STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

NOTICE TO BIDDERS
AND
SPECIAL PROVISIONS

FOR CONSTRUCTION ON STATE HIGHWAY IN SOLANO COUNTY IN DIXON
FROM NORTH ADAMS STREET TO ROUTE 80
In District 04 On Route 113
Under

Bid book dated April 3, 2017
Project plans approved March 1, 2017

Identified by
Contract No. 04-1K0704
04-Sol-113-19.9/21.2
Project ID 0416000185

Standard Specifications dated 2015
Standard Plans dated 2015

Electronic Bidding Contract

Bids open Wednesday, April 26, 2017
Dated April 3, 2017
SPECIAL NOTICES

- See sections 2 and 3 for contractors' registration requirements.
CONTRACT NO. 04-1K0704

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

HIGHWAYS

[Signature]

2/24/17

REGISTERED CIVIL ENGINEER

[Stamp]

Md Salahuddin

48167

12/31/18

CIVIL

STATE OF CALIFORNIA
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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)
A20A  Pavement Markers and Traffic Lines - Typical Details
A20B  Pavement Markers and Traffic Lines - Typical Details
A20C  Pavement Markers and Traffic Lines - Typical Details
A20D  Pavement Markers and Traffic Lines - Typical Details
A24A  Pavement Markings - Arrows
A24B  Pavement Markings - Arrows and Symbols
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 T9 Traffic Control System Tables for Lane and Ramp Closures
T11   Traffic Control System for Lane Closure on Multilane Conventional Highways
T14   Traffic Control System for Ramp Closure
T15   Traffic Control System for Moving Lane Closure on Multilane Highways
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)
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
ES-1A Electrical Systems (Legend)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES-1B</td>
<td>Electrical Systems (Legend)</td>
</tr>
<tr>
<td>RSP ES-1C</td>
<td>Electrical Systems (Legend)</td>
</tr>
<tr>
<td>RSP ES-5A</td>
<td>Electrical Systems (Loop Detectors)</td>
</tr>
<tr>
<td>RSP ES-5B</td>
<td>Electrical Systems (Detectors)</td>
</tr>
<tr>
<td>ES-5D</td>
<td>Electrical Systems (Curb and Shoulder Termination, Trench, and Handhole Details)</td>
</tr>
<tr>
<td>RSP ES-8A</td>
<td>Electrical Systems (Non-Traffic Pull Box)</td>
</tr>
<tr>
<td>RSP ES-13A</td>
<td>Electrical Systems (Splicing Details)</td>
</tr>
</tbody>
</table>
# CANCELED STANDARD PLANS LIST

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

<table>
<thead>
<tr>
<th>Plan No.</th>
<th>Date Canceled</th>
</tr>
</thead>
<tbody>
<tr>
<td>D72</td>
<td>07-15-16</td>
</tr>
<tr>
<td>D73</td>
<td>07-15-16</td>
</tr>
<tr>
<td>D74A</td>
<td>07-15-16</td>
</tr>
<tr>
<td>D74B</td>
<td>07-15-16</td>
</tr>
<tr>
<td>D74C</td>
<td>07-15-16</td>
</tr>
<tr>
<td>D98C</td>
<td>01-20-17</td>
</tr>
<tr>
<td>RSP B11-54</td>
<td>01-20-17</td>
</tr>
<tr>
<td>ES-15B</td>
<td>04-15-16</td>
</tr>
</tbody>
</table>
NOTICE TO BIDDERS

Bids open Wednesday, April 26, 2017

Dated April 3, 2017

General work description: Cold plane AC pavement and place HMA (Type A).

The Department will receive sealed bids for CONSTRUCTION ON STATE HIGHWAY IN SOLANO COUNTY IN DIXON FROM NORTH ADAMS STREET TO ROUTE 80.

District-County-Route-Post Mile: 04-Sol-113-19.9/21.2

Contract No. 04-1K0704

The Contractor must have either a Class A license or one of the following Class C licenses: C-12.

The DVBE Contract goal is 3 percent.

Bids must be on a unit price basis.

Complete the work within 40 working days.

The estimated cost of the project is $1,280,000.

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 Bidders' Exchange website.

The Department will open and publicly read the bids at 1727 30th Street, Bidders' Exchange, MS 26, Sacramento, CA 95816 immediately after the specified closing time.

District office addresses are provided in the Standard Specifications.

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


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.

Under Govt Code § 14835 et seq. and 2 CA Code of Regs § 1896 et seq., the Department gives preference to certified small businesses and non–small businesses who commit to 25 percent certified small business participation.

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.

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 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

D04MS
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Code</th>
<th>Item Description</th>
<th>Unit of Measure</th>
<th>Estimated Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>070030</td>
<td>LEAD COMPLIANCE PLAN</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>2</td>
<td>120090</td>
<td>CONSTRUCTION AREA SIGNS</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>3</td>
<td>120100</td>
<td>TRAFFIC CONTROL SYSTEM</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>4</td>
<td>128652</td>
<td>PORTABLE CHANGEABLE MESSAGE SIGN (LS)</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>5</td>
<td>130100</td>
<td>JOB SITE MANAGEMENT</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>6</td>
<td>130200</td>
<td>PREPARE WATER POLLUTION CONTROL PROGRAM</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>7</td>
<td>130620</td>
<td>TEMPORARY DRAINAGE INLET PROTECTION</td>
<td>EA</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>130730</td>
<td>STREET SWEEPING</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>9</td>
<td>148005</td>
<td>NOISE MONITORING</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>10</td>
<td>390030</td>
<td>INTELLIGENT COMPACTION</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>11</td>
<td>390132</td>
<td>HOT MIX ASPHALT (TYPE A)</td>
<td>TON</td>
<td>7,900</td>
</tr>
<tr>
<td>12</td>
<td>393004</td>
<td>GEOSYNTHETIC PAVEMENT INTERLAYER (PAVING FABRIC)</td>
<td>SQYD</td>
<td>29,400</td>
</tr>
<tr>
<td>13</td>
<td>394060</td>
<td>DATA CORE</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
<tr>
<td>14</td>
<td>394076</td>
<td>PLACE HOT MIX ASPHALT DIKE (TYPE E)</td>
<td>LF</td>
<td>410</td>
</tr>
<tr>
<td>15</td>
<td>394077</td>
<td>PLACE HOT MIX ASPHALT DIKE (TYPE F)</td>
<td>LF</td>
<td>110</td>
</tr>
<tr>
<td>16</td>
<td>397005</td>
<td>TACK COAT</td>
<td>TON</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>398100</td>
<td>REMOVE ASPHALT CONCRETE DIKE</td>
<td>LF</td>
<td>520</td>
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<tr>
<td>18</td>
<td>398200</td>
<td>COLD PLANE ASPHALT CONCRETE PAVEMENT</td>
<td>SQYD</td>
<td>42,600</td>
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<tr>
<td>19</td>
<td>730070</td>
<td>DETECTABLE WARNING SURFACE</td>
<td>SQFT</td>
<td>120</td>
</tr>
<tr>
<td>20</td>
<td>810230</td>
<td>PAVEMENT MARKER (RETROREFLECTIVE)</td>
<td>EA</td>
<td>730</td>
</tr>
<tr>
<td>Item No.</td>
<td>Item Code</td>
<td>Item Description</td>
<td>Unit of Measure</td>
<td>Estimated Quantity</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>21</td>
<td>840516</td>
<td>THERMOPLASTIC PAVEMENT MARKING (ENHANCED WET NIGHT VISIBILITY)</td>
<td>SQFT</td>
<td>3,040</td>
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<tr>
<td>22</td>
<td>033107</td>
<td>4&quot; THERMOPLASTIC TRAFFIC STRIPE (BROKEN 48-14)</td>
<td>LF</td>
<td>330</td>
</tr>
<tr>
<td>23</td>
<td>846001</td>
<td>4&quot; THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY)</td>
<td>LF</td>
<td>18,740</td>
</tr>
<tr>
<td>24</td>
<td>846004</td>
<td>4&quot; THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY) (BROKEN 17-7)</td>
<td>LF</td>
<td>8,540</td>
</tr>
<tr>
<td>25</td>
<td>846009</td>
<td>8&quot; THERMOPLASTIC TRAFFIC STRIPE (ENHANCED WET NIGHT VISIBILITY)</td>
<td>LF</td>
<td>2,120</td>
</tr>
<tr>
<td>26</td>
<td>872130</td>
<td>MODIFYING EXISTING ELECTRICAL SYSTEM</td>
<td>LS</td>
<td>LUMP SUM</td>
</tr>
</tbody>
</table>
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.

DIVISION I  GENERAL PROVISIONS

1 GENERAL

Add to section 1-1.01:

Bid Items and Applicable Sections

<table>
<thead>
<tr>
<th>Item code</th>
<th>Item description</th>
<th>Applicable section</th>
</tr>
</thead>
<tbody>
<tr>
<td>033107</td>
<td>4” THERMOPLASTIC TRAFFIC STRIPE (BROKEN 48-14)</td>
<td>84</td>
</tr>
</tbody>
</table>

5 CONTROL OF WORK

Add to the end of section 5-1.20A:

During the progress of the work under this Contract, work under the following contracts may be in progress at or near the job site of this Contract:

Coincident or Adjacent Contracts

<table>
<thead>
<tr>
<th>Contract no.</th>
<th>County–Route–Post Mile</th>
<th>Location</th>
<th>Type of work</th>
</tr>
</thead>
<tbody>
<tr>
<td>04-0G7504</td>
<td>Sol-113-21.8/22.2</td>
<td>Between route 113/80 separation (west) over route 80 and the eastbound connector overcrossing to route 80.</td>
<td>Thrie beam Barrier</td>
</tr>
</tbody>
</table>

Add to the end of section 5-1.32:

Personal vehicles of your employees must not be parked on the traveled way or shoulders, including sections closed to traffic.
8 PROSECUTION AND PROGRESS

Replace Reserved in section 8-1.04G with:

The 1st paragraph of section 8-1.04B does not apply.

Within 10 days after receiving notice that the Contract has been approved by the Attorney General or the attorney appointed and authorized to represent the Department or within 5 business days after the 2017-2018 FY Budget Act becomes law, whichever occurs later, submit a request for authorization to start job site activities. The request must include:

1. CPM baseline schedule
2. Date you plan to start job site activities

The Department does not allow changes to the request after it is authorized.

Except for measuring controlling field dimensions and locating utilities, do not start job site activities until your WPCP or SWPPP, whichever applies, is authorized and the Department has received the following submittals:

1. Notice of Materials To Be Used form.
2. Contingency plan for reopening closures to traffic.

If you obtain authorization to start job site activities on the date you requested, start job site activities on the requested date. If you fail to submit a request for authorization to start job site activities as specified or if the request is not authorized, start job site activities within 15 days after Contract approval or 5 business days after the 2017-2018 FY Budget Act becomes law, whichever occurs later, except as specified below for the case of funds becoming available in the 2016-2017 FY Budget Act. Start work before August 16th, 2017.

Except as specified below for the case of funds becoming available in the 2016-2017 FY Budget Act, start job site activities by the later of the following dates:

1. 15th day after Contract approval
2. 5th business day after the 2017-2018 FY Budget Act becomes law
3. July 1, 2017

Work performed after July 1, 2017 that complies with the Contract is authorized and is paid for as specified when the 2017-2018 FY Budget Act becomes law and the Contract is approved.

Do not start work before July 1, 2017 unless:

1. Funds become available in the 2016-2017 FY Budget Act
2. Engineer and you agree on a start date after Contract approval

If the 2017-2018 FY Budget Act does not become law by August 1, 2017 and no work on the Contract has been performed, you may terminate the Contract at no cost to the State. This choice to terminate will not prejudice your performance and payment securities or your rights to participate in future bidding for the project. If you choose to terminate the Contract, you must submit notification of the termination by USPS certified mail with a return receipt and certificate of mailing to the Office Engineer.

The notification must be postmarked before the effective date of the 2017-2018 FY Budget Act.

The Department notifies you when the 2017-2018 FY Budget Act becomes law.
12 TEMPORARY TRAFFIC CONTROL

Add to the beginning of 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. Off-ramp closure
3. Connector closure

Add between the 5th and 6th paragraphs of section 12-3.32C:
Start displaying the message on the sign 5 minutes before closing the lane or shoulder or when directed by the Engineer.

