lamp grips to ensure electrical contact under conditions of normal vibrations. The socket must be rated for 1,500 W, 600 V(ac) and 4,000 V(ac) pulse for a 400 W lamp and 5,000 V(ac) pulse for a 1,000 W lamp.

The luminaire must have a dual fuse holder for 2 fuses rated at 5 A, 480 V(ac). The fuses must be 13/32 inch by 1-1/2 inches, standard midget ferrule type with a nontime-delay feature.

The lamps must be vertical burning, protected from undue vibration, and prevented from backing out of the socket by a stainless steel clamp attached to the luminaire.

A 1,000 W metal halide lamp must have an initial output of 100,000 lumens and an average rated life of 12,000 hours based on 10 hours per start.

A 400 W high-pressure sodium lamp must have an initial output of 50,000 lumens. A 1,000 W high-pressure sodium lamp must have an initial output of 140,000 lumens.

The ballast for the luminaire must be a regulator type and have a core and coils, capacitors, and starting aid.

Ballast must be:

1. Mounted within a weatherproof housing that integrally attaches to the top of a luminaire support bracket and lamp support assembly
2. Readily removable without removing the luminaire from the bracket arm
3. Electrically connected to the optical assembly by a prewired quick disconnect

The ballast for a metal halide luminaire must comply with luminaire manufacturer's specifications.

The wattage regulation spread at any lamp voltage, from nominal through the life of the lamp, must vary no more than 22 percent for a 1,000 W lamp and a ±10 percent input voltage variation. The ballast's starting line current must be less than its operating current.

87-2.02C Soffit and Wall-Mounted Luminaires

87-2.02C(1) General

Soffit and wall-mounted luminaires must be weatherproof and corrosion resistant.

Each luminaire must include a 70 W high-pressure sodium lamp with a minimum average rated life of 24,000 hours. The lamp socket must be positioned such that the light center of the lamp is located within 1/2 inch of the designed light center of the luminaire.

Luminaire wiring must be SFF-2.

Flush-mounted soffit luminaire must have:

1. Metal body with two 1-inch-minimum conduit hubs and a means of anchoring the body into the concrete
2. Prismatic refractor made of heat-resistant polycarbonate:
   2.1. Mounted in a door frame
   2.2. With the street side identified
3. Aluminum reflector with a specular anodized finish
4. Ballast located either within the housing or in a ceiling pull box if shown
5. Lamp socket

The door frame assembly must be hinged, gasketed, and secured to the luminaire body with at least 3 machine screws.

A pendant soffit luminaire must be enclosed and gasketed and have an aluminum finish. Luminaire must have:

1. Aluminum reflector with a specular anodized finish
2. Refractor made of heat-resistant polycarbonate
3. Optical assembly that is hinged and latched for lamp access and a device to prevent dropping
4. Ballast designed for operation in a raintight enclosure
5. Galvanized metal box with a gasketed cover, 2 captive screws, and 2 chains to prevent dropping and for luminaire mounting

Wall-mounted luminaire must have:

1. Cast metal body
2. Prismatic refractor:
   2.1. Made of glass
   2.2. Mounted in a door frame
3. Aluminum reflector with a specular anodized finish
4. Integral ballast
5. Lamp socket
6. Gasket between the refractor and the body
7. At least 2 mounting bolts of minimum 5/16-inch diameter

A cast aluminum body of a luminaire to be cast into or mounted against concrete must have a thick coat of alkali-resistant bituminous paint on all surfaces to be in contact with the concrete.

87-2.02C(2) High-Pressure Sodium Lamp Ballasts

87-2.02C(2)(a) General

A high-pressure sodium lamp ballast must operate the lamp for its rated wattage.

Starting aids for a ballast must be interchangeable between ballasts of the same wattage and manufacturer without adjustment.

The ballast must be provided with a heat-generating component to serve as a heat sink. The capacitor must be placed at the maximum practicable distance from the heat-generating components or thermally shielded to limit the case temperature to 75 degrees C.

The transformer and inductor must be resin impregnated for protection against moisture. Capacitors, except for those in starting aids, must be metal cased and hermetically sealed.

The ballast must have a power factor of 90 percent or greater.

For the nominal input voltage and lamp voltage, the ballast design center must not vary more than 7.5 percent from the rated lamp wattage.

87-2.02C(2)(b) Regulator-Type Ballasts

A regulator-type ballast must be designed such that a capacitance variance of ±6 percent does not cause more than ±8 percent variation in the lamp wattage regulation.

The ballast must have a current crest factor not exceeding 1.8 for an input voltage variation of ±10 percent.

The lamp wattage regulation spread for a lag-type ballast must not vary by more than 18 percent for ±10 percent input voltage variations. The primary and secondary windings must be electrically isolated.

The lamp wattage regulation spread for a constant-wattage, autoregulator, lead-type ballast must not vary by more than 30 percent for ±10 percent input voltage variations.

87-2.02C(2)(c) Nonregulator-Type Ballasts

A nonregulator-type ballast must have a current crest factor not exceeding 1.8 for an input voltage variation of ±5 percent.

The lamp wattage regulation spread for an autotransformer or high reactance type ballast must not vary by more than 25 percent for ±5 percent input voltage variations.

87-2.03 CONSTRUCTION

87-2.03A General

Set the foundations for standards such that the mast arm is perpendicular to the centerline of the roadway.

Tighten the cap screws of the luminaire's clamping bracket to 10 ft-lb for LED and low-pressure luminaires.

Label the month and year of the installation inside the luminaire housing's door.

Perform the conductor and operational tests for the system.

87-2.03B High Mast Lighting Assemblies

Mount and connect the luminaires to the accessory support ring. Aim the asymmetrical luminaire to orient the distribution of light.

87-2.03C Soffit and Wall-Mounted Luminaires

For a flush-mounted soffit luminaire:

1. Prevent concrete from getting into the housing during pouring of the concrete for the structure
2. Install the luminaire with the axis vertical and the street side of the refractor oriented as indicated
3. Locate the luminaire to provide a minimum 2-foot clearance from the inside surface of the girders and 1-foot clearance from the near face of the diaphragm
4. Install the bridge soffit and ceiling pull box over the same lane

For a pendant soffit luminaire:

1. Cast in place the inserts for the no. 8 pull box during concrete placement for a new structure
2. Drill holes for expansion anchors to support the no. 8 pull box on existing structures
3. Bond the suspension conduit and luminaire to the pull box

For a wall-mounted luminaire, provide:

1. Extension junction box or ring on a new structure
2. 4 external mounting taps on an existing structure

Place the soffits or wall-mounted luminaires in operation as soon as practicable after the falsework has been removed from the structure.

If the Engineer orders soffit or wall-mounted luminaires to be activated before permanent power service is available, installing and removing the temporary power service is change order work.

87-2.04 PAYMENT

Not Used

87-3 SIGN ILLUMINATION SYSTEMS

87-3.01 GENERAL

87-3.01A Summary

Section 87-3 includes specifications for constructing sign illumination systems.

Sign illumination system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Sign lighting fixtures
6. Enclosure for the disconnect circuit breaker
7. Service equipment enclosure
8. Photoelectric control

The components of a sign illumination system are shown on the project plans.

87-3.01B Definitions

Reserved

87-3.01C Submittals

Submit the manufacturer's test data for the induction sign-lighting fixtures.

87-3.01D Quality Assurance

Reserved

87-3.02 MATERIALS

An induction sign-lighting fixture must include a housing with a door, reflector, refractor or lens, lamp, socket assembly, power coupler, high-frequency generator, fuse block, and fuses.

The fixture must comply with the isofootcandle curves as shown.