Replace the table in the definition of designated holidays in section 12-4.02A(2) with:

<table>
<thead>
<tr>
<th>Designated Holidays</th>
<th>Date observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Year's Day</td>
<td>January 1st</td>
</tr>
<tr>
<td>Washington's Birthday</td>
<td>3rd Monday in February</td>
</tr>
<tr>
<td>Memorial Day</td>
<td>Last Monday in May</td>
</tr>
<tr>
<td>Independence Day</td>
<td>July 4th</td>
</tr>
<tr>
<td>Labor Day</td>
<td>1st Monday in September</td>
</tr>
<tr>
<td>Veterans Day</td>
<td>November 11th</td>
</tr>
<tr>
<td>Thanksgiving Day</td>
<td>4th Thursday in November</td>
</tr>
<tr>
<td>Christmas Day</td>
<td>December 25th</td>
</tr>
</tbody>
</table>

Add to section 12-4.02A(2):
special days: 3rd Monday in January.

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. HMA Paving
2. Striping
3. Cold-planning asphalt concrete for the depth of 2” or greater.

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 and special days.
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.

<table>
<thead>
<tr>
<th>Type of facility</th>
<th>Route</th>
<th>Direction or segment</th>
<th>Period</th>
<th>Liquidated damages/interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainline</td>
<td>113</td>
<td></td>
<td>1st half hour</td>
<td>$1,000/10 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2nd half hour</td>
<td>$1,000/10 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2nd hour and beyond</td>
<td>$1,000/10 minutes</td>
</tr>
<tr>
<td>Connector</td>
<td>113 / 80</td>
<td></td>
<td>1st half hour</td>
<td>$1,000/10 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2nd half hour</td>
<td>$1,000 /10 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2nd hour and beyond</td>
<td>$1,000/10 minutes</td>
</tr>
</tbody>
</table>

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. Installing loop detectors

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

Closure restrictions for designated holidays and special days are shown in the following table:
<table>
<thead>
<tr>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>H</td>
<td>xx</td>
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<td>x</td>
<td>xx</td>
<td>H</td>
<td>xx</td>
<td>xx</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>xxx</td>
<td>xxx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td></td>
<td></td>
<td></td>
<td>xxx</td>
<td>xxx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Refer to lane requirement charts.
- **x** The full width of the traveled way must be open for use by traffic after 05:00 AM.
- **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 8:00 PM.
- **H** Designated holiday
- **SD** Special day
Replace *Reserved* in section 12-4.02C(3)(i) with:

Comply with the requirements for the Complete Connector Closure Hours shown in the following chart:

<table>
<thead>
<tr>
<th>Chart No. I1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complete Connector Closure Hours</strong></td>
</tr>
<tr>
<td><strong>County:</strong> Solano</td>
</tr>
<tr>
<td><strong>Closure limits:</strong> Connector off-ramp to SB SR 113 South</td>
</tr>
<tr>
<td>Hour</td>
</tr>
<tr>
<td>Mon–Thu</td>
</tr>
<tr>
<td>Fri</td>
</tr>
<tr>
<td>Sat</td>
</tr>
<tr>
<td>Sun</td>
</tr>
</tbody>
</table>

**Legend:**

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

**REMARKS:** Detour traffic to next off-ramp (Off-ramp to Pitt School Rd.).

---

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:

<table>
<thead>
<tr>
<th>Chart No. K1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conventional Highway Lane Requirements</strong></td>
</tr>
<tr>
<td><strong>County:</strong> Solano</td>
</tr>
<tr>
<td><strong>Closure limits:</strong> From North Adams St. to Rte. 113/Rte.80 Separation (Br. No. 23-153)</td>
</tr>
<tr>
<td>Hour</td>
</tr>
<tr>
<td>Mon–Thu</td>
</tr>
<tr>
<td>Fri</td>
</tr>
<tr>
<td>Sat</td>
</tr>
<tr>
<td>Sun</td>
</tr>
</tbody>
</table>

**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:**
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 a 2-lane, 2-way highway where the useable shoulder width is less than 10 feet unless authorized.

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):
For multilane freeway or expressway lane closures, do not place the 2L tangent section shown along lane lines between the lane closure tapers.

Not more than 1 stationary closure is allowed in each direction of travel at one time.

14 ENVIRONMENTAL STEWARDSHIP

Replace the 2nd paragraph of section 14-8.02 with:
Noise from job site activities must not exceed 86 dBA Lmax at 50 feet from the job site from 10:00 p.m. to 6:00 a.m., except the following activities may exceed this noise restriction during the hours and on the days shown in the following table:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold plane asphalt concrete pavement</td>
<td>10:00 p.m. to 6:00 a.m.</td>
<td>Monday to Friday</td>
</tr>
</tbody>
</table>

Add to section 14-8.02:
Furnish 1 Type 1 sound-level meter and 1 acoustic calibrator for the Department to use until Contract acceptance to monitor noise.

The sound-level meter must:
1. Be calibrated and certified by the manufacturer or an independent acoustical laboratory before delivery to the Department
2. Be capable of taking measurements using the A-weighting network and the slow-response settings
3. Have a microphone fitted with a windscreen
4. Be recalibrated annually by the manufacturer or an independent acoustical laboratory

Provide training in noise monitoring to 1 Department employee designated by the Engineer. The person delivering the training must be trained in noise monitoring.

The Department returns the equipment to you at Contract acceptance.
39 ASPHALT CONCRETE

Replace the 2nd paragraph in section 39-2.02A(1) with:

Produce Type A HMA using a WMA additive technology.

Replace the paragraph in the RSS for section 39-2.02A(3)(b) with:

The JMF must be based on the Superpave HMA mix design system as described in the 7th edition of the MS-2 Asphalt Mix Design Methods by the Asphalt Institute.

For a Type A HMA mixture using RAP substitution greater than 15 percent of the aggregate blend, the asphalt binder grade from the HMA mixture must comply with the binder grade specified in section 39-2.02B(3). The HMA mixture binder grade must not be stiffer than the PG binder grade specified and must be determined by blending charts for high, intermediate, and low critical temperatures. Original binder requirements, ductility requirements, and footnote d in the table in the 1st paragraph in section 92-1.02B do not apply in the determination of the HMA mixture binder grade using blending charts.

Add to section 39-2.02A(3)(c):

For RAP substitution greater than 15 percent of the aggregate blend, submit blending calculation sheets and blending charts for high, intermediate, and low critical temperatures. The blending calculation sheets and blending charts must be based on the MS-2 Asphalt Mix Design Methods by the Asphalt Institute. You may use critical temperatures of virgin binder or the maximum theoretical critical temperature of the PG grade of the virgin binder. Critical temperatures must be in whole degree. The calculation sheets must be sealed and signed by an engineer who is registered as a civil engineer in the State or by the AMRL-AASHTO-accredited laboratory manager responsible for the calculations and blending charts.

Add between the heading and the 1st paragraph of section 39-2.02A(4)(b)(iii):

39-2.02A(4)(b)(iii)(A) General

Section 39-2.02A(4)(b)(iii) applies to Type A HMA mixtures using RAP substitution greater than 15 percent of the aggregate blend.

39-2.02A(4)(b)(iii)(B) Reclaimed Asphalt Pavement Stockpiles

Add to section 39-2.02A(4)(b)(iii):

39-2.02A(4)(b)(iii)(C) Virgin and Recovered Reclaimed Asphalt Pavement Binder

Perform solvent extraction of RAP binder under AASHTO T 164, Method A, and recovery under AASHTO R 59 or ASTM D1856. Test the quality characteristics of recovered RAP binder under the test methods and frequencies shown in the following table:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum testing frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical temperatures of RAP binder</td>
<td>AASHTO T 315 and AASHTO T 313</td>
<td>1 per project if RAP is not augmented or 1 per 500 tons of augmented RAP</td>
</tr>
</tbody>
</table>

If you use critical temperature of virgin binder in blending charts, test the quality characteristics of the virgin binder under the test methods and frequencies shown in the following table:
<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum testing frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical temperatures of virgin binder</td>
<td>AASHTO T 315 and</td>
<td>1 per 5 paving days or 1 per project, whichever is greater</td>
</tr>
<tr>
<td></td>
<td>AASHTO T 313</td>
<td></td>
</tr>
</tbody>
</table>

Determine the blended binder grade using blending charts under the MS-2 Asphalt Mix Design Methods by the Asphalt Institute each time the critical temperatures are determined.

Replace if RAP is used in item 2 in the list in section 39-2.02A(4)(e) with:
For RAP substitution greater than 15 percent of the aggregate blend

Replace the row for Moisture susceptibility (min, psi, dry strength) in the table in item 3 in the list in section 39-2.02A(4)(e) with:

| Moisture susceptibility (psi, dry strength) | AASHTO T 283 | 100–300 |

Add to the list in section 39-2.02A(4)(e):

4. For RAP substitution greater than 15 percent of the aggregate blend, the asphalt binder grade must comply with the specified binder grade. A tolerance of +2 degrees C may be applied to the critical high and low temperatures of the blended binder. Original binder requirements, ductility requirements, and footnote d in the table in the 1st paragraph in section 92-1.02B do not apply in the determination of the PG binder grade using blending charts.

Replace the row for Moisture susceptibility, dry strength (min, psi), in the table in section 39-2.02B(2) with:

| Moisture susceptibility, dry strength (psi) | AASHTO T 283 | 100–300 |

Replace the 3rd and 4th paragraphs in section 39-2.02B(2) with:
For a Type A HMA mixture using RAP substitution greater than 15 percent of the aggregate blend, the mix design blended binder grade must comply with the specified binder grade. The mix design blended binder grade must be determined using blending charts as described in the MS-2 Asphalt Mix Design Methods by the Asphalt Institute. Original binder requirements, ductility requirements, and footnote d in the table in the 1st paragraph in section 92-1.02B do not apply in the determination of the HMA mixture binder grade using blending charts.

Replace Reserved in section 39-2.02B(3) with:
The grade of asphalt binder for Type A HMA must be PG 64-10.

For Type A HMA using RAP substitution of greater than 15 percent of the aggregate blend, the HMA mixture binder grade must comply with the PG binder grade specified above.

For Type A HMA using RAP substitution of 15 percent or less of the aggregate blend, the grade of the virgin binder must comply with the PG binder grade specified above.

Replace the 2nd sentence in the 2nd paragraph of section 39-2.02B(11) with:
For RAP substitution of 15 percent or less, RAP must be within ±3 of RAP percentage shown in your Contractor Job Mix Formula Proposal form without exceeding 15 percent. For RAP substitution of greater than 15 percent, RAP must be within ±3 of RAP percentage shown in your Contractor Job Mix Formula Proposal form without exceeding 25 percent.
Replace section 39-2.08 with:

39-2.08 INTELLIGENT COMPACTION FOR HOT MIX ASPHALT

39-2.08A General

39-2.08A(1) Summary
Section 39-2.08 includes specifications for compacting HMA using intelligent compaction. This is a pilot project for evaluating intelligent compaction and the Department will not consider a VECP that substitutes the processes or equipment specified for intelligent compaction. Intelligent compaction does not waive any specifications for HMA.

Intelligent compaction uses vibratory steel drum rollers with intelligent compaction equipment and static pneumatic tire rollers equipped with automated machine guidance system that provide roller operator with real time information for quality control and produce data for standardized software Veta. For Veta, go to:

www.intelligentcompaction.com

Use Veta software to analyze the data for coverage uniformity, HMA temperature, and intelligent compaction measurement values.

Use intelligent compaction rollers and automated machine guidance rollers for breakdown, and intermediate compaction.

Create project layout files for the intelligent compaction system, automated machine guidance system and Veta from the existing pavement using GPS rover calibrated for the project site.

Project layout files must delineate the HMA construction area of project.

39-2.08A(2) Definitions

action limit: The minimum and maximum values of a quality control measurement that can be interpreted as representing acceptable performance with respect to the parameter being tested. Values less than the minimum or greater than the maximum action limit or level indicate that corrective action must be taken by the contractor.

all passes data: Compaction data that contain measurements from all passes.

automated machine guidance roller: Rollers equipped with measurement devices installed by the roller manufacturer or a post manufacture retrofit system including GPS, temperature sensor, on-board documentation system, and displays.