Fixture must weigh no more than 44 lb, be rated for 87 W at 120/240 V(ac), and have a mounting assembly made of one of the following materials:

1. Cast aluminum
2. Hot-dip galvanized steel plate
3. Galvanized steel plate finished with one of the following:
   3.1. Polymeric coating
   3.2. Same finish used for the housing

Housing must:

1. Be corrosion resistant and suitable for wet locations
2. Be above the top of the mounting rails at a maximum height of 12 inches
3. Have weep holes

Door must:

1. Hold a refractor or lens
2. Open without the use of special tools
3. Have a locking position at 50 degrees minimum from the plane of the door opening
4. Be hinged to the housing on the side of the fixture away from the sign panel
5. Have 2 captive latch bolts or other latching device

When the door is opened, it must lock in the 50 degrees position when an 85 mph, 3-second wind-gust load strikes the door from either side.

The housing and door must be manufactured of sheet or cast aluminum and have a gray powder coat or polyester paint finish. The sheet aluminum must comply with ASTM B209 or B209M for 5052-H32 aluminum sheet. External bolts, screws, hinges, hinge pins, and door closure devices must be corrosion resistant.

The housing and door must be gasketed. The thickness of the gasket must be a minimum of 1/4 inch.

Reflector must not be attached to the outside of the housing and must be:

1. Made of a single piece of aluminum with a specular finish
2. Protected with an electrochemically applied anodized finish or a chemically applied silicate film
3. Designed to drain condensation away from it
4. Secured to the housing with a minimum of 2 screws
5. Removable without removing any fixture parts

Refractor or lens must have a smooth exterior and must be manufactured from the materials shown in the following table:

Refractor and Lens Material Requirements

Component	Material
Flat lens	Heat-resistant glass
Convex lens	Heat-resistant, high-impact-resistant tempered glass
Refractor	Borosilicate heat-resistant glass

The refractor and convex lens must be designed or shielded such that no luminance is visible if the fixture is approached directly from the rear and viewed from below. If a shield is used, it must be an integral part of the door casting.

Lamp must:

1. Be an 85 W induction type with a fluorescent, phosphor-coated, interior wall
2. Have a minimum 70 percent light output of its original lumen output after 60,000 hours of operation
3. Have a minimum color-rendering index of 80
4. Be rated at a color temperature of 4,000K
5. Be removable with common hand tools

The lamp socket must be rated for 1,500 W and 600 V(ac) and be a porcelain-enclosed mogul type with a shell that contains integral lamp grips to ensure electrical contact under normal vibration conditions. The shell and center contact must be made of nickel-plated brass. The center contact must be spring loaded.

The power coupler must be removable with common hand tools.

High-frequency generator must:

1. Start and operate lamps at an ambient temperature of -25 degrees C or greater for the rated life of the lamp
2. Operate continuously at ambient air temperatures from -25 to 55 degrees C without a reduction in the generator life
3. Have a design life of at least 100,000 hours at 55 degrees C
4. Have an output frequency of 2.65 MHz ± 10 percent
5. Have radio frequency interference that complies with 47 CFR 18 regulations regarding harmful interference
6. Have a power factor greater than 90 percent and total harmonic distortion less than 10 percent

The high frequency generator must be mounted such that the fixture can be used as a heat sink and be replaceable with common hand tools.

Each fixture must include a barrier-type fuse block for terminating field connections. Fuse block must:

1. Be rated 600 V(ac)
2. Have box terminals
3. Be secured to the housing and accessible without removal of any fixture parts
4. Be mounted to leave a minimum of 1/2 inch of air space from the sidewalls of the housing
5. Be designed for easy removal of fuses with a fuse puller

The fixture's fuses must be 13/32-inch-diameter, 1-1/2-inch-long ferrule type and UL listed or NRTL certified. For a 120 V(ac) fixture, only the ungrounded conductor must be fused and a solid connection must be provided between the grounded conductor and the high frequency generator.

The fixture must be permanently marked with the manufacturer's brand name, trademark, model number, serial number, and date of manufacture on the inside and outside on the housing. The same information must be marked on the package.

If a wire guard is used, it must be made of a minimum 1/4-inch-diameter galvanized steel wire. The wires must be spaced to prevent rocks larger than 1-1/2-inch diameter from passing through the guard. The guard must be either hot-dip galvanized or electroplated zinc-coated as specified in ASTM B633, service condition SC4, with a clear chromate dip treatment.

87-3.03 CONSTRUCTION

Perform the conductor and operational tests for the system.

87-3.04 PAYMENT

Not Used

87-4 SIGNAL AND LIGHTING SYSTEMS

87-4.01 GENERAL

87-4.01A Summary

Section 87-4 includes specifications for constructing signal and lighting systems.

Signal and lighting system includes:

1. Foundations
2. Pull boxes
3. Conduit

04-20-18

4. Conductors and cables
5. Standards
6. Signal heads
7. Internally illuminated street name signs
8. Service equipment enclosure
9. Department-furnished controller assembly
10. Detectors
11. Telephone demarcation cabinet
12. Accessible pedestrian signals
13. Push button assemblies
14. Pedestrian signal heads
15. Luminaires
16. Photoelectric control
17. Fuse splice connectors
18. Battery backup system
19. Flashing beacons
20. Flashing beacon control assembly

04-15-16

The components of a signal and lighting system are shown on the project plans.

87-4.01B Definitions

Reserved

87-4.01C Submittals

Submit shop drawings showing the message for each internally illuminated street sign, including the size of letters, symbols, and arrows.

87-4.01D Quality Assurance

87-4.01D(1) General

Reserved

87-4.01D(2) Quality Control

87-4.01D(2)(a) General

Reserved

87-4.02 MATERIALS

87-4.02A General

Reserved

87-4.02B Reserved

87-4.02C Internally Illuminated Street Name Signs

An internally illuminated street name sign includes housing, brackets, sign panels, gaskets, ballast, lampholder, terminal blocks, conductors, and fuses.

An internally illuminated street sign must be designed and constructed to prevent deformation or failure when subjected to an 85 mph, 3-second wind-gust load as specified in the AASHTO publication, "Standard Specifications for Structural Supports of Highway Signs, Luminaires and Traffic Signals."

Sign must:

1. Be Types A or B
2. Have galvanized or cadmium-plated ferrous parts
3. Have screened weep holes
4. Have fasteners, screws, and hardware made of passive stainless steel, Type 302 or 304, or aluminum Type 6060-T6
5. Operate at a temperature from -20 to 74 degrees C

Photoelectric unit sockets are not allowed.

The housing must be constructed to resist torsional twist and warp. The housing must be designed such that opening or removing the panels provides access to the interior of the sign for lamp, ballast, and fuse replacement.

The top and bottom of the sign must be manufactured from formed or extruded aluminum and attached to formed or cast aluminum end fittings. The top, bottom, and end fittings must form a sealed housing.

For a Type A sign, both sides of the sign must be hinged at the top to allow installation or removal of the sign panel.

For a Type B sign, the sign panel must be slide mounted into the housing.

The top of the housing must have 2 free-swinging mounting brackets. Each bracket must be vertically adjustable for leveling the sign to either a straight or curved mast arm. The bracket assembly must allow the lighting fixture to swing perpendicular to the sign panel.

The reflectors must be formed aluminum and have an acrylic, baked-white-enamel surface with a minimum reflectance of 0.85.

Sign panel must be translucent, high-impact-resistant, and made of one of the following plastic materials:

1. Glass-fiber-reinforced, acrylated resin

2. Polycarbonate resin
3. Cellulose acetate butyrate

The sign panel must be designed not to crack or shatter if a 1-inch-diameter steel ball weighing 2.4 ounces is dropped from a height of 8.5 feet above the sign panel to any point on the panel. For this test, the sign panel must be lying in a horizontal position and supported within its frame.