California coordinate system of 1983 (CCS83): A set of 6 geographic zones or coordinate systems designed for specific regions of the State of California, the boundaries of which follow county lines. CCS83 is based on NAD83. When a project crosses state plane zone boundaries, a single zone will be used for the entire project.

compaction data: Data collected by intelligent compaction equipment and automated machine guidance compaction equipment.

coordinated universal time (UTC): A time measurement system commonly referred to as Greenwich Mean Time (GMT) based on a 24-hour time scale from the mean solar time at the Earth's prime meridian (zero degrees longitude) located near Greenwich, England.

coverage: Single roller pass over a given area.

final coverage: Compaction data that contain the last pass measurements for a given area.

foot: Unit of measurement equal to U.S. survey foot.

good etic coordinates: A coordinate system to describe a position in longitude, latitude, and altitude above the imaginary ellipsoid surface based on a specific geodetic datum. The NAD83 datum is required for use with CCS83 State Plane Coordinates.
global positioning system (GPS): A space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth to determine the location in geodetic coordinates. GPS refers to all GPS-related signals including US GPS, and other Global Navigation Satellite Systems (GNSS). GPS satellite signals are subject to interference from canyons, buildings, trees or even fencing. Not all locations are suitable for GPS techniques, and it is your responsibility to determine if the job site conditions are practical for GPS, and to notify the Engineer if they are not.

GPS base station: A single ground-based system consisting of a GPS receiver, GPS antenna, and telemetry equipment (typically radio and radio antenna or cellular phone) to provide L1/L2 differential GPS correction signals to other GPS receivers.

GPS correction service subscription: A service that can be subscribed to receive differential GPS correction signals for higher accuracy GPS positioning without the need of a GPS Base Station. Signals are normally received via cellular wireless data services. Examples of GPS correction service subscriptions are: Trimble VRS™, Leica Smart RTK™, STARFIRE™, Topcon TopNet™ and OmniSTAR™.

GPS rover: A portable L1/L2 GPS antenna, mount, and receiver with telemetry equipment for Real Time in-situ point measurements.

GPS site calibration or localization: A process to establish a relationship between the observed GPS coordinates and the known grid coordinates.

grid: A Cartesian system of XY (or North-East) coordinates utilizing the California State Plane Coordinates, known as the California Coordinate System of 1983 (CCS 83).

intelligent compaction measurement value: A generic term for all intelligent compaction measurements in units specific to each roller manufacturer.

intelligent compaction equipment: Measurement devices installed by the roller manufacturer or a post manufacture retrofit system including accelerometer, GPS, temperature sensor, on-board documentation system, and displays.

intelligent compaction roller: Rollers equipped with measurement devices installed by the roller manufacturer or a post manufacture retrofit system including accelerometer, GPS, temperature sensor, on-board documentation system, and displays.

intelligent compaction target value: Compaction target values established at test strip or specified that are used by roller operator to monitor compaction and in data analysis to generate compaction quality control report.

network real time kinematic (Network RTK): A system that uses multiple bases in real-time to provide high-accuracy GPS positioning within the coverage area that is generally larger than that covered by a single GPS base station.

real time kinematic global positioning system (RTK-GPS): A system based on the use of carrier phase measurements of the available GPS signals where a single GPS base station or RTK network provides the corrections in order to achieve centimeter-level accuracy in real time.

roller pass: Movement of the roller in either direction.

universal transverse mercator (UTM) coordinate system: Is a 2-dimentional Cartesian coordinates system that divides the surface of Earth between 80°S and 84°N latitude into 60 zones, each 6° of longitude in width and centered over a meridian of longitude. Zone 1 is bounded by longitude 180° to 174° W and is centered on the 177th West meridian. The UTM system uses projection techniques to transform an ellipsoidal surface to a flat map that can be printed on paper or displayed on a computer screen. Note that UTM is metric-based.

39-2.08A(3) Submittals
39-2.08A(3)(a) General
At least 15 days before performing intelligent compaction, 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 the following electronic mailbox address:
IC@dot.ca.gov

Forms for intelligent compaction submittals are available at:
http://www.dot.ca.gov/hq/construc/ic/

39-2.08A(3)(b) Intelligent Compaction Training
39-2.08A(3)(b)(i) Just-In-Time Training

At the time of JMF submittal, submit a list of names participating in the just-in-time training. Identify each participant by name, employer, title, and role in intelligent compaction.

At least 10 days before just-in-time training, submit:
1. Just-in-time training presentation and handouts for review
2. Completed Intelligent Compaction Field Operations Just-In-Time Training Review Checklist form
3. Completed Geospatial Data and Analysis Just-In-Time Training Review Checklist form

39-2.08A(3)(b)(ii) Intelligent Compaction Quality Control Technician Training

At least 15 days before performing intelligent compaction, submit the name of your intelligent compaction quality control technician. Effective January 1, 2017, submit documentation that the technician has completed a Department-authorized intelligent compaction quality control training course within the last 12 months.

39-2.08A(3)(b)(iii) Data Analysis Technician Training

At least 5 days before performing intelligent compaction, submit the name of your data analysis technician. Effective January 1, 2017, submit documentation that the technician has completed a Department-authorized intelligent compaction data analysis training course within the last 12 months.

39-2.08A(3)(b)(IV) GPS Site Calibration or Localization Report and Check Testing

Submit GPS site calibration or localization report and check testing results for intelligent compaction rollers and automated machine guidance rollers within 1 business day of calibration or check testing.

39-2.08A(3)(c) Reports and Information
39-2.08A(3)(c)(i) General

If unable to submit or upload report and information within the specified time, notify the Engineer of the actions being taken to submit and upload information timely.

39-2.08A(3)(c)(ii) Reports
39-2.08A(3)(c)(ii)(A) Test Strip

Within 1 business day of test strip submit:
1. Hard copy of completed Intelligent Compaction Hot Mix Asphalt Construction Test Strip Submittals Summary
2. Adobe (*.pdf) file of the test strip report by email to the Engineer
3. Adobe (*.pdf) file of Intelligent Compaction Hot Mix Asphalt Quality Control Report Checklist form by email to the Engineer

39-2.08A(3)(c)(ii)(B) HMA Placement

Within 1 business day of HMA placement submit:
1. Hard copy of completed:
   1.1. Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt With Method Compaction
   1.2. Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Density Requirement.
2. Adobe (*.pdf) file of the compaction quality control report by email to the Engineer
3. Adobe (*.pdf) file of Intelligent Compaction Hot Mix Asphalt Quality Control Report Checklist form by email to the Engineer
39-2.08A(3)(c)(iii) Information
Within 3 business days of test strip or HMA placement:

1. Submit information on a digital medium to the Engineer.
2. Upload information to the Department's secure file sharing system.
3. After uploading the compaction information to the Department's file sharing system, send an email notification of your electronic submittal to the Engineer and IC@dot.ca.gov with the appropriate completed checklist form as an attachment:
   3.1. Intelligent Compaction Hot Mix Asphalt Test Strip Information Checklist
   3.2. Intelligent Compaction Hot Mix Asphalt Quality Control Information Checklist

39-2.08A(3)(d) Data and Software Analysis Results
39-2.08A(3)(d)(i) General
Not Used

39-2.08A(3)(d)(ii) Data
Submit compaction data in a format that is readable by Veta. You may combine roller data for multiple rollers operating in echelon into a section file.

Name the data file using:

`YYYYMMDD_TTCCCRRR_DB_L_B_E_X_PT_TC_T_Data`

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, no leading zeros
- `DB` = Traffic direction as NB, SB, WB, or EB
- `L` = Lane number from left to right in direction of travel
- `B` = Beginning station to the nearest foot (i.e., 10+20) or beginning post mile to the nearest hundredth (e.g., 25.06) no leading zero
- `E` = Ending station to the nearest foot (i.e., 14+20) or ending post mile to the nearest hundredth (i.e., 28.06) maximum 6 characters with no leading zero
- `X` = HMA layer number, 1, 2 …etc.
- `PT` = Pavement Type (e.g., HMA, RHMA, HMA-O, RHMA-O, RHMA-G, etc.) with maximum 6 characters
- `TC` = Type of compaction “BC” for breakdown compaction, “IC” for intermediate compaction, “FC” for finish compaction. When combined use combination e.g. “BC-IC” for breakdown and intermediate compaction.
- `T` = Type of roller “R” for rubber tire, “SV” for steel drum with vibrator on, “SS” for steel drum static, “SV-SS” for single roller combination of steel drum static and vibratory on.

Use the following header information for each compaction data file or section:
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Section Title</td>
</tr>
<tr>
<td>2</td>
<td>Machine Manufacture</td>
</tr>
<tr>
<td>3</td>
<td>Machine Type</td>
</tr>
<tr>
<td>4</td>
<td>Machine Model</td>
</tr>
<tr>
<td>5</td>
<td>Drum Width (inch)</td>
</tr>
<tr>
<td>6</td>
<td>Drum Diameter (inch)</td>
</tr>
<tr>
<td>7</td>
<td>Machine Weight (ton)</td>
</tr>
<tr>
<td>8</td>
<td>Name index of intelligent compaction measurement values</td>
</tr>
<tr>
<td>9</td>
<td>Unit index for intelligent compaction measurement values</td>
</tr>
<tr>
<td>10</td>
<td>Reporting resolution for independent for intelligent compaction measurement values 90 degrees to the roller moving direction (inch)</td>
</tr>
<tr>
<td>11</td>
<td>Reporting resolution for independent intelligent compaction measurement values in the roller moving direction (inch)</td>
</tr>
<tr>
<td>12</td>
<td>CCS83 Zone</td>
</tr>
<tr>
<td>13</td>
<td>Offset to UTC (hrs)</td>
</tr>
<tr>
<td>14</td>
<td>Number of IC data points</td>
</tr>
</tbody>
</table>

**Use the following data field names for each compaction data point:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Data Field Name</th>
<th>Example of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Date Stamp (YYYYMMDD)</td>
<td>20080701</td>
</tr>
<tr>
<td>2</td>
<td>Time Stamp (HHMMSS.SS -military format)</td>
<td>090504.00 (9 hr 5 min. 4.00 s.)</td>
</tr>
<tr>
<td>3</td>
<td>Longitude (decimal degrees or degrees minutes-seconds)</td>
<td>94.85920403</td>
</tr>
<tr>
<td>4</td>
<td>Latitude (decimal degrees or degrees-minutes-seconds)</td>
<td>45.22777335</td>
</tr>
<tr>
<td>5</td>
<td>Easting (Foot)</td>
<td>6,096,666.000</td>
</tr>
<tr>
<td>6</td>
<td>Northing (Foot)</td>
<td>1,524,166.650</td>
</tr>
<tr>
<td>7</td>
<td>Elevation (Foot)</td>
<td>339.9450</td>
</tr>
<tr>
<td>8</td>
<td>Roller pass number</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Direction index</td>
<td>1 forward, 2 reverse</td>
</tr>
<tr>
<td>10</td>
<td>Roller speed (mph)</td>
<td>2.0</td>
</tr>
<tr>
<td>11</td>
<td>Vibration on</td>
<td>1 for yes, 2 for no</td>
</tr>
<tr>
<td>12</td>
<td>Frequency (vpm)</td>
<td>3500.0</td>
</tr>
<tr>
<td>13</td>
<td>Amplitude (inch)</td>
<td>0.0236</td>
</tr>
<tr>
<td>14</td>
<td>Surface temperature (°F)</td>
<td>270</td>
</tr>
<tr>
<td>15</td>
<td>Intelligent compaction measurement values</td>
<td>20.0</td>
</tr>
</tbody>
</table>

**Note:** Provide either items 3 and 4 or items 5 and 6.
The GPS coordinate for each compaction data point recorded in data files must be at the center of the front drum or center of the roller in front.

The size of data mesh after post processing must be less than 1.5 feet by 1.5 feet in the X and Y directions.

39-2.08A(3)(d)(iii) Software Analysis Results

39-2.08A(3)(d)(iii)(A) General

Analyze the compaction data daily using Veta and include nuclear gauge and temperature data point tests, target values for passes, HMA temperature, and intelligent compaction measurement values. For a subplot report, use subplot length of 528 feet.

For test strips and daily compaction quality control reports create and apply a boundary filter for the area of hot mix to be analyzed to exclude extraneous intelligent compaction data. The boundary filter may be applied in the preprocessed raw roller data or created and applied in the Veta analyses. Create the boundary in Veta analyses by either importing GPS coordinates measured in the field from the boundary of the area of hot mix asphalt placed or by using the project layout and applying a filter to limit the analysis to the area of hot mix asphalt placed.