The sign panel's surface must be evenly illuminated. The brightness measurements for the letters must be a minimum of 150 foot-lamberts, average. The letter-to-background brightness ratio must be from 10:1 to 20:1. The background luminance must not vary by more than 40 percent from the average background brightness measurement. The luminance of letters, symbols, and arrows must not vary by more than 20 percent from their average brightness measurement.

The sign panel's white or green color must not fade or darken if exposed to an accelerated test of UV light equivalent to 2 years of outdoor exposure.

The sign panel's legend, symbols, arrows, and border on each face must be white on a green background. The background must comply with color no. 14109 of FED-STD-595.

The message must appear on both sides of the sign and be protected from UV radiation. The letters must be 8-inch upper case and 6-inch lower case, series E.

A Type A sign must have a closed-cell, sponge-neoprene gasket installed between the sign panel frame to prevent the entry of water. The gasket must be uniform and even textured.

The sign ballast must be a high-power-factor type for outdoor operation from 110 to 125 V(ac) and 60 Hz and must comply with ANSI C82.1 and C82.2.

The ballast for a Type A sign must be rated at 200 mA. The ballast for a Type B sign must be rated at 430 mA.

Sign lampholder must:

1. Be the spring-loaded type
2. Have silver-coated contacts and waterproofed entrance leads
3. Have a heat-resistant, circular cross section with a partially recessed neoprene ring

Removal of the lamp from the socket must de-energize the primary of the ballast.

The springs for the lampholders must not be a part of the current-carrying circuit.

The sign's wiring connections must terminate on a molded, phenolic, barrier-type, terminal block rated at 15 A, 1,000 V(ac). The connections must have a white, integral, waterproof marking strip. The terminal screws must not be smaller than a no. 10.

The terminal block must be insulated from the fixture to provide protection from the line-to-ground flashover voltage.

A sectionalized terminal block must have an integral barrier on each side and must allow rigid mounting and alignment.

Fixture's conductors must:

1. Be stranded copper wire with a minimum thermoplastic insulation of 28 mils
2. Be rated at 1,000 V(ac) and for use up to 90 degrees C
3. Be a minimum of no. 16
4. Match the color coding of the ballast leads
5. Be secured with spring cross straps, installed 12 inches apart or less in the chassis or fixture

Stranded copper conductors connected to screw-type terminals must terminate in crimp-type ring connectors.

No splicing is allowed within the fixture.

The sign's fuse must be the Type 3AG, miniature, slow-blow type.

The fuse holder must be a panel-mounting type with a threaded or bayonet knob that grips the fuse tightly for extraction. Each ballast must have a separate fuse.

87-4.03 CONSTRUCTION

87-4.03A General

Set the foundations for standards such that the mast arm is perpendicular to the centerline of the roadway.

Tighten the cap screws of the luminaire's clamping bracket to 10 ft-lb for LED and low-pressure luminaires.

Label the month and year of the installation inside the luminaire housing's door.

Perform the conductor and operational tests for the system.

87-4.03B Reserved

87-4.03C Internally Illuminated Street Name Signs

Mount the internally illuminated street name sign to the signal mast arm using the adjustable brackets. Connect the conductors to the terminal blocks in the signal head mounting terminal block.

87-4.04 PAYMENT

Not Used

87-5 RAMP METERING SYSTEMS

87-5.01 GENERAL

Section 87-5 includes specifications for constructing ramp metering systems.

Ramp metering system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Signal heads
7. Service equipment enclosure
8. Department-furnished controller assembly
9. Detectors
10. Telephone demarcation cabinet

The components of a ramp metering system are shown on the project plans.

87-5.02 MATERIALS

Not Used

87-5.03 CONSTRUCTION

Connect the field wiring to the terminal blocks in the controller cabinet. The Engineer provides you a list of field conductor terminations for each controller cabinet.

Perform the conductor and operational tests for the system.

87-5.04 PAYMENT

Not Used

87-6 TRAFFIC MONITORING STATION SYSTEMS

87-6.01 GENERAL

Section 87-6 includes specifications for constructing traffic monitoring station systems.

Traffic monitoring station system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Cables
5. Conductors
6. Service equipment enclosure
7. Controller cabinet
8. Detectors
9. Telephone demarcation cabinet

The components of a traffic monitoring station system are shown on the project plans.

87-6.02 MATERIALS

Not Used

87-6.03 CONSTRUCTION

Connect the field wiring to the terminal blocks in the controller cabinet. The Engineer provides you a list of field conductor terminations for the controller cabinet.

Perform the conductor and operational tests for the system.

87-6.04 PAYMENT

Not Used

87-7 FLASHING BEACON SYSTEMS

87-7.01 GENERAL

Section 87-7 includes specifications for constructing flashing beacon systems.

Flashing beacon system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors
5. Standards
6. Service equipment enclosure
7. Signal heads
8. Flashing beacon control assembly

The components of a flashing beacon system are shown on the project plans.

The flash rate for the flashing beacon must comply with chapter 4L, "Flashing Beacons," of the *California MUTCD*.

The flashing beacon must allow alternating flashing wig-wag operation.

The flashing beacon must have a separate flasher unit installed in the flashing beacon control assembly.

87-7.02 MATERIALS

Flashing beacon control assembly must:

1. Have a NEMA 3R enclosure with a dead front panel and a hasp with a 7/16-inch hole for a padlock. The enclosure must have one of the following finishes:
   1.1. Powder coating.
   1.2. Hot-dip galvanized coating.
   1.3. Factory-applied, rust-resistant prime coat and finish coat.
2. Have barrier-type terminal blocks rated for 25 A, 600 V(ac), made of molded phenolic or nylon material and have plated-brass screw terminals and integral marking strips.
3. Include a solid state flasher complying with section 8 of NEMA standards publication no. TS 1 for 10 A, dual circuits.

87-7.03 CONSTRUCTION

Perform the conductor and operational tests for the system.

87-7.04 PAYMENT

Not Used

04-20-18

87-8 PEDESTRIAN HYBRID BEACON SYSTEMS

87-8.01 GENERAL

87-8.01A Summary

Section 87-8 includes specifications for constructing pedestrian hybrid beacon systems.

A pedestrian hybrid beacon system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors and cables
5. Standards
6. Pedestrian hybrid beacon face
7. Pedestrian signal heads
8. Service equipment enclosure
9. Department-furnished controller assembly
10. Accessible pedestrian signals
11. Push button assemblies
12 Luminaires
13 Fuse splice connectors
14. Battery backup system

87-8.01B Definitions

Reserved

87-8.01C Submittals

Reserved

87-8.01D Quality Assurance

87-8.01D(1) General

Reserved

87-8.01D(2) Quality Control

Verify the sequence for the pedestrian hybrid beacon system per California Chapter 4F, Figure 3F-3 "Sequence for a Pedestrian Hybrid Beacon" during the operational test.

87-8.02 MATERIALS

87-8.02A General

The system must comply with California *MUTCD*, Chapter 4F.

87-8.02B Pedestrian Hybrid Beacon Face

A pedestrian hybrid beacon face consists of 3 12-inch signal heads.

87-8.03 CONSTRUCTION

Install pedestrian hybrid beacon system under sections 87-4.03A and 87-4.03B.

87-8.04 PAYMENT

Not Used

04-15-16

87-9–87-11 RESERVED

87-12 CHANGEABLE MESSAGE SIGN SYSTEMS

87-12.01 GENERAL

Section 87-12 includes specifications for constructing changeable message sign systems.

Changeable message sign system includes:

1. Foundations
2. Pull boxes
3. Conduit

04-20-18

4. Conductors and cables
5. Service equipment enclosure
6. Department-furnished controller cabinet
7. Department-furnished changeable message sign
8. Department-furnished wiring harness
9. Sign disconnect

04-15-16

The components of a changeable message sign system are shown on the project plans.

87-12.02 MATERIALS

Not Used

87-12.03 CONSTRUCTION

Install the changeable message sign.

Connect the field wiring to the terminal blocks in the sign assembly and controller cabinet.

The Engineer provides you a list of field conductor terminations for each sign cabinet and controller cabinet.

The Department maintains the sign assemblies.

87-12.04 PAYMENT

Not Used

87-13 RESERVED

04-20-18

87-14 RADAR SPEED FEEDBACK SIGN SYSTEMS

87-14.01 GENERAL

87-14.01A Summary

Section 87-14 includes specifications for installing radar speed feedback sign systems.

Radar speed feedback sign system includes:

1. Foundations
2. Pull boxes
3. Conduit
4. Conductors and cables
5. Standards or wood posts
6 Vehicle speed feedback sign
7. Service equipment enclosure

The components of a radar speed feedback sign system are shown on the project plans.

87-14.01B Definitions

Not Used

87-14.01C Submittals

Submit 2 copies of:

1. Test data report complying with NEMA-TS-2 for the vehicle speed feedback sign
2. Shop drawings or installation manuals for the sign support, electrical connections, attachments, and mounting configurations

87-14.01D Quality Assurance

87-14.01D(1) General

Not Used

87-14.01D(2) Quality Control

Equipment setup must comply with the sign manufacturer's instructions.

Notify the Engineer at least 5 business days before performing the system test. Test the system in the presence of the Engineer.

Radar speed feedback sign system test consists of:

1. Turning on the radar speed feedback sign system
2 Driving a vehicle and recording the speeds displayed:
   2.1 By the vehicle speedometer
   2.2 On the vehicle speed feedback sign for the vehicles
3. Performing the test 5 times per lane detected
4. Ensuring that the 5 recorded speeds of the vehicle speed feedback sign are within ± 1 mph of the vehicle speeds recorded from the vehicle speedometer

After successful testing, present the recorded results to the Engineer.

87-14.01D(3) Training

Provide training to a maximum of 4 Department employees on the operation of the vehicle speed feedback sign. Training must be a minimum of 1 hour and include how to program, adjust, troubleshoot, and repair the sign.

87-14.02 MATERIALS

87-14.02A General

Not Used

87-14.02B Vehicle Speed Feedback Signs

Vehicle speed feedback sign consists of a housing, display window, and radar unit.

Sign must:

1. Comply with the California MUTCD, Chapter 2B
2. Have an operating voltage of 120 V(ac) for permanent installations
3. Have a maximum weight of 45 lb
4. Have a wind load rating of 90 mph
5. Have an operating temperature range from -34 to 165 degrees F
6. Have a retroreflective white sheeting background

87-14.02B(1) Housings

Housing must:

1. Be weather proof (NEMA 3R or better) and vandal resistant
2. Be made of 0.09-inch-gauge welded aluminum with the outer surfaces being UV resistant
3. Have the manufacturer's name, model number, serial number, date of manufacture, rated voltage and rated current marked inside
4. Have the internal components easily accessible for field repair without removal of the sign

87-14.02B(2) Display Windows

Display window consists of a cover, LED character display, and dimming control. Character display and cover must deflect together without damage to the internal electronics and speed detection components.

87-14.02B(2)(a) Covers

Cover must be:

1. Vandal resistant and shock absorbent
2. Field replaceable with the removal of external stainless-steel, tamper proof fasteners

Cover must be made of a minimum .25-inch-thick, shatter-resistant polycarbonate.

87-14.02B(2)(b) LED Character Displays

LED character display must:

1. Consist of two 7-segment, solid-state, numeric characters
2. Be capable of displaying the detected vehicle speed within 1 second
3. Remain blank when no vehicles are detected within the radar detection zone
4. Have the option to flash the pre-set speed limit when the detected vehicle speed is 5 miles higher than the pre-set speed
5. Be viewable only by the approaching traffic

Characters must:

1. Be a minimum 15 inches in height
2. Be visible and legible from a minimum distance of 1500 feet and legible from a minimum distance of 750 feet
3. Consist of a minimum 16 LEDs

LEDs must:

1. Be amber and have a wavelength from 590 to 600 nm andrated for minimum 100,000 hours
2. Must maintain a minimum 85 percent of the initial light output after 48 months of continuous use over the temperature range

87-14.02B(2)(c) Dimming Controls

Dimming control must:

1. Automatically adjust the character light intensity to provide optimum character visibility and legibility under all ambient lighting conditions
2. Have minimum 3 manual dimming modes of different intensities

87-14.02B(3) Radar Units

Radar unit must:

1. Be able to detect up to 3 lanes of approaching traffic
2. Operate with an internal, low power, 24.159 GHz (K-band)
3. Be FCC approved Part 15 certified
4. Have a speed accuracy of ±1 mph
5 Have a maximum 15W power consumption

87-14.03 CONSTRUCTION

Install the vehicle speed feedback sign under the manufacturer's instructions.

Perform the conductor test.

Configure the radar speed feedback sign system to detect only traffic in the approach direction of travel.

Perform the radar speed feedback sign system test.

Perform the operational test for the system.

87-14.04 PAYMENT

Not Used

04-15-16

87-15–87-17 RESERVED

87-18 INTERCONNECTION CONDUIT AND CABLE

87-18.01 GENERAL

Section 87-18 includes specifications for constructing interconnection conduit and cable.

Interconnection conduit and cable includes:

1. Pull boxes
2. Conduit
3. Signal interconnect cables

The components of an interconnection conduit and cable are shown.

87-18.02 MATERIALS

Not Used

87-18.03 CONSTRUCTION

Test the signal interconnect cable.

Connect the signal interconnect cable to the terminal block in the controller cabinets. The Engineer provides you a list of terminations for each controller cabinet.

87-18.04 PAYMENT

Not Used

04-20-18

87-19 FIBER OPTIC CABLE SYSTEMS

87-19.01 GENERAL

87-19.01A Summary

Section 87-19 includes specifications for constructing fiber optic cable systems.

A fiber optic cable system includes:

1. Conduit and accessories
2. Splice vaults
3. Warning tape
4. Fiber optic cables
5. Fiber optic splice enclosures
6. Fiber distribution units
7. Fiber optic markers
8 Fiber optic connectors and couplers

The components of a fiber optic system are shown on the project plans.

87-19.01B Definitions

Reserved

87-19.01C Submittals

At least 15 days before cable installation, submit:

1. Manufacturer’s procedures for pulling fiber optic cable
2. Test reports from a laboratory accredited to International Standards Organization/International Electrotechnical Commission 17025 by the American Association for Laboratory Accreditation (A2LA) or the ANSI-ASQ National Accreditation Board (ANAB) for:
   2.1. Water penetration
   2.2. Cable temperature cycling

2.3. Cable impact
2.4. Cable tensile loading and fiber strain
2.5. Cable compressive loading
2.6. Compound flow
2.7. Cyclic flexing

3. Proof of calibration for the test equipment including:
   3.1. Name of calibration facility
   3.2. Date of calibration
   3.3. Type of equipment, model number and serial number
   3.4. Calibration result

Submit the data file and software from the OTDR with the test results for all OTDR tests. The software must support Windows computer operating systems.

After performing the OTDR and the power meter and light source tests, submit within 4 business days:

1. Cable Verification Worksheet
2. Segment Verification Worksheet
3. Link Loss Budget Worksheet

The worksheets are available at the Division of Construction website and copies are included in the *Information Handout*. Submittals must be in Microsoft Excel format. Include hard copies and copies in an electronic format.

87-19.01D Quality Assurance

87-19.01D(1) General

Reserved

87-19.01D(2) Quality Control

Notify the Engineer 4 days before performing field tests. Include exact location of the system or components to be tested. Do not proceed with the testing until authorized. Perform each test in the presence of the Engineer.