Name report files and post processed Veta files using:

$$ YYYYMMDD\_TTCCRRR\_DB\_L\_B\_E\_X\_PT\_TC\_T\_TYPE $$

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, no leading zeros
- $DB$ = Traffic direction as NB, SB, WB, or EB
- $L$ = Lane number from left to right in direction of travel
- $B$ = Beginning station to the nearest foot (i.e., 10+20) or beginning post mile to the nearest hundredth (i.e., 25.06) maximum 6 characters with no leading zero.
- $E$ = Ending station to the nearest foot e.g., 14+20) or ending post mile to the nearest hundredth (i.e., 28.06) maximum 6 characters with no leading zero.
- $X$ = HMA layer number, 1, 2 …etc.
- $PT$ = Pavement Type (e.g., HMA, RHMA, HMA-O, RHMA-O, RHMA-G, etc.) maximum 6 characters.
- $TC$ = Type of compaction “BC” for breakdown compaction, “IC” for intermediate compaction or “FC” for finish compaction
- $T$ = Type of roller “R” for rubber tire or “S” for steel drum

39-2.08A(3)(d)(iii)(B) Test Strip

Test strip report must include:

1. Completed Intelligent Compaction Hot Mix Asphalt Test Strip Report Summary form
2. Nuclear gauge density per location and corresponding GPS measured coordinates per location
3. All passes compaction curves from Veta
4. All passes correlation analysis plot from Veta
5. Field compaction curve density versus number of passes
6. All passes histogram for each roller
7. Color layout plots of:
   7.1. Roller passes for each roller
   7.2. HMA temperature for 1st coverage of breakdown compaction
   7.3. HMA temperature for final coverage of intermediate compaction
   7.4. Intelligent compaction measurement value for final coverage of steel drum with vibration on

Plots must be scaled to be legible and must be 11 by 17 inches.

Contract No. 04-1K0704
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8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates

Test strip information must include:

1. Adobe (*.pdf) file of the test strip report from data analysis performed using Veta software
2. Project layout data files which can be imported to Veta
3. Test strip boundary data files which can be imported to Veta
4. Nuclear gauge density readings and the corresponding coordinates which can be imported into Veta
5. Electronic data from compaction rollers in file format readable by Veta
6. Post processed Veta file (*.vetaproj) used for creating the test strip report

39-2.08A(3)(d)(iii)(C) HMA Compaction

For each day of production, prepare a HMA compaction quality control report that includes:

1. Summary of HMA compaction quality control results on Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt With Method Compaction form or Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Density Requirement form
2. Veta analysis report results for:
   2.1. Percent compliance with target roller passes
   2.2. Percent compliance with target HMA temperature for first coverage of breakdown compaction
   2.3. Percent compliance with target HMA temperature for final coverage of intermediate compaction
   2.4. Percent compliance with target HMA intelligent compaction measurement value when measurement of intelligent compaction measurement value is required
3. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on
4. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a sublot
5. All passes histogram for each roller
6. Color layout plots of:
   6.1. Roller passes for each roller
   6.2. HMA temperature for first coverage of breakdown compaction.
   6.3. HMA temperature for final coverage of intermediate compaction.
   6.4. Intelligent compaction measurement value for final coverage of intermediate compaction when required.
7. Quality control density measurements and corresponding GPS coordinate
8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates

Plots must include quality control density testing and HMA mat temperature locations and test results.

Quality control compaction information must include:

1. Adobe (*.pdf) file of the compaction quality control report from data analysis performed using Veta software
2. Project layout data files which can be imported to Veta
3. Boundary data files which can be imported to Veta
4. Nuclear gauge density readings and the corresponding GPS coordinates which can be imported into Veta
5. HMA mat temperatures and the corresponding GPS coordinates which can be imported into Veta
6. Electronic data from compaction rollers in file format readable by Veta
7. Post processed Veta file (*.vetaproj) used for creating the test strip

39-2.08A(4) Quality Assurance

39-2.08A(4)(a) General

For HMA placed under section 39-1.03O(2) method compaction, use intelligent compaction rollers and automated machine guidance rollers for documenting that HMA compaction complies with the method compaction requirements for the followings:

1. Number of roller passes
2. HMA temperature for first coverage of breakdown compaction
3. HMA temperature at the completion of intermediate compaction
Do not collect intelligent compaction measurement values when the compacted HMA layer is less than 0.15 foot.

When HMA thickness is 0.15 foot or greater, intelligent compaction rollers provide additional real time quality control for HMA density based on the intelligent compaction measurement value which is correlated to the specified HMA target density at the test strip.

The number of roller passes, HMA temperature, and intelligent compaction measurement values are for report only and are not used for compaction acceptance.

39-2.08A(4)(b) Technical Representative
A technical representative from the intelligent compaction equipment manufacturer and automated machine guidance system or post manufacture retrofit system must be on job site during the initial setup, verification testing of the compaction rollers, and first 2 days of production. If requested, the technical representative must assist the Engineer with data management using Veta including compaction data input and processing.

39-2.08A(4)(c) Quality Control Technician
During HMA compaction provide a full time intelligent compaction quality control technician to be responsible for oversight of the following:

1. GPS site calibration or localization and upload to all GPS receivers.
2. GPS check testing for the compaction rollers and rovers.
3. Accuracy verification of the temperature sensor by comparing to a NIST traceable standard. The equipment temperature sensor measurement must be within +/- 3 degrees F of NIST traceable standard.
4. Test section construction to establish target compaction pass counts and target values for the stiffness of the HMA using nuclear gauges, pavement cores, and intelligent compaction rollers.
5. Construction operation monitoring of the compaction rollers.
6. Quality control testing for pavement temperature and compaction.
7. Backing up data compaction data twice per day.
8. Downloading data from rollers at the end of the work shift.
9. Monitoring daily compaction quality control report results for compliance with the requirements in these specifications and taking corrective action when necessary for compliance.
10. Daily set-up, take-down, of GPS and compaction roller components.

39-2.08A(4)(d) Data Analysis Technician
Provide an intelligent compaction data analysis technician who is responsible for performing the following:

1. Exporting final coverage and all-passes data to Veta compatible form by using vendor specific intelligent compaction software
2. Analyzing the data from the compaction rollers using Veta and producing reports
3. Submitting and uploading intelligent compaction reports and information

39-2.08A(4)(e) Intelligent Compaction Training
39-2.08A(4)(e)(i) General
Not Used

39-2.08A(4)(e)(ii) Just-in-Time Training
Provide just-in-time training onsite or near the job site for your personnel and Department project personnel. Provide an enclosed facility with electrical availability for visual presentations.

The just-in-time-training for intelligent compaction is divided into 2 sessions:

1. Intelligent compaction field operations
2. Intelligent compaction geospatial data and analysis
39-2.08A(4)(e)(iii) Intelligent Compaction Field Operations Just-in-Time Training

At least 2 business days before training, notify the Engineer of the time and place of intelligent compaction field operations just-in-time training. Intelligent compaction field operations just-in-time training must be at least 2 hours in duration and include the following topics:

1. Background information for the specific intelligent compaction system and automated machine guidance system to be used
2. Setup and checks for compaction systems, including:
   2.1. GPS receiver
   2.2. GPS rovers
   2.3. Rollers
3. Operation of the intelligent compaction system and automated machine guidance systems on the rollers, including:
   3.1. Setup data collection
   3.2. Start/stop of data recording
   3.3. On-board display options
4. Action limits to be used by the roller operators for:
   4.1 HMA Mat Temperature
   4.2 Number of passes

The following personnel must attend the intelligent compaction field operations just-in-time training:

1. Roller operators
2. Intelligent compaction quality control technician
3. Technical representative
4. HMA foreman

39-2.08A(4)(e)(iv) Intelligent Compaction Geospatial Data and Analysis Just-in-Time Training

Schedule the just-in-time training with the Engineer at a mutually agreed time and place. Provide training materials for 1 Department personnel. Intelligent compaction geospatial data and analysis just-in-time training must be at least 2 hours in duration and include the following topics:

1. Transferring raw compaction data from the rollers using USB connections.
2. Operation of vendor’s software to open and view raw compaction data files and to export all-passes and proofing data files in Veta-compatible format. If using the vendor’s software to create boundary for the area of hot mix asphalt daily production, demonstrate the procedure.
3. Operation of Veta software to:
   3.1. Import the exported all-passes and proofing data files
   3.2. Import project layout
   3.3. Demonstrate the procedure for creating the boundary, if using the Veta software to create boundary for the area of hot mix asphalt daily production.
   3.4 Review the compaction maps
   3.5. Import compaction point test data
   3.6. Perform statistical analysis
   3.7. Generate specified reports
4. Method for establishing target values for:
   4.1 Number of passes
   4.2 Temperature
   4.3 Intelligent compaction measurement values
5. Coverage and uniformity requirements.
6. Corrective actions to be taken when coverage and uniformity requirements are not met.

The following personnel must attend the intelligent compaction geospatial data and analysis just-in-time training:

1. Technical representative
2. Intelligent compaction quality control technicians
3. Data analysis technician
4. HMA foreman
39-2.08A(4)(e)(v) Intelligent Compaction Quality Control Technician Training

Effective April 1, 2017, submit documentation that the technician has completed a Department-authorized intelligent compaction quality control training course within the last 12 months. A Department-authorized intelligent compaction quality control training course must cover:

1. Intelligent compaction specification requirements for quality control technician responsibilities
2. GPS site calibration or localization
3. GPS check testing for the compaction rollers and rovers
4. Equipment operation verification of:
   4.1. Positioning system
   4.2. Temperature sensor
   4.3. Accelerometer
5. Establishing project layout
6. Establishing construction boundary for:
   6.1. Test strip
   6.2. Daily HMA placement
7. Test section construction to establish target compaction pass counts, temperature and target values for the stiffness of the HMA using nuclear gauges, pavement cores, and intelligent compaction rollers
8. Establishing of action limits for:
   8.1. Roller passes
   8.2. HMA mat temperature
9. Monitoring the rollers operation for compliance with target values
10. Quality control testing for pavement temperature and compaction
11. Review of daily compaction quality control report results for compliance with the specifications and taking corrective action when necessary for compliance
12. Data management
   12.1. Verify uploading of data
   12.2. Downloading data from rollers
   12.3. Backing up compaction data
13. Daily set-up, take-down, of GPS and compaction roller components

39-2.08A(4)(e)(vi) Data Analysis Technician Training

Effective January 1, 2017, submit documentation that the technician has completed a Department-authorized intelligent compaction data analysis training course within the last 12 months. A Department-authorized data analysis training course must cover:

1. Intelligent compaction specification requirements for:
   1.1. Data analysis using Veta
   1.2. Reporting
2. Operation of Veta software to:
   2.1. Import post processed all-passes and final coverage data files
   2.2. Import project layout
   2.3. Import points and create boundary
   2.4. Create boundary for the area of hot mix asphalt daily production using project layout and beginning and ending stations
   2.5. Import compaction point test data
   2.6. Import HMA mat temperature data
   2.7. Review the compaction maps
   2.8. Generate 11 by 17 inches plots
   2.9. Perform statistical analysis
   2.10. Generate specified reports
3. Using example project data, provide hand-on Veta analysis training to produce a mock up test strip report
4. Using example project data, provide hand-on Veta analysis training to produce a mock up compaction quality control report
5. Provide training for completing intelligent compaction forms
6. Cover specification requirements for submittal of reports and information including file naming requirements
39-2.08A(5) Prepaving Meeting

The intelligent compaction quality control technician must attend the prepaving meeting.

39-2.08A(6) IC Test Strip

39-2.08A(6)(a) General

When HMA thickness is 0.15 foot or greater, a test strip is used to establish intelligent compaction target values. Establish intelligent compaction target values for the following:

1. Number of roller passes for breakdown compaction
2. Minimum temperature in degrees F for roller 1st pass of breakdown compaction
3. Number of roller passes for intermediate compaction
4. Minimum temperature in degrees F for completing intermediate compaction
5. Intelligent compaction measurement value

The target number of roller passes is based on your roller pattern established to achieve specified density.

To establish target minimum hot mix asphalt mat temperatures:

1. Use Veta to analyze the hot mix asphalt mat temperature for 1st pass of breakdown compaction to establish the target minimum temperature in degrees for the 1st pass of breakdown compaction.
2. Use Veta to analyze the hot mix asphalt mat temperature for last pass of intermediate compaction to establish the target minimum temperature in degrees for F for the last pass of intermediate compaction.