The OTDR test consists of:

1. Inspecting the cable segment for physical damage.
2. Measuring the attenuation levels for wavelengths of 1310 nm and 1550 nm in both directions for each fiber using a light source at one end and OTDR at the other end.
3. Comparing the test results with the data sheet provided with the shipment. If there are attenuation deviations greater than 5 percent, the test will be considered unsatisfactory and the cable segment will be rejected. The failure of any single fiber is a cause for rejection of the entire segment. Replace any rejected cable segments and repeat the test.

The power meter and light source test consists of:

1. Testing each fiber in a link using a light source at one end of the link and a power meter at the other end
2. Measuring and recording the power loss for wavelengths of 1310 nm and 1550 nm in both directions

Index matching gel is not allowed in connectors during power meter and light source test.

Test results must be generated from test equipment software and recorded, compared and proven to be within the calculated link loss budget, and filed with the other recordings of the same link.

Installation and splicing of the fiber optic cable system must be performed by a certified fiber optic installer.

The OTDR test and the power meter and light source test must be performed by a certified fiber optic technician.

The certification for the fiber optic installer and fiber optic technician must be from an organization recognized by the International Certification Accreditations Council and must be current through the installation of the fiber optic system.

87-19.02 MATERIALS

87-19.02A General

All metal components of the fiber optic cable system must be corrosion resistant.

All connectors must be factory-installed and tested.

Patch cords, pigtails and connectors must comply with ANSI/TIA-568.

Pigtails must have a minimum 80 N pull out strength.

Each cable reel must be labeled as specified in ANSI/ICEA S-87-640 including:

1. Contractor's name
2. Contract number
3. Cable diameter
4. Number of fibers
5. Cable attenuation loss per fiber at 1310 nm and 1550 nm

The information must be on a weatherproof label or tag and in a shipping record in a weatherproof envelope. The envelope must be removed only by the Engineer.

87-19.02B Splice Vaults

A splice vault must:

1. Comply with section 86 1.02C, AASHTO HS 20-44 and AASHTO M 306.
2. Be a minimum of 4 feet wide by 4 feet high by 4 feet long nominal inside dimensions or a minimum of 4 feet outside diameter for round splice vaults.
3. Be precast either modular or monolithic.
4. Have cable racks installed on the interior sides. A rack must:
   - 4.1. Be fabricated from ASTM A36 steel plate
   - 4.2 Support a minimum of 100 pounds per rack arm.
   - 4.3 Support a minimum of 4 splice enclosures and a minimum of 4 cables with a minimum slack of 50 feet each.
   - 4.4 Be hot-dip galvanized after manufacturing.
   - 4.5 Be bonded and grounded.
5. Have a minimum of 4 knockouts for cable entry points. Entry points must not cause the cable to exceed its maximum bend radius.
6. Have a minimum 2 inch diameter drain hole at the base.
7. Be weatherproof.
8. Have cable accesses with rubber grommets or similar material to prevent the cable from coming in contact with the bare metal.

The cover must:

1. Be in two-piece torsion-assisted sections for non-rounded enclosures.
2. Be galvanized steel with a minimum of 30 inches diameter for round enclosures.
3. Have inset lifting pull slots.
4. Have markings "CALTRANS FIBER OPTIC" on each section.

87-19.02C Fiber Optic Cable

The fiber optic cable must:

1. Comply with 7 CFR 1755.900 to 1755.902 and ANSI/ICEA S-87-640
2. Be a single mode, zero-dispersion, and have non-gel loose type buffer tubes
3. Have no splices, including factory splices

4. Have a Type H or Type M outer jacket

The fiber optic cable must:

1. Be shipped on a reel
2. Have 10 feet of length on each end of the cable accessible for testing

The fiber optic riser cable must:

1. Comply with ICEA S-104-696
2. Be rated for underground and riser application
3. Have a minimum of 4 fibers.
4. Be singlemode and operate at wavelengths of 1310 and 1550 nanometers

Fiber optic cable must be identified as shown in the following table:

Cable Identification

No.	Description	Code
1	Fiber Type	**S:** Singlemode
2	Fiber Count	**048 (example):** Actual number of fibers
3	Begin Point	T: TMC H: Hub V: Video Node D: Data Node C: Cable Node TV: CCTV Camera CM: CMS E: Traffic Signal RM: Ramp Meter TM: Traffic Monitoring/ Count Station/Vehicle Count Station (VDS, TMS) HA: Highway Advisory Radio EM: Extinguishable Message Sign RW: Roadway Weather Information System WM: Weigh In Motion WS: Weigh-Station Bypass System SV: Splice Vault or Fiber Optic Vault SC: Splice Cabinet
4	Begin Point County Abbreviation	Examples: Orange (Ora), San Mateo (SM). County abbreviations are available Plans Preparation Manual at Division of Design website.
5	Begin Point Route Number	Examples 005, 082, 114
6	Begin Point Post Mile	02470 (example 024.70): Actual PM value to the 1/100 value
7	End Point	In the same manner as for Begin Point
8	End Point County Abbreviation	
9	End Point Route Number	
10	End Point Post Mile	

87-19.02D Fiber Optic Splice Enclosures

A fiber optic splice enclosure must:

1. Be a maximum of 36 by 8 inches

2. Be thermoplastic, weather proof, chemical and UV resistant, and resealable
3. Accommodate a minimum of 8 internal splice trays
4. Have 1/4 to 1 inch diameter cable entry ports to accommodate cables as shown
5. Have brackets, clips and cable ties
5. Have means to anchor the dielectric member of the fiber optic cable
6. Include grounding hardware

87-19.02E Fiber Distribution Units

The Fiber Distribution Unit (FDU) consists of a housing, a patch panel, a 12 multicolor pigtail, and a splice tray.

The FDU must be self-contained and pre-assembled.

The housing must:

1. Be a 19-inch rack mountable modular metal enclosure
2. Be a one rack unit
3. Have cable clamps to secure fiber optic cables to the chassis
4. Have cable accesses with rubber grommets or similar material to prevent the cable from coming in contact with the bare metal
5. Be weatherproof
6. Have a hinged top door with a latch or thumbscrew to hold it in the closed position

A patch panel must have a minimum of 12 single-fiber type connector sleeves.

A pigtail must:

1. Be a simplex single mode fiber in a 900 µm tight buffer with a 0.12 inch outer diameter PVC jacket
2. Have a fiber optic connector attached on one end and bare fiber on the other end
3. Be at least 3 feet in length
4. Have the manufacturer's part number on the jacket

Pigtails must be single-fiber or ribbon type.

Patch cords must:

1. Be a single mode fiber in a 900 µm tight buffer with a 0.12 inch outer diameter PVC jacket
2. Have fiber optic connectors attached on both ends
3. Be at least 6 feet in length
4. Have manufacturer's part number on the jacket

Duplex patch cords must be of round cable structure, and not have zip-cord structure.

Splice trays must:

1. Have brackets to spool incoming fibers a minimum of 2 turns.
2. Have means to secure and protect incoming buffer tubes, pigtails, and a minimum of 12 heat shrink fusion splices.
3. Be stackable.
4. Have a snap-on or hinged cover. The cover may be transparent.

A splice cassette may be used in place of a pigtail and a splice tray.

87-19.02F Fiber Optic Markers

Fiber optic markers must be:

1. Type K-2 (CA) object markers for splice vaults or pull boxes.
2. Type G retroreflective pavement markers for paved areas and transition points from unpaved to paved areas.
3. Non-reflective Class 1, Type F, flexible post delineators for unpaved areas.

87-19.02G Fiber Optic Connectors and Couplers

Singlemode fiber optic connectors must have a yellow strain relief boot or a yellow base.

Connectors must be:

1. 0.1-inch ceramic ferrule pre-radiused type
2. Capped when not used

Couplers must be made of the same material as the connector's housing and have ceramic sleeves.

87-19.03 CONSTRUCTION

87-19.03A General

Perform the OTDR test:

1. On the fiber optic cable upon its arrival to the job site and before its installation. Complete the Cable Verification Worksheet. Do not install the fiber optic cable until the Engineer's written approval is received.
2. After the fiber optic cable segments have been pulled but before breakout and termination. Complete the Segment Verification Worksheet.
3. Once the passive cabling system has been installed and is ready for activation. If the measured individual fusion splice losses exceed -0.30 dB, re-splice and retest. At the conclusion of the OTDR test, perform the power meter and light source test. If the measured link loss exceeds the calculated link loss, replace the unsatisfactory cable segments or splices and retest. Complete the Link Loss Budget Worksheet.

87-19.03B Splice Vaults Installation

Install a splice vault as shown and with the side facing the roadway a minimum of 2 feet from the edge of pavement or back of dike, away from traffic.

Install the top of the vault flush with surrounding grade in paved areas and 2 inches above the surrounding grade in unpaved areas.

Place minor concrete around and under vaults. In unpaved areas, finish top of concrete at a 2 percent slope away from cover. In paved areas, finish top of concrete to match existing slope.

Bolt the steel cover to the vault when not working in it.

87-19.03C Fiber Optic Cable Installation

Install fiber optic cable under manufacturer's instructions. Fiber optic cable must be installed by a certified installer or a representative from the fiber optic cable manufacturer must be present during installation.

For installation of fiber optic cable using mechanical aids:

1. Maintain a cable bend radius at least twenty times the outside diameter of the cable.
2. Cable grips have a ball bearing swivel.
3. Pulling force on a cable must not exceed 500 pound-foot or manufacturer’s recommended pulling tension, whichever is less.

Cable installed using the air blown method must withstand a static air pressure of 110 psi.

Lubricate the cable using a lubricant recommended by the cable manufacture.

Use only a non-abrasive pull tape.

Install fiber optic cable without splices except where shown or authorized.

Provide a minimum of 65 feet of slack for each fiber optic cable at each splice vault. Divide the slack equally on each side of the splice enclosure.

Install tracer wires in the fiber optic conduits and innerducts as shown. Provide a minimum 5 feet of slack tracer wire in each pull box and splice vault from each direction. You may splice tracer wire at intervals of not less than 500 feet and only inside splice vaults or pull boxes.

If a fiber optic cable and tracer wire is installed in an innerduct, pulling a separate fiber optic cable into a spare duct to replace damaged fiber will not be allowed.

Apply a flooding material to fiber optic cable openings.

Seal the ends of conduit after cables are installed.

Install strain relief for fiber optic cable entering a fiber optic enclosure.

Identify fibers and cables by direct labeling, metal tags, or bands fastened in such a way that they will not move. Use mechanical methods for labeling.

Provide identification on each fiber or each group of fibers in each splice vault and near the end of terminated fibers.

Place labels on the cables at the following points:

1. Fiber optic splice vault entrance and exit
2. Splice enclosures entrance and exit
3. FDU entrance

For fiber optic riser cable inside controller cabinets, lace and secure the cable to the cage.

Support the fiber optic riser cable within 6 inches from a termination and every 2 feet.

Secure fiber optic cables to the cable racks. Store excess cable in a figure 8 fashion.

87-19.03D Fiber Optic Cable Splices

Use fusion splicing for fiber optic cables.

Splice single-buffer tube cable to multi-buffer tube cable using the mid-span access method under manufacturer's instructions. Any mid-span access splice or FDU termination must involve only those fibers being spliced as shown.

Place fiber splices in the splice enclosures installed in the splice vaults.

87-19.03E Splice Enclosures Installation

Maintain an equal amount of slack on each side of the splice enclosure.

Secure the fiber optic splices in splice tray.

Secure the splice trays to the inner enclosure.

Label cables and buffer tubes.

Do not seal fiber splice enclosure until authorized and the power meter and light source test is performed. Seal the enclosure under manufacturer's recommendation.

Flash test the outer enclosure under manufacturer's instructions in the presence of the Engineer. Visually inspect the enclosure. If bubbles are present, identify the locations where the bubbles are present, take corrective actions and repeat the flash test until no bubbles are present.

Attach the splice enclosure to the side wall of a splice vault or hub with a minimum 2 feet distance between the ground and the bottom of the enclosure.

Secure fiber optic cables to the chassis using cable clamps for fiber optic units.

Connect a minimum of one bonding conductor to a grounding electrode after mounting the fiber optic enclosure to the wall. If there are multiple bonding conductors, organize the conductors in a neat manner.

87-19.03F Fiber Optic Distribution Unit Installation

Spool incoming buffer tubes 2 feet in the splice tray and expose 1 foot of individual fibers.

Maintain a minimum 2-inch-bend radius during and after installation in the splice tray.

Splice incoming fibers in the splice tray.

Restrain each fiber in the splice tray. Do not apply stress on the fiber when located in its final position.

Secure buffer tubes near the entrance of the splice tray.

Secure splice trays under manufacturer's instructions.

Label splice tray after splicing is completed.

Install patch cords in FDUs and patch panels. Permanently label each cord and each connector in the panel with the system as shown.

87-19.03G Fiber Optic Markers Installation

Install fiber optic markers at 12-inch offset on the side furthest away from the edge of travel way:

1. For fiber optic cable at 500 feet apart in areas where the distance between splice vaults or pull boxes is greater than 500 feet
2. Adjacent to pull boxes and splice vaults
3. For fiber optic cable turns at:
   - 3.1. Beginning of the turn
   - 3.2. Middle of the arc
   - 3.3. End of the turn

When a fiber optic cable crosses a roadway or ramp, install a Type G marker over the conduit on:

1. Every shoulder within 6 inches from the edge of pavement
2. Delineated median
3. Each side of the barrier

Install markers under section 81 except each retroreflective face must be parallel to the road centerline and facing away from traffic.

87-19.04 PAYMENT

Not Used

04-15-16

87-20 TEMPORARY ELECTRICAL SYSTEMS

87-20.01 GENERAL

Section 87-20 includes specifications for providing temporary electrical systems.

Obtain the Department's authorization for the type of temporary electrical system and its installation method.

A temporary system must operate on a continuous, 24-hour basis.

01-20-17

Temporary wood poles must comply with section 48-6.

04-15-16

87-20.02 MATERIALS

87-20.02A General

Material and equipment may be new or used.

The components of a temporary system are shown on the project plans.

If you use Type UF-B cable, the minimum conductor size must be no. 12.

87-20.02B Temporary Flashing Beacon Systems

A temporary flashing beacon system consists of a flashing beacon system, wood post, generator, and photovoltaic system.

The system must comply with the specifications for a flashing beacon system in section 87-7, except it may be mounted on a wood post or a trailer.

87-20.02C Temporary Lighting Systems

A temporary lighting system consists of a lighting system, generator, and wood poles.

The system must comply with the specifications for a lighting system in section 87-2, except it may be mounted on a wood pole or a trailer.

87-20.02D Temporary Signal Systems

A temporary signal system consists of a signal and lighting system, wood poles and posts, and a generator.

System must comply with the specifications for a signal and lighting system in section 87-4, except:

1. Signal heads may be mounted on a wood pole, mast arm, tether wire, or a trailer
2. Flashing beacons may be mounted on a wood post, or a trailer

87-20.03 CONSTRUCTION

87-20.03A General

Provide electrical and telecommunication services for temporary systems. Do not use existing services unless authorized.

Provide power for the temporary electrical systems under section 12-3.33, except you may use a photovoltaic system for the temporary flashing beacon system.