39-2.08A(6)(b) Initial Establishment of Target Value for Intelligent Compaction Measurement Value

On the 1st day of placement of each layer of HMA, construct a test strip at least 500 feet long to determine the intelligent compaction target values. The compaction curve must be created by Veta and relate the number of roller passes to intelligent compaction measurement values. Use handheld rover to establish boundary for the 500-foot section. Use handheld rover to establish 3 randomly selected nuclear gauge density test locations. Nuclear gauges must be correlated with density cores under Part 2 of California Test 375.

To establish the target intelligent compaction measurement value within the test strip:

1. After each coverage, use a nuclear gauge to measure the density of the HMA at 3 preselected locations throughout the covered 500 foot section. Record the density readings, and number of roller passes.
2. Establish the density of the test strip for each coverage by averaging the density at the 3 locations.
3. Continue roller passes and collecting nuclear gauge density readings until the density remains constant, decreases, or reaches maximum specified density.
4. When you determine that the density remains constant, decreases, or reaches maximum specified density, take an additional 7 randomly selected nuclear gauge readings. If the average density of the 10 locations determined for the last coverage indicates an increase in density by more than 3 percent, then continue rolling and testing, except if the average density equals or exceeds the maximum specified density.
5. Use Veta to create compaction curve and relate the number of target value for roller passes to intelligent compaction measurement values.
6. Use the Veta generated correlation analysis report for all passes to establish production target intelligent compaction measurement value based on target density (percent theoretical maximum density) that meets the specified in-place compaction requirements.

If the last roller coverage of intermediate compaction is not done with the steel drum roller with vibration on, establish target intelligent compaction measurement value for the final roller pass of the steel drum roller with vibration on based on your test strip roller pattern.

39-2.08A(6)(c) Reestablishment of Target Value for Intelligent Compaction Measurement Value

Reestablish the target intelligent compaction measurement value by recording density readings versus measured intelligent compaction measurement value. During HMA placement within a 500-foot section, for the roller pass used as the basis for the target intelligent compaction measurement value use a
nuclear gauge to measure the density at 3 random locations. Record the density readings, roller pass number, and the GPS coordinates for each test location. Use handheld rover to establish boundary for the 500-foot section.

Use the Veta generated correlation analysis report to reestablish production target value for intelligent compaction measurement value based on target density (percent theoretical maximum density) that meets the specified in-place compaction requirements. If the last roller coverage of intermediate compaction is not done with the steel drum roller with vibration on, reestablish target intelligent compaction measurement value for the final roller pass of the steel drum roller with vibration on based on your roller pattern.

39-2.08B Materials
Not Used

39-2.08C Construction

39-2.08C(1) General
Before the start of production, upload the project layout file into the intelligent compaction data analysis software and depending on the roller manufacture, on-board documentation system of the rollers.

39-2.08C(2) Equipment

39-2.08C(2)(a) General
Not Used

39-2.08C(2)(b) Rollers
In addition to the requirements of section 39-2.01C(2)(a), each intelligent compaction roller must:

1. Be double-drum vibratory rollers equipped with accelerometers mounted in or about the drum to measure the interactions between the rollers and compacted materials in order to evaluate the applied compaction effort
2. Be equipped with non-contact temperature sensors for measuring pavement surface temperatures
3. With vibratory on, produce output that represents the stiffness of the material based on the vibration of the roller drums and the measured response from the underlying materials
4. Have mounted GPS receiver, antenna, and telemetry equipment to monitor the drum locations and track the number of passes
5. Include an integrated on-board documentation system that is capable of displaying real-time color-coded maps, including the stiffness response values, vibration frequencies, roller drum amplitude, roller location, number of roller passes, roller speeds and capable of transferring data from a USB port

In addition to the requirements in section 39-2.01C(2)(a), automated machine guidance pneumatic tire rollers must meet the following:

1. Be equipped with non-contact temperature sensors for measuring pavement surface temperatures
2. Have GPS radio and receiver units mounted on each automated machine guidance roller to monitor the roller locations and track the number of passes of the rollers
3. Include an integrated on-board documentation system that is capable of displaying real-time color-coded maps of roller location, number of roller passes, roller speeds and capable of transferring data from a USB port

39-2.08C(2)(c) Global Positioning System

39-2.08C(2)(c)(i) General
GPS must be real time kinematic using one of the following:

1. GPS base station
2. Network real time kinematic (RTK)
3. Satellite based augmentation station system capable of providing position accuracy within 0.25 foot

You may use other high precision positioning systems in lieu of GPS. The positioning system must meet or exceed the precision specified for GPS.
GPS used must provide a minimum 90 percent coverage of job site.

GPS devices for this project must be set to the same consistent datum, coordinate system, CCS83 zone, and site calibration or localization. The CCS83 zone must be set to zone no_.

Prior to July 2016, you may use UTM coordinate system if your roller on-board documentation system and display are not compatible with CCS83. Notify the engineer if you will use UTM coordinate system.

39-2.08C(2)(c)(ii) Correction Signal Source
Provide either a GPS base station correction signal or a GPS correction service subscription. The GPS correction signal must be received by the GPS receivers on the compaction roller and the rovers during operations with a survey tolerance of not greater than 0.25 foot in both X and Y horizontal directions.

Install GPS repeaters at selected locations to relate the GPS correction signal to resolve GPS shadows.

39-2.08C(2)(c)(iii) Survey Control Points
Request horizontal survey control points at least 15 days prior to GPS site calibration or localization. Survey control points will be provided at least every mile.

39-2.08C(2)(c)(iv) GPS Site Calibration or Localization and Check Testing
At least 2 business days before start of production, perform a GPS site calibration or localization to the survey control points.

Whenever the GPS base station is moved to a new location, verify GPS base station position by measuring the position of two known points using a rover. Perform a GPS site calibration or localization if the position of known points and measured positions differ by more than 3 centimeters.

At least 2 business days before start of production, perform roller verification testing by conducting roller check testing.

Before the start of daily production and using the same datum, conduct check testing for the proper setup of the GPS, the GPS on the rollers, and the GPS rover:
1. On a location nearby or within the project limits, the GPS base station, if required by the GPS, must be established and the compaction roller and the GPS rover must be tied into the same base station
2. Verify that the roller and rover are working properly and that there is a connection with the base station
3. Verify the roller GPS coordinates by:
   3.1. Stopping the roller at a location.
   3.2. Marking the location of both ends of the roller drum or the outside of the front tires on the surface with a tee.
   3.3. Recording the GPS measurements from the roller ensuring the distance offsets are applied so that the GPS coordinate is at the center of the front drum.
   3.4. Moving the roller from the marked location.
   3.5. Finding the mid-point of the two marked ends of the roller and mark this location on the surface. This marked location is the theoretical center of the front drum or center of front axle.
   3.6. Using the GPS rover to measure GPS coordinates of the marked location and record the GPS measurements.
   3.7. Computing the difference between recorded compaction roller GPS coordinates and GPS rover recorded GPS measured coordinates. The differences of the coordinates in grid must be within 0.5 foot in both the horizontal axes X and Y.

39-2.08C(3) HMA Compaction
39-2.08C(3)(a) General
Intelligent compaction does not apply to areas of hot mix asphalt placed under Bid Item “Replace Asphalt Concrete Surfacing” or areas shown as digouts.

During HMA compaction, monitor each roller’s compaction graphical user interface display for roller passes, and HMA temperature. When HMA layer thickness is 0.15 foot or greater, monitor each roller’s compaction graphical user interface display for intelligent compaction measurement value.
For every 4 hours of HMA placement, Use a verified NIST traceable temperature measuring device and measure the temperature of the HMA at 3 random locations on first pass of breakdown and last pass of intermediate compaction. The temperature measuring device must be within +/− 3 degrees F of NIST traceable standard. Use GPS rover to measure and record coordinates of each temperature test point reading.

For intermediate compaction of RHMA-G, use an intelligent compaction roller instead of the automated machine guidance pneumatic tire roller.

When HMA thickness is 0.15 foot or greater, use GPS rover to measure and record coordinates of each quality control nuclear gauge reading.

For each day of HMA placement establish the boundaries of the area for HMA placed using the rover.

39-2.08C(3)(b) Roller Coverage, HMA Temperature, and Intelligent Compaction Measurement Values

At least 90 percent coverage of the construction area must meet or exceed the target number of passes for each roller type. When the daily HMA compaction quality control report shows the specified or target roller passes are not met, take corrective action and notify the Engineer of action taken.

When the roller HMA temperature sensor indicates compaction temperatures are below target temperatures take immediate corrective action.

At least 95 percent of the construction area must comply with the target temperatures. When the daily HMA compaction quality control report indicates less than 95 percent of the construction area is completed after HMA is below the minimum target temperature, implement corrective action before the next HMA placement day and notify the Engineer.

For HMA 0.15 foot or greater in layer thickness, monitor the intelligent compaction measurement value against the target value established in the test strip. If intelligent compaction measurement value is 10 percent or more below the target value, verify that HMA compaction complies with density specified requirements with a nuclear gauge.

If the daily average intelligent compaction measurement value is 20 percent or more below the target measurement value, reestablish the target value for intelligent compaction measurement value.

For HMA 0.15 foot or greater in layer thickness, when density is verified, then the corrective action for number of passes and temperature is not required.

39-2.08D Payment

Not Used

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DIVISION X ELECTRICAL WORK
86–88 RESERVED

Add to the list in the 2nd paragraph of section 86-1.02C(1) of the RSS for section 86:
13. CALTRANS, on all the pull boxes unless noted otherwise.

Add to the 3rd paragraph of section 87-1.03A of the RSS for section 87:
Notify the Department of Transportation, Electrical and Signal Maintenance Superintendent at (415) 330-6500, 3 days before performing work on any existing system.

Replace the 1st sentence of the 9th paragraph of section 87-1.03A of the RSS for section 87 with:
Limit the shutdown of traffic signal systems between the hours of 10:00 a.m. and 3:00 p.m.
Add to the 23rd paragraph of section 87-1.03A of the RSS for section 87:
Verify the location of the loop detectors to be replaced before repaving.

Provide two reports for each location on the status of loops replacement for continuity and insulation resistance. The report must submit to the Engineer 1 day before starting work and after work has been completed.

Replace the 1st paragraph of section 87-1.03F(3)(c)(ii) of the RSS for section 87 with:
Use a Type 2 loop wire.

Replace the 2nd paragraph of section 87-1.03H(2) of the RSS for section 87 with:
Use Method B to insulate a splice.

Add to the section 87-1.03V(1) of the RSS for section 87:
Where one or more traffic signal detectors consist of a sequence of 4 loops in a single lane, the front loop closest to limit line or crosswalk must be located 1 foot from the line. The set of 3 or 4 loops assigned to the same loop detector lead-in cable (DLC) must be connected in series for traffic signal system.

Add between the 11th and 12th paragraphs of section 87-1.03V(2) of the RSS for section 87:
Use elastomeric sealant or hot-melt rubberized sealant to fill slots.

Add to the end of section 87-21.03C of the RSS for section 87:
Modifying a signal and lighting system includes removing, adjusting, or adding:
1. Pull boxes
2. Conduit
3. Conductors
4. Cables
5. Detectors
6. Detector handholes
REVISED STANDARD SPECIFICATIONS
APPLICABLE TO THE 2015 EDITION
OF THE STANDARD SPECIFICATIONS
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.

DIVISION I  GENERAL PROVISIONS

1  GENERAL

Delete item 1 in the list in the 12th paragraph of section 1-1.01.

Add to the 1st table of section 1-1.06:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>APCD</td>
<td>air pollution control district</td>
</tr>
<tr>
<td>AQMD</td>
<td>air quality management district</td>
</tr>
<tr>
<td>CISS</td>
<td>cast-in-steel shell</td>
</tr>
<tr>
<td>CSL</td>
<td>crosshole sonic logging</td>
</tr>
<tr>
<td>GGL</td>
<td>gamma-gamma logging</td>
</tr>
</tbody>
</table>

Replace plant establishment period and its definition in section 1-1.07B with:

plant establishment period: Number of working days shown on the Notice to Bidders for plant establishment work.

Add to section 1-1.07B:

permanent erosion control establishment period: Number of working days shown on the Notice to Bidders for permanent erosion control establishment work.
Delete the row for Bidders' Exchange in the table of section 1-1.11.

2 BIDDING
03-03-17
Replace the headings and paragraphs of section 2 with:

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)].

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

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.

If an Information Handout or cross sections are available, you may view them at the Contract Plans and Special Provisions link at the Department's Office of Construction Contract Awards website.

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.
2-1.15 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:

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:


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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.


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:

<table>
<thead>
<tr>
<th>Form</th>
<th>Submittal deadline</th>
</tr>
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<tbody>
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<td>Bid to the Department of Transportation</td>
<td>Time of bid except for the public works contractor registration number</td>
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<tr>
<td>Copy of the Bid to the Department of Transportation as submitted at the time of bid with the public works contractor registration number</td>
<td>10 days after bid opening</td>
</tr>
<tr>
<td>Subcontractor List</td>
<td>Time of bid except for the public works contractor registration number</td>
</tr>
<tr>
<td>Copy of the Subcontractor List as submitted at the time of bid with the public works contractor registration number</td>
<td>10 days after bid opening</td>
</tr>
<tr>
<td>Small Business Status</td>
<td>Time of bid</td>
</tr>
<tr>
<td>Opt Out of Payment Adjustments for Price Index Fluctuations*</td>
<td>Time of bid</td>
</tr>
<tr>
<td>DBE Commitment</td>
<td>No later than 4 p.m. on the 5th day after bid opening^</td>
</tr>
<tr>
<td>DBE Confirmation</td>
<td>No later than 4 p.m. on the 5th day after bid opening^</td>
</tr>
<tr>
<td>DBE Good Faith Efforts Documentation</td>
<td>No later than 4 p.m. on the 5th day after bid opening^</td>
</tr>
</tbody>
</table>

*Submit only if you choose the option.
^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.

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:
Bid Form Submittal Schedule for an Informal-Bid Federal-Aid Contract with a DBE Goal

<table>
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<tr>
<td>Opt Out of Payment Adjustments for Price Index Fluctuations&lt;sup&gt;a&lt;/sup&gt;</td>
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</table>

<sup>a</sup>Submit only if you choose the option.  
<sup>b</sup>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.

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

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<td>Time of bid</td>
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</table>

<sup>a</sup>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 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               |
| Subcontractor List               | Time of bid               |
| Small Business Status            | Time of bid               |
| Opt Out of Payment Adjustments for Price Index Fluctuations<sup>a</sup> | Time of bid               |

<sup>a</sup>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 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<sup>a</sup> | 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<sup>a</sup> | Time of bid               |
| Certified Small Business Listing for the Non–Small Business Preference<sup>a</sup> | No later than 4 p.m. on the 2nd business day after bid opening |

<sup>a</sup>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:

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*aSubmit 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:

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<td>Time of bid</td>
</tr>
<tr>
<td>Certified DVBE Summary</td>
<td>No later than 4 p.m. on the 4th business day after bid opening</td>
</tr>
<tr>
<td>Certified Small Business Listing for the Non-Small Business Preference*</td>
<td>No later than 4 p.m. on the 2nd business day after bid opening</td>
</tr>
</tbody>
</table>

*aSubmit only if you choose the option or preference.
*bSubmit 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:
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<td>Time of bid</td>
</tr>
<tr>
<td>Certified Small Business Listing for the Non-Small Business Preference</td>
<td>Time of bid</td>
</tr>
</tbody>
</table>

*Submit only if you choose the option or preference.

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
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

01-20-17

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.

01-20-17

Delete item 1 in the list in the paragraph of section 5-1.23C.

01-20-17

Replace section 5-1.36 with:

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.

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:

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 the 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.

7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

07-15-16

Replace the paragraphs in section 7-1.02l(2) with:

Under 2 CA Code of Regs § 11005:

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:
   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.

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):**

, and hauling and delivery of ready-mixed concrete.

**Add between the 4th and 5th paragraphs of section 7-1.02K(3):**

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 9th and 10th paragraphs of section 7-1.03:**

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:

<table>
<thead>
<tr>
<th>Height differential (foot)</th>
<th>Slope (horizontal:vertical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 0.08</td>
<td>100:1 or flatter</td>
</tr>
<tr>
<td>0.04–0.08</td>
<td>70:1 or flatter</td>
</tr>
</tbody>
</table>

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

Contract No. 04-1K0704
04-1K0704
25 of 232
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.

Replace § 337.15 in the 3rd item in the list in the paragraph of section 7-1.06B with:

§ 337.1

Add between the 1st and 2nd paragraphs of section 7-1.11A:

Comply with 46 CFR 381.7(a)–(b).

8 PROSECUTION AND PROGRESS

Add between establishment and are in the introductory clause of the 3rd paragraph of section 8-1.10A:

or permanent erosion control establishment

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

<table>
<thead>
<tr>
<th>Total bid From over</th>
<th>Total bid To</th>
<th>Liquidated damages per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>$60,000</td>
<td>$1,400</td>
</tr>
<tr>
<td>$60,000</td>
<td>$200,000</td>
<td>$2,900</td>
</tr>
<tr>
<td>$200,000</td>
<td>$500,000</td>
<td>$3,200</td>
</tr>
<tr>
<td>$500,000</td>
<td>$1,000,000</td>
<td>$3,500</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>$2,000,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>$2,000,000</td>
<td>$5,000,000</td>
<td>$4,800</td>
</tr>
<tr>
<td>$5,000,000</td>
<td>$10,000,000</td>
<td>$6,800</td>
</tr>
<tr>
<td>$10,000,000</td>
<td>$20,000,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>$20,000,000</td>
<td>$50,000,000</td>
<td>$13,500</td>
</tr>
<tr>
<td>$50,000,000</td>
<td>$100,000,000</td>
<td>$19,200</td>
</tr>
<tr>
<td>$100,000,000</td>
<td>$250,000,000</td>
<td>$25,300</td>
</tr>
</tbody>
</table>

Replace the 4th paragraph of section 8-1.10A with:

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
01-20-17

Replace the 1st paragraph of section 9-1.11B with:

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:

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:

withholds

DIVISION II GENERAL CONSTRUCTION
10 GENERAL
04-15-16

Replace section 10-1.02B with:

10-1.02B Traffic Elements

Before starting the operational test of a traffic management system that directly impacts traffic, the system must be ready for operation, and all signs, pavement delineation, and pavement markings must be in place at the system's location.

If maintaining existing traffic management system elements during construction is shown on the Bid Item List, a list of the systems shown within the project limits and their operational status is included in the Information Handout. Before starting job site activities, conduct a preconstruction operational status check of the existing system's elements and each element's communication status with the transportation management center to which it communicates. If an existing system element is discovered and has not been identified, the Department adds the element to the list of systems. The pre- and postconstruction operational status check of the discovered elements is change order work.

If maintaining existing traffic management system elements during construction is not shown on the Bid Item List and an existing system element is discovered during the work, notify the Engineer. The Engineer orders a pre- and postconstruction operational status check of the discovered elements. The status check of the discovered elements is change order work.

Conduct the status check with the Engineer and an electrical representative from the traffic operations office of the district in which the work is located. The Department provides you a list of the preconstruction operational status-check results, including:
1. Existing traffic management system elements and their locations within the project limits
2. Fully functioning elements
3. Nonoperational elements

Before Contract acceptance, conduct a postconstruction operational status check of all elements shown on the list with the Engineer and an electrical representative from the traffic operations office of the district in which the work is located.

Replace 10-3 of section 10 with:

10-2–10-3 RESERVED

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

12 TEMPORARY TRAFFIC CONTROL

01-20-17
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 between the 1st sentence and 2nd sentences in the 1st paragraph of section 12-4.02A(3)(a):

For a project in District 7, submit the request at least 15 days before the proposed closure date.

Replace section 12-4.02C(2) with:

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.

The project is not accessible in LCS after Contract acceptance.

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.