Install conductors and cables in a conduit, suspended from wood poles at least 25 feet above the roadway, or use direct burial conductors and cables.

You may saw slots across paved areas for burial conductors and cables.

Install conduit outside the paved area at a minimum of 12 inches below grade for Type 1 and 2 conduit and at a minimum of 18 inches below grade for Type 3 conduit.

Install direct burial conductors and cables outside the paved area at a minimum depth of 24 inches below grade.

Place the portions of the conductors installed on the face of wood poles in either Type 1, 2, or 3 conduit between the point 10 feet above grade at the pole and the pull box. The conduit between the pole and the pull box must be buried at a depth of at least 18 inches below grade.

Place conductors across structures in a Type 1, 2, or 3 conduit. Attach the conduit to the outside face of the railing.

Mount the photoelectric unit at the top of the standard or wood post.

You may abandon in place conductors and cables in sawed slots or in conduit installed below the ground surface.

87-20.03B Temporary Flashing Beacon Systems

Install a fused-splice connector in the pull box adjacent to each flashing beacon. Wherever conductors are run overhead, install the splice connector in the line side outside of the control assembly.

87-20.03C Temporary Lighting Systems

Wherever conductors are run overhead, install the fuse splice connectors in the line side before entering the mast arm.

87-20.03D Temporary Signal Systems

You may splice conductors that run to a terminal compartment or a signal head on a pole to the through conductors of the same phase in a pull box adjacent to the pole. Do not splice conductors or cables except in a pull box or in a NEMA 3R enclosure.

The Department provides the timing for the temporary signal.

Maintain the temporary signal except for the Department-furnished controller assembly.

87-20.04 PAYMENT

Not Used

87-21 EXISTING ELECTRICAL SYSTEMS

87-21.01 GENERAL

Section 87-21 includes general specifications for performing work on existing electrical systems.

87-21.02 MATERIALS

Not Used

87-21.03 CONSTRUCTION

87-21.03A General

You may abandon unused underground conduit after pulling out all conductors and removing conduit terminations from the pull boxes.

If standards are to be salvaged, remove:

1. All components
2. Mast arms from the standards
3. Luminaires, signal heads, and signal mounting assemblies from the standards and mast arms

If the existing material is unsatisfactory for reuse and the Engineer orders you to replace it with new material, replacing the existing material with new material is change order work.

If the removed electrical equipment is to be reinstalled, supply all materials and equipment, including signal mounting assemblies, anchor bolts, nuts, washers, and concrete, needed to complete the new installation.

87-21.03B Maintaining Existing Electrical Systems

87-21.03B(1) General

Maintain the existing electrical system in working order during the progress of the work. Conduct your operations to avoid damage to the elements of the systems.

87-21.03B(2) Maintaining Existing Traffic Management System Elements During Construction

07-21-17

Section 87-21.03B(2) applies if a bid item for maintaining existing traffic management system elements during construction is shown on the Bid Item List.

04-15-16

Traffic management system elements include:

1. Ramp metering system
2. Traffic monitoring stations
3. Microwave vehicle detection system
4. Changeable message sign system
5. Extinguishable message sign system
6. Highway advisory radio system
7. Closed circuit television camera system
8. Roadway weather information system

Obtain authorization at least 72 hours before interrupting communication between an existing system and the traffic management center.

If the Engineer notifies you that an existing system is not fully operational due to your activities, repair or replace the system within 72 hours. If the system cannot be fixed within 72 hours or it is located on a structure, provide a temporary system within 24 hours until the system can be fixed. Perform a functional test of the system in the presence of the Engineer. If you fail to perform the necessary repair or replacement work, the Department may perform the repair or replacement work and deduct the cost.

If you damage an existing fiber optic cable, install a new cable such that the length of cable slack is the same as before the damage, measured from an original splice point or termination. All splices must be made using the fusion method.

You may interrupt the operation of traffic monitoring stations:

1. For 60 days if another operational traffic monitoring station is located within 3 miles
2. For 15 days if another operational traffic monitoring station is located more than 3 miles away

If a traffic monitoring station must be interrupted for longer periods than specified, provide a temporary detection system. Obtain the Department's authorization for the type of temporary system and its installation method.

87-21.03C Modifying Existing Electrical Systems

Modify electrical systems as shown.

87-21.03D Removing Existing Electrical Systems

The components to be removed are shown on the project plans.

87-21.04 PAYMENT

Not Used

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3. Material testing procedures
4. Testing laboratory
5. Procedures and equipment
6. Systems for tracking and identifying PC concrete members
7. QC personnel
8. Methods for controlling internal concrete temperature

Add to the list in the 2nd paragraph of section 90-4.01C(4):

01-20-17

7. Daily temperature data for internally monitored tier 1 PC concrete members

Replace *Temperature* in the 2nd table in the 5th paragraph of section 90-4.01D(2)(c) with:

01-20-17

Temperature at time of mixing

Add to section 90-4.01D(2):

01-20-17

90-4.01D(2)(d) Temperature Monitoring

90-4.01D(2)(d)(i) General

At a minimum, provide temperature monitoring devices as shown in the following table:

Temperature Monitoring Requirements

Component	Steam curing	Other curing methods
Tier 1 PC bridge components except piling and deck panels	1 internal temperature sensor for each individually cast member; 1 internal temperature sensor for every 100 feet of bed length for continuously cast elements[a]	1 internal temperature sensor for each individually cast member; 1 internal temperature sensor for every 100 feet of bed length for continuously cast elements[a]
PC piling, deck panels, and PS pavement	1 enclosure temperature sensor for every 200 feet of bed length for continuously cast elements	Not required
Other PC components	1 enclosure temperature sensor for every 200 feet of bed length for continuously cast elements	Not required

[a]Members not instrumented are represented by the nearest internal temperature probe.

Temperature monitoring devices must provide an accurate, continuous, permanent record of the temperature during curing activities.

90-4.01D(2)(d)(ii) Tier 1 Bridge Components

Except for piling and deck panels, provide a temperature monitoring and recording system during concrete placement and curing for tier 1 PC bridge components. The system must consist of temperature sensors connected to a data acquisition system. The system must be capable of recording, printing, and downloading temperature data to a computer. Temperature sensors must be accurate to within ±2 degrees F.

Position each internal concrete temperature sensor as shown in the following table:

Internal Concrete Sensor Locations

PC component	Sensor location
Wide flange, 'I', and bulb tee girders	6–8 inches below top surface along center line at midpoint
Other girder shapes	6–8 inches below top surface along center line of stem at midpoint
Deck slabs	Center of element at mid-depth
Other elements	Position sensor to provide maximum concrete cover

Record temperature readings automatically at least every 15 minutes. You may discontinue temperature recording (1) when the maximum internal concrete temperature is falling for a minimum of 1 hour, or (2) immediately before stress transfer to the concrete.

Do not allow the ends of temperature sensors to come into contact with concrete supports, forms, or reinforcement.

Correct equipment failures in temperature control and monitoring and recording systems immediately.

Add to section 90-4.01D(3):

01-20-17

For tier 1 PC bridge components that are monitored for internal temperature, the Engineer rejects components if at any temperature sensor (1) the maximum internal concrete temperature exceeds 165 degrees F, or (2) the internal temperature gain exceeds 40 degrees F per hour. If the maximum internal concrete temperature is from 161 to 165 degrees F, the Engineer reduces payment for furnish PC concrete member by a percentage equal to 2 times the difference of the maximum measured temperature in degrees F minus 160.

Add between the 3rd and 4th paragraphs of section 90-4.02:

01-20-17

For tier 1 PC concrete members with internal temperature monitoring:

1. Maximum internal concrete temperature must not exceed 165 degrees F at any temperature sensor
2. Maximum temperature gain must not exceed 40 degrees F per hour at any temperature sensor

Replace the 5th paragraph of section 90-4.02 with:

01-20-17

Portland cement based repair material must be on the Authorized Material List for precast portland cement based repair material.

Replace the 4th item in the list in the 2nd paragraph of section 90-4.03 with:

01-20-17

4. Steam at the jets must be at low pressure and in a saturated condition. Steam jets must not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure must not exceed 40 degrees F per hour. Except for internally monitored components, the curing temperature throughout the enclosure must not exceed 150 degrees F. Maintain the curing temperature at a constant level for the time necessary to develop the required transfer strength. Cover control cylinders to prevent moisture loss and place them in a location where the temperature is representative of the average enclosure temperature.

01-20-17

Delete the 5th item in the list in the 2nd paragraph of section 90-4.03.

Add to section 90-4.03:

01-20-17

For internally monitored tier 1 PC bridge components with a maximum internal concrete temperature of 161 to 165 degrees F, the following apply:

1. Do not apply curing compound
2. Cure an additional 7 days using the water cure method
3. After 7 days apply a silane waterproofing treatment under the following conditions:
   3.1. Silane waterproofing treatment selected for use must be on the Authorized Material List for silane reactive penetrating sealers
   3.2. Concrete surfaces must be completely dry when silane is applied
   3.3. Apply a single application of undiluted silane under the manufacturer's application instructions until surfaces are saturated

Replace section 90-9 with:

07-15-16

90-9 RETURNED PLASTIC CONCRETE

90-9.01 GENERAL

90-9.01A Summary

Section 90-9 includes specifications for incorporating returned plastic concrete (RPC) into concrete.

RPC must be used only where the specifications allow its use. Do not use RPC in pavement or structural concrete.

90-9.01B Definitions

returned plastic concrete (RPC): Excess concrete that is returned to a concrete plant in a plastic state and that has not attained initial set.

hydration stabilizing admixture (HSA): Extended set retarding admixture that controls and predictably reduces the hydration rate of the cementitious material.

90-9.01C Submittals

Submit the following with the weighmaster certificate:

1. Weight or volume of RPC
2. Type, brand, and dosage of HSA
3. Time of adding HSA
4. Copy of the original weighmaster certificate for the RPC
5. Temperature of RPC

When requested, submit the HSA manufacturer's instructions, including dosage tables.

90-9.01D Quality Assurance

The material plant producing concrete containing RPC must be authorized under the MPQP.

For volumetric proportioning of RPC:

1. The volumetric container must be imprinted with manufacturer’s name, model number, serial number, the as-calibrated volume and date of the last calibration. Cross sectional dimensions of the container must remain the same as those during its calibration.
2. The device must be re-calibrated monthly and at any time when the container shape has been deformed from its original condition or there is evidence of material build-up on the inside of the device.

3. The device must be held in a level condition during filling. Fill the device to the measure or strike-off line. Each measurement must be filled to within 1.0% of the device as-calibrated volume.
4. The device interior must be cleaned after each measurement to maintain a zero condition.

For weight proportioning, proportion RPC with a weigh hopper attached to the plant at a position which allows the addition of the RPC to the mixer truck with the conventional PCC ingredients. The plant process controller must control the proportioning of RPC to within 1.0% of its target weight.

90-9.02 MATERIALS

90-9.02A General

The quantity of RPC added to the concrete must not exceed 15 percent.

The cementitious material content of the RPC must be at least that specified for the concrete that allows the use of RPC.

Water must not be added to the RPC after batching, including in the truck mixer.

Use HSA for controlling and reducing the hydration rate of RPC.

Incorporate RPC by mixing into the concrete before arriving at the jobsite.

90-9.02B Returned Plastic Concrete

The RPC must not exceed 100 degrees F at any time.

If HSA is not used, RPC must be incorporated into the concrete before attaining initial set or within 4 hours after batching of RPC, whichever is earlier.

If HSA is used:

1. Add HSA to RPC within 4 hours after original batching.
2. Measure and record the time, dosage of HSA, and temperature of RPC when HSA is added.
3. Mix the RPC under the HSA manufacturer's instructions after adding HSA or at least 30 revolutions, whichever is greater.
4. Incorporate RPC into the concrete within 4 hours after adding HSA.

RPC must not contain:

1. Accelerating admixture
2. Fiber
3. Pigment
4. Lightweight aggregate
5. Previously returned RPC
6. Any ingredient incompatible with the resultant concrete

90-9.02C Hydration Stabilizing Admixture

HSA must comply with ASTM C494 admixture Type B or Type D.

HSA must have a proven history of specifically maintaining and extending both plasticity and set.

HSA dosage must comply with the manufacturer's instructions.

90-9.02D Production

Proportion concrete containing RPC under section 90-2.02E.

Proportion RPC by weight or by volume.

90-9.03 CONSTRUCTION

Not Used

90-9.04 PAYMENT

Not Used

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92 ASPHALT BINDERS

04-15-16

Replace the 4th paragraph of section 92-1.02B with:

04-15-16

Crumb rubber modifier used must be on the Authorized Materials List for crumb rubber modifier.

Production equipment for PG modified asphalt binder with crumb rubber modifier must be authorized under the Department's *MPQP*.

Crumb rubber must be derived from waste tires described in Pub Res Code § 42703 and must be free from contaminants including fabric, metal, minerals, and other nonrubber substances.

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95 EPOXY

04-20-18

Replace the requirement in the row for Brookfield viscosity in the table in section 95-1.02H with:

04-20-18

9

^^

96 GEOSYNTHETICS

04-20-18

Replace *product name, manufacturing source, and date of manufacture* in the 2nd sentence of the 1st paragraph of section 96-1.01D with:

01-15-16

manufacturing source code

Replace *Apparent opening size, (min, inches)* in the table in the 2nd paragraph of section 96-1.02O with:

01-20-17

Apparent opening size, (max, inches)

Replace section 96-1.02R with:

04-20-18

96-1.02R Geomembrane

Geomembrane must be:

1. Polyethylene or polypropylene
2. Water resistant
3. Unreinforced or scrim reinforced

Cushion fabric must be nonwoven.

Geomembrane and cushion fabric must comply with the requirements shown in the following tables:

Unreinforced Geomembrane

Quality characteristic	Test method	Requirement		
		Class A	Class B	Class C
Thickness, smooth (min, mil)	ASTM D5199	20	20	20
Thickness, textured (min, mil)	ASTM D5994			
Tensile break strength (min, lb/in)	ASTM D6693 Type IV	75	65	55
Puncture resistance (min, lb)	ASTM D4833	45	40	35
Tear resistance (min, lb)	ASTM D1004	20	15	10
Carbon black content (%)	ASTM D4218	2–3		

Scrim Reinforced Geomembrane

Quality characteristic	Test method	Requirement		
		Class A	Class B	Class C
Thickness, smooth (min, mil)	ASTM D5199	20	20	20
Thickness, textured (min, mil)	ASTM D5994			
Tensile break strength (min, lb)	ASTM D7004	250	200	150
Puncture resistance (min, lb)	ASTM D4833	45	40	35
Tear resistance (min, lb)	ASTM D5884	55	55	55
Ply adhesion (min, lb)	ASTM D6636	20	20	20
Carbon black content (%)	ASTM D4218	2–3		

Cushion Fabric

Quality characteristic	Test method	Requirement					
Mass per unit area (oz/sq yd)	ASTM D5261	10	12	16	24	32	60
Grab tensile break strength (min, lb)	ASTM D4632	230	300	370	450	500	630
Grab tensile break elongation (min, %)	ASTM D4632	50					
Puncture strength (min, lb)	ASTM D6241	700	800	900	1100	1700	2400
Trapezoidal tear strength (min, lb)	ASTM D4533	95	115	145	200	215	290
UV resistance (min, %)	ASTM D7238	70					