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:

~~~~~~~~~~~~~~~~~~~~~~~~~

13 WATER POLLUTION CONTROL

01-20-17

Replace construction phase and its definition in section 13-1.01B with:

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:

Industrial General Permit

05-06-16

Add to the list in the paragraph of section 13-1.01C(3):

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.

01-20-17

Replace section 13-1.01C(5) with:

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.

01-20-17

Replace the 2nd paragraph of section 13-1.01D(2) with:

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.

05-06-16

Replace General Industrial Permit in the 3rd paragraph of section 13-1.01D(2) with:

Industrial General Permit

05-06-16

Add to the list in the 2nd paragraph of section 13-1.03B:

7. Offsite drying facilities for drying wastes before disposal

01-20-17

Add between Unit and the in the 1st sentence in the 3rd paragraph of section 13-3.01A:

or on federal or tribal lands

01-20-17

Replace the paragraph in section 13-3.01C(1) with:

Submit the documents shown with an X in the following table:

01-20-17
**Submittal Requirements**

<table>
<thead>
<tr>
<th>Document</th>
<th>Risk level 1</th>
<th>Risk level 2</th>
<th>Risk level 3</th>
<th>EPA</th>
<th>Lake Tahoe Hydrologic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWPPP</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Construction Site Monitoring Program</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X^a</td>
</tr>
<tr>
<td>Job site monitoring reports</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sampling and analysis plan</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sampling and analysis plan for nonvisible pollutants</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sampling and analysis plan for pH and turbidity</td>
<td>--</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>NAL reports</td>
<td>--</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Receiving water monitoring trigger reports</td>
<td>--</td>
<td>--</td>
<td>X</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Rain Event Action Plan</td>
<td>--</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Annual Certification</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stormwater Annual Report</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

^aFor a project in the Lake Tahoe Hydrologic Unit, this program is referred to as the Construction Site Monitoring and Reporting Program

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**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):

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:

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:

Spread temporary mulch as specified for spreading wood mulch in section 20.

Replace the 2nd paragraph of section 13-8.01D(2) with:

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:

temporary high-visibility fence

14 ENVIRONMENTAL STEWARDSHIP

Add between the 2nd and 3rd sentences in the 3rd paragraph of section 14-10.01:

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 last paragraph of section 14-11.03 with:

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 the 2nd paragraph of section 14-11.13G(3) with:

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.

16 TEMPORARY FACILITIES

Replace the heading of section 16-2.03 with:

TEMPORARY HIGH-VISIBILITY FENCES

Replace section 16-2.03A(1) with:

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.

Delete the 2nd paragraph of section 16-2.04A(1)(a).

DIVISION III  EARTHWORK AND LANDSCAPE

19 EARTHWORK

Replace section 19-4 with:

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:

<table>
<thead>
<tr>
<th>Sieve size</th>
<th>Percentage passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 8</td>
<td>10</td>
</tr>
</tbody>
</table>

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 ofRegs 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:
   5.2. 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:

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:

19-10.03B Subgrade Enhancement Geotextile
20 LANDSCAPE

01-20-17

Replace the 1st paragraph of section 20-1.01D(2) with:

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

Replace 86 in the 1st paragraph of section 20-2.01C(2) with:

87

Replace the 8th paragraph of section 20-2.01C(2) with:

07-15-16

Trenches for irrigation supply lines and conduits 3 inches and larger in diameter must be a minimum of 18 inches below the finished grade, measured to the top of the installed pipe.

Replace 86 in the 1st paragraph of section 20-2.01C(3) with:

87

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 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:

Replace section 20-2.07B(5) with:

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 section 20-2.07C(3) with:

20-2.07C(3)  PVC Pipe Conduit Sleeve
Where PVC pipe conduit sleeves 2 inches or less in outside diameter is installed under surfacing, you may install by directional boring under section 20-2.07C(2)(b).
For sleeves 2 inches or less in diameter, the top of the conduit must be a minimum of 18 inches below surfacing.
Extend sleeves 6 inches beyond surfacing. Cap ends of conduit until used.

Replace sections 20-2.09B and 20-2.09C with:

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:

<table>
<thead>
<tr>
<th>Nominal hose diameter (inch)</th>
<th>Minimum wall thickness (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>0.127</td>
</tr>
<tr>
<td>3/4</td>
<td>0.154</td>
</tr>
<tr>
<td>1</td>
<td>0.179</td>
</tr>
</tbody>
</table>

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:

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

Replace the paragraph of section 20-2.10C(3) with:

Install check valves as necessary to prevent low-head drainage.

Replace the paragraphs of section 20-3.01B(10) with:

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:

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):

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:

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:

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.

Delete AND MULCHES in the heading of section 20-5.03.

Delete and mulches in the paragraph of section 20-5.03A(1)(a).

Replace the paragraph of section 20-5.03A(3)(a) with:

Before installing inert ground cover, remove plants and weeds to the ground level.

Delete or mulch at each occurrence in sections 20-5.03A(3)(c) and 20-5.03A(3)(d).

Replace section 20-5.03E with:

20-5.03E Reserved

Replace section 20-5.04 with:

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.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

21 EROSION CONTROL
01-20-17
Replace the paragraph of section 21-1.01 with:

Section 21-1 includes general specifications for applying permanent erosion control measures.

Replace section 21-2.02K with:

21-2.02K Compost
Compost must be derived from one or a combination of the following types of materials:
1. Green material consisting of chipped, shredded, or ground vegetation or clean, processed, recycled wood products
2. Biosolids
3. Manure
4. Mixed food waste

Compost must not be derived from mixed municipal solid waste and must not contain paint, petroleum products, pesticides, or other chemical residues harmful to plant or animal life. Metal concentrations in compost must not exceed the maximum listed under 14 CA Code of Regs § 17868.2.

Process compost materials under 14 CA Code of Regs § 17868.3.

The quality characteristics of compost must have the values shown in the following table:

<table>
<thead>
<tr>
<th>Compost</th>
<th>Quality characteristic</th>
<th>Test methoda</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pH</td>
<td>TMECC 04.11-A</td>
<td>6–8.5</td>
</tr>
<tr>
<td></td>
<td>Soluble salts (dS/m)</td>
<td>TMECC 04.10-A</td>
<td>0–10</td>
</tr>
<tr>
<td></td>
<td>Moisture content (% wet weight)</td>
<td>TMECC 03.09-A</td>
<td>30–60</td>
</tr>
<tr>
<td></td>
<td>Organic matter content (% dry weight)</td>
<td>TMECC 05.07-A</td>
<td>30–70</td>
</tr>
<tr>
<td></td>
<td>Maturity (seed emergence) (% relative to positive control)</td>
<td>TMECC 05.05-A</td>
<td>80 or above</td>
</tr>
<tr>
<td></td>
<td>Maturity (seedling vigor) (% relative to positive control)</td>
<td>TMECC 05.05-A</td>
<td>80 or above</td>
</tr>
<tr>
<td></td>
<td>Stability (mg CO2-C/g OM per day)</td>
<td>TMECC 05.08-B</td>
<td>8 or below</td>
</tr>
<tr>
<td></td>
<td>Pathogen</td>
<td>TMECC 07.01-B</td>
<td>&lt; 3</td>
</tr>
<tr>
<td></td>
<td>Salmonella (most probable number per 4 grams dry weight basis)</td>
<td>TMECC 07.01-B</td>
<td>&lt; 3</td>
</tr>
</tbody>
</table>

Pathogens | TMECC 07.01-B | < 1,000
The particle size for fine, medium, and coarse compost must comply with the requirements shown in the following table:

<table>
<thead>
<tr>
<th>Compost Gradation</th>
<th>Quality characteristic</th>
<th>Test method&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Percentage passing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TMECC 02.02-B</td>
<td></td>
</tr>
<tr>
<td>Fine compost (dry weight):</td>
<td>2-inch sieve</td>
<td>98</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>3/8-inch sieve</td>
<td>95</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Max particle length: 2&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium compost (dry weight):</td>
<td>Pass 2-inch sieve</td>
<td>90</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Pass 3/8-inch sieve (min 25% retained)</td>
<td>40</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Max particle length: 6&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse compost (dry weight):</td>
<td>Pass 2-inch sieve</td>
<td>95</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Pass 3/8-inch sieve (min 60% retained)</td>
<td>--</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Max particle length: 6&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> TMECC refers to *Test Methods for the Examination of Composting and Compost*, published by the United States Department of Agriculture and the United States Compost Council (USCC).

Replace the 1st and 2nd paragraphs of section 21-2.02Q with:

Compost sock must be a mesh tube filled with compost and must have a functional longevity of 1 year. The mesh tube must be composed of a natural biodegradable product, such as cotton, jute, sisal, burlap, wood-based yarn, or coir. The tube must have one of the following diameters:

1. From 8 to 9 inches
2. 12 inches in diameter

The mesh tube must be clean, evenly woven, and free of encrusted concrete or other contaminating materials, cuts, tears, broken or missing yarns, and thin, open, or weak places.

Replace section 21-3 with:

21-3 PERMANENT EROSION CONTROL ESTABLISHMENT WORK

Reserved
DIVISION IV  SUBBASES AND BASES

23  GENERAL

01-20-17

Replace the headings and paragraphs in section 23 with:

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.

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

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

<table>
<thead>
<tr>
<th>Subbase or base</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilized soil (sq yd)</td>
<td>≥ 20,000</td>
</tr>
<tr>
<td>Aggregate subbases (cu yd)</td>
<td>≥ 20,000</td>
</tr>
<tr>
<td>Aggregate bases (cu yd)</td>
<td>≥ 20,000</td>
</tr>
<tr>
<td>CTB (cu yd)</td>
<td>≥ 10,000</td>
</tr>
<tr>
<td>Lean concrete base (cu yd)</td>
<td>≥ 2,000</td>
</tr>
<tr>
<td>Rapid strength concrete base (cu yd)</td>
<td>≥ 1,000</td>
</tr>
<tr>
<td>Lean concrete base rapid setting (cu yd)</td>
<td>≥ 1,000</td>
</tr>
<tr>
<td>Concrete base (cu yd)</td>
<td>≥ 1,000</td>
</tr>
<tr>
<td>Treated permeable bases (cu yd)</td>
<td>≥ 2,000</td>
</tr>
<tr>
<td>Reclaimed pavements (sq yd)</td>
<td>≥ 10,000</td>
</tr>
</tbody>
</table>

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

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Submit a stabilized soil quality control plan.

Add to section 24-1.01D(1):

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:

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.

Replace the 1st paragraph of section 24-1.03C with:

The Engineer orders the application rate as pounds of stabilizing agent per square yard of basement material to be stabilized.

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:

500

Add to section 24-2.01D(2):

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sampling location</th>
<th>Minimum frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground surface temperature before adding lime and full depth</td>
<td>--</td>
<td>Each temperature location</td>
<td>1 test per 20,000 sq ft, minimum 1 per day</td>
</tr>
<tr>
<td>ground temperature during mixing operations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lime application rate</td>
<td>Calibrated tray or equal</td>
<td>Roadway</td>
<td>1 test per 40,000 sq ft, minimum 2 per day</td>
</tr>
<tr>
<td>Gradation on mixed material</td>
<td>California Test 202</td>
<td>Roadway</td>
<td>1 per 500 cu yd, minimum 1 per day</td>
</tr>
<tr>
<td>Moisture content</td>
<td>California Test 226</td>
<td>Roadway</td>
<td>1 per 500 cu yd on each layer, each day during mixing and mellowing periods,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>minimum 1 per day</td>
</tr>
<tr>
<td>Relative compaction</td>
<td>California Test 231</td>
<td>Roadway</td>
<td>1 per 500 cu yd on each layer, minimum 1 per day</td>
</tr>
</tbody>
</table>

---

### 25 AGGREGATE SUBBASES

07-15-16

**Replace Reserved in section 25-1.01C with:**

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sampling location</th>
<th>Minimum frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-value</td>
<td>California Test 301</td>
<td>Stockpiles, transportation units, windrows, or roadways</td>
<td>1 test before beginning work and every 2000 cu yd thereafter&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Aggregate gradation</td>
<td>California Test 202</td>
<td>Stockpiles, transportation units, windrows, or roadways</td>
<td>1 per 500 cu yd but at least one per day of placement</td>
</tr>
<tr>
<td>Sand equivalent</td>
<td>California Test 217</td>
<td>Stockpiles, transportation units, windrows, or roadways</td>
<td></td>
</tr>
<tr>
<td>Relative compaction</td>
<td>California Test 231</td>
<td>Roadway</td>
<td>1 per 500 sq yd on each layer</td>
</tr>
</tbody>
</table>

<sup>a</sup>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):**

The Engineer takes aggregate subbase samples for R-value, aggregate gradation, and sand equivalent from any of the following locations:

1. Windrow
2. Roadway

**Delete for each noncompliant test result in the 4th paragraph of section 25-1.01D(3).**

**Delete a in the 5th paragraph of section 25-1.01D(3).**

---

**26 AGGREGATE BASES**

**Replace Reserved in section 26-1.01C with:**

Submit an aggregate base QC plan.

**Replace Reserved in section 26-1.01D(1) with:**

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:

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sampling location</th>
<th>Minimum frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-value</td>
<td>California Test 301</td>
<td>Stockpiles, transportation units, windrows, or roadways</td>
<td>1 test before starting work and every 2,000 cu yd thereafter&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Aggregate gradation</td>
<td>California Test 202</td>
<td>Stockpiles, transportation units, windrows, or roadways</td>
<td>1 per 500 cu yd but at least one per day of placement</td>
</tr>
<tr>
<td>Sand equivalent</td>
<td>California Test 217</td>
<td>Stockpiles, transportation units, windrows, or roadways</td>
<td></td>
</tr>
<tr>
<td>Durability index&lt;sup&gt;b&lt;/sup&gt;</td>
<td>California Test 229</td>
<td>Stockpiles, transportation units, windrows, or roadways</td>
<td>1 per project</td>
</tr>
<tr>
<td>Relative compaction</td>
<td>California Test 231</td>
<td>Roadway</td>
<td>1 per 500 sq yd on each layer</td>
</tr>
</tbody>
</table>

<sup>a</sup>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.

<sup>b</sup>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):

durability,

Add between the 2nd and 3rd paragraphs of section 26-1.01D(3):

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

Delete the 3rd paragraph of section 26-1.01D(3).
Submit cement treated base QC plan.

Replace the headings and paragraphs in section 27-1.01D with:

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sampling location</th>
<th>Minimum frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate gradation</td>
<td>California Test 202 modified</td>
<td>Stockpiles, plant, transportation units, windrow, or roadway</td>
<td>1 per 500 cu yd but at least one per day of placement</td>
</tr>
<tr>
<td>Sand equivalent</td>
<td>California Test 217</td>
<td>Stockpiles, plant, transportation units, windrow, or roadway</td>
<td>1 test before starting work and every 2000 cu yd thereafterb</td>
</tr>
<tr>
<td>R-valuea</td>
<td>California Test 301</td>
<td>Stockpiles, plant, transportation units, windrows, or roadway</td>
<td>1 per day of placement</td>
</tr>
<tr>
<td>Optimum moisture content</td>
<td>California Test 312</td>
<td>Plant, transportation units, windrow, or roadway</td>
<td>1 per day of placement</td>
</tr>
<tr>
<td>Moisture content</td>
<td>California Test 226</td>
<td>Roadway</td>
<td>1 per 500 cu yd but at least one per day of placement</td>
</tr>
<tr>
<td>Cement content</td>
<td>California Test 338</td>
<td>Windrows or roadway</td>
<td>1 per 1000 cu yd but at least one per day of placement</td>
</tr>
<tr>
<td>Relative compaction</td>
<td>California Test 312 or 231</td>
<td>Roadway</td>
<td>1 per 2000 sq yd but at least one per day of placement</td>
</tr>
<tr>
<td>Compressive strengthb</td>
<td>California Test 312</td>
<td>Windrow or roadways</td>
<td>1 per day of placement</td>
</tr>
</tbody>
</table>

aR-value is required for Class B CTB only
bAdditional 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.

27-1.01D(3) Department Acceptance
The Department’s acceptance testing includes testing the CTB quality characteristics shown in the following table:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate gradation</td>
<td>California Test 202 modified</td>
</tr>
<tr>
<td>Sand equivalent</td>
<td>California Test 217</td>
</tr>
<tr>
<td>R-valuea</td>
<td>California Test 301</td>
</tr>
<tr>
<td>Optimum moisture content</td>
<td>California Test 312</td>
</tr>
<tr>
<td>Moisture content</td>
<td>California Test 226</td>
</tr>
<tr>
<td>Cement content</td>
<td>California Test 338</td>
</tr>
<tr>
<td>Relative compaction</td>
<td>California Test 312 or 231</td>
</tr>
<tr>
<td>Compressive strengthb</td>
<td>California Test 312</td>
</tr>
</tbody>
</table>

aR-value is required for Class B CTB only
bCompressive 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:
Add to section 27-1.02:

Water must comply with section 90-1.02D.

Add to section 27-1.03F:

The relative compaction of CTB must be at least 95 percent.

28 CONCRETE BASES

Replace the headings and paragraphs in section 28-1.01D with:

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):

Submit a lean concrete base QC plan.

Replace the headings and paragraphs in section 28-2.01D with:

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:

<table>
<thead>
<tr>
<th>LCB Sampling Location and Testing Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Sand equivalent</td>
</tr>
<tr>
<td>Aggregate gradation</td>
</tr>
<tr>
<td>Air content</td>
</tr>
<tr>
<td>Penetration(^a)</td>
</tr>
<tr>
<td>Slump(^a)</td>
</tr>
<tr>
<td>Compressive strength</td>
</tr>
</tbody>
</table>

\(^a\)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:

<table>
<thead>
<tr>
<th>LCB Requirements for Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Compressive strength (min, psi at 7 days)</td>
</tr>
</tbody>
</table>

\(^a\)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:

Replace section 28-2.01D(1)(c) in item 3 of the 5th paragraph in section 28-2.03D with:

section 28-2.01D(1)(c)

Replace the 1st paragraph in section 28-2.03F with:

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:

Submit a rapid strength concrete base QC plan.
Replace the headings and paragraphs in section 28-3.01D with:

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
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanness value</td>
<td>California Test 227</td>
<td>Source</td>
<td>1 per 500 cubic yards but at least 1 per shift</td>
</tr>
<tr>
<td>Sand equivalent</td>
<td>California Test 217</td>
<td>Job site</td>
<td>1 per 130 cu yd but at least 1 per shift</td>
</tr>
<tr>
<td>Aggregate gradation</td>
<td>California Test 202</td>
<td></td>
<td>1 per 130 cu yd but at least 1 per shift</td>
</tr>
<tr>
<td>Air content</td>
<td>California Test 504</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Yield</td>
<td>California Test 518</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Slump or penetration</td>
<td>ASTM C143 or California Test 533</td>
<td></td>
<td>1 per 2 hours of placement</td>
</tr>
<tr>
<td>Density</td>
<td>California Test 518</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Aggregate moisture meter calibration(^b)</td>
<td>California Test 223 or California Test 226</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Modulus of rupture</td>
<td>California Test 524</td>
<td></td>
<td>1 per 130 cu yd but at least 1 per shift</td>
</tr>
</tbody>
</table>

\(^a\)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:

<table>
<thead>
<tr>
<th>RSC Base Requirements for Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Modulus of rupture</td>
</tr>
</tbody>
</table>

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):

Submit a lean concrete base rapid setting QC plan.
Replace the headings and paragraphs in section 28-4.01D with:

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:

<table>
<thead>
<tr>
<th>LCB Rapid Setting Sampling Location and Testing Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Sand equivalent</td>
</tr>
<tr>
<td>Aggregate gradation</td>
</tr>
<tr>
<td>Air content</td>
</tr>
<tr>
<td>Penetration*</td>
</tr>
<tr>
<td>Slump*</td>
</tr>
<tr>
<td>Compressive strength</td>
</tr>
</tbody>
</table>

*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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive strength (min, psi at 7 days)</td>
<td>California Test 521(^a)</td>
<td>725</td>
</tr>
</tbody>
</table>

\(^a\)Cylinders made under California Test 540

Replace the 2nd and 3rd paragraphs in section 28-4.03A with:

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:

Submit a concrete base QC plan.

Replace the headings and paragraphs in section 28-5.01D(2) with:

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sample location</th>
<th>Minimum testing frequencya</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanness value</td>
<td>California Test 227</td>
<td>Source</td>
<td>1 per 500 cubic yards but at least 1 per shift</td>
</tr>
<tr>
<td>Sand equivalent</td>
<td>California Test 217</td>
<td>Job site</td>
<td>1 per 500 cu yd but at least 1 per shift</td>
</tr>
<tr>
<td>Aggregate gradation</td>
<td>California Test 202</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Air content</td>
<td>California Test 504</td>
<td></td>
<td>1 per 2 hours of placement</td>
</tr>
<tr>
<td>Yield</td>
<td>California Test 518</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Slump or penetration</td>
<td>ASTM C143 or California Test 533</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Density</td>
<td>California Test 518</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Aggregate moisture meter calibrationb</td>
<td>California Test 223 or California Test 226</td>
<td></td>
<td>1 per shift</td>
</tr>
<tr>
<td>Modulus of rupture</td>
<td>California Test 524</td>
<td></td>
<td>1 per 500 cu yd but at least 1 per shift</td>
</tr>
</tbody>
</table>

aTest at the most frequent interval.
bCheck 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulus of rupture (min, psi at 28 days)</td>
<td>California Test 523</td>
<td>570</td>
</tr>
</tbody>
</table>

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

Replace the headings and paragraphs in section 29-1.01 with:

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sampling location</th>
<th>Minimum frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation</td>
<td>California Test 202</td>
<td>Stockpiles or plant</td>
<td>1 for every 4 hours of production but at least one per day of placement</td>
</tr>
<tr>
<td>Cleanness value</td>
<td>California Test 227</td>
<td>Stockpiles or plant</td>
<td>1 for every 4 hours of production but at least one per day</td>
</tr>
<tr>
<td>Percentage of crushed particles</td>
<td>California Test 205</td>
<td>Stockpiles or plant</td>
<td>1 test before production and one every 5,000 cu yd thereafter</td>
</tr>
<tr>
<td>Los Angeles rattler loss at 500 rev</td>
<td>California Test 211</td>
<td>Stockpiles or plant</td>
<td>1 test before production and one every 5,000 cu yd thereafter</td>
</tr>
<tr>
<td>Film stripping</td>
<td>California Test 302</td>
<td>Plant</td>
<td>1 test before production and one every 5000 cu yd thereafter</td>
</tr>
<tr>
<td>Asphalt content of the asphalt mixture</td>
<td>California Test 382</td>
<td>Plant, transportation units, windrows, or roadway</td>
<td>1 for every 4 hours of production but at least one per day</td>
</tr>
</tbody>
</table>
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:

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sampling location</th>
<th>Minimum frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation</td>
<td>California Test 202</td>
<td>Stockpiles or plant</td>
<td>1 for every 4 hours of production but at least one per day of placement</td>
</tr>
<tr>
<td>Cleanness value</td>
<td>California Test 227</td>
<td>Stockpiles or plant</td>
<td>1 for every 4 hours of production but at least one per day</td>
</tr>
<tr>
<td>Los Angeles rattler loss at 500 rev</td>
<td>California Test 211</td>
<td>Stockpiles or plant</td>
<td>1 test before production and one every 5,000 cu yd thereafter</td>
</tr>
<tr>
<td>Soundness</td>
<td>California Test 214</td>
<td>Stockpiles or plant</td>
<td>1 test before production and one every 5,000 cu yd thereafter</td>
</tr>
</tbody>
</table>

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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:

Water must comply with section 90-1.02D.

Replace 3rd in the 2nd paragraph in section 29-3.03 with:

4th

30 RECLAIMED PAVEMENT

Replace section 30-1.01C(2)(c) in the 1st paragraph of section 30-3.01C(2)(c) with:

section 30-1.01C(3)(c)
Replace the table in section 30-3.02A with:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content before HMA paving</td>
<td>California Test 226</td>
<td>&lt; 50% of OMC</td>
</tr>
<tr>
<td>Asphalt binder expansion ratio (min, %)</td>
<td>Note a</td>
<td>10</td>
</tr>
<tr>
<td>Asphalt binder half-life (seconds, min)</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Gradation (% passing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sieve Size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 inch</td>
<td>California Test 202</td>
<td>100</td>
</tr>
<tr>
<td>2 inch</td>
<td></td>
<td>95–100</td>
</tr>
<tr>
<td>1-1/2 inch</td>
<td></td>
<td>85–100</td>
</tr>
<tr>
<td>Moisture content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>California Test 226</td>
<td>OMC</td>
</tr>
<tr>
<td>Minimum</td>
<td></td>
<td>OMC - 2%</td>
</tr>
<tr>
<td>In-place wet density (lb/cu ft)</td>
<td>California Test 216</td>
<td>Report only</td>
</tr>
<tr>
<td>Relative compaction (min, %)</td>
<td>California Test 231</td>
<td>98</td>
</tr>
<tr>
<td>Indirect dry tensile strength (psi)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>California Test 371</td>
<td>90% of mix design value</td>
</tr>
<tr>
<td>Indirect wet tensile strength (psi)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>California Test 371</td>
<td>90% of mix design value</td>
</tr>
<tr>
<td>Tensile strength ratio (%)</td>
<td>California Test 371</td>
<td>90% of mix design value</td>
</tr>
</tbody>
</table>

<sup>a</sup>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.

<sup>b</sup>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:

section 30-4.01D(4)

Replace section 30-4.01D(1)(a) in the table in section 30-4.02A with:

section 30-4.01D(2)
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.

For emulsion testing, quality control laboratories must participate in the AASHTO re:source proficiency sample program.

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:

<table>
<thead>
<tr>
<th>Quality Control Test Result Reporting</th>
<th>Maximum reporting time allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Rattler loss (max, %)</td>
<td>48 hours</td>
</tr>
<tr>
<td>Percent of crushed particles (min, %)</td>
<td>48 hours</td>
</tr>
<tr>
<td>Flat and elongated particles (max by weight at 3:1, %)</td>
<td>48 hours</td>
</tr>
<tr>
<td>Film stripping (max, %)</td>
<td>48 hours</td>
</tr>
<tr>
<td>Durability (min)</td>
<td>48 hours</td>
</tr>
<tr>
<td>Gradation (percentage passing)</td>
<td>24 hours</td>
</tr>
<tr>
<td>Cleanness value (min)</td>
<td>24 hours</td>
</tr>
<tr>
<td>Asphaltic emulsion spread rate (gal/sq yd)</td>
<td>24 hours</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Location of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Rattler loss (max, %)</td>
<td>California Test 211</td>
<td>1st day of production</td>
<td>See California Test 125</td>
</tr>
<tr>
<td></td>
<td>At 100 revolutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>At 500 revolutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of crushed particles</td>
<td>AASHTO T 335</td>
<td>1st day of production</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Coarse aggregate (min, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-fractured face</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two-fractured faces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine aggregate (min, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Passing No. 4 sieve and retained on No. 8 sieve)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One fractured face</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat and elongated particles (max by weight at 3:1, %)</td>
<td>ASTM D4791</td>
<td>1st day of production</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Film stripping (max, %)</td>
<td>California Test 302</td>
<td>1st day of production</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Durability (min)</td>
<td>California Test 229</td>
<td>1st day of production</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Gradation (% passing)</td>
<td>California Test 202</td>
<td>2 per day</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Cleanness value (min)</td>
<td>California Test 227</td>
<td>2 per day</td>
<td>See California Test 125</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Location of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphaltic emulsion binder spread rate (gal/sq yd)</td>
<td>California Test 339</td>
<td>1 per day per distributor truck</td>
<td>Pavement surface</td>
</tr>
</tbody>
</table>

**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:

<table>
<thead>
<tr>
<th>Chip Seal Aggregate Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>Los Angeles Rattler loss (max, %)</td>
</tr>
<tr>
<td>At 100 revolutions</td>
</tr>
<tr>
<td>At 500 revolutions</td>
</tr>
<tr>
<td>Percent of crushed particles:</td>
</tr>
<tr>
<td>Coarse aggregate (min, %)</td>
</tr>
<tr>
<td>One-fractured face</td>
</tr>
<tr>
<td>Two-fractured faces</td>
</tr>
<tr>
<td>Fine aggregate (min, %)</td>
</tr>
<tr>
<td>(Passing No. 4 sieve and retained on No. 8 sieve)</td>
</tr>
<tr>
<td>One fractured face</td>
</tr>
<tr>
<td>Flat and elongated particles (max by weight at 3:1, %)</td>
</tr>
<tr>
<td>Film stripping (max, %)</td>
</tr>
<tr>
<td>Durability (min)</td>
</tr>
<tr>
<td>Gradation (% passing by weight)</td>
</tr>
<tr>
<td>Cleanness value (min)</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Chip Seal Cleanness Value Deductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanness value</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>80 or over</td>
</tr>
<tr>
<td>79</td>
</tr>
<tr>
<td>77–78</td>
</tr>
<tr>
<td>75–76</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Chip Seal Aggregate Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Los Angeles Rattler loss (max, %)</td>
</tr>
<tr>
<td>At 100 revolutions</td>
</tr>
<tr>
<td>At 500 revolutions</td>
</tr>
<tr>
<td>Percent of crushed particles</td>
</tr>
<tr>
<td>Coarse aggregate (min, %)</td>
</tr>
<tr>
<td>One-fractured face</td>
</tr>
<tr>
<td>Two-fractured faces</td>
</tr>
<tr>
<td>Fine aggregate (min, %)</td>
</tr>
<tr>
<td>(Passing No. 4 sieve and retained on No. 8 sieve)</td>
</tr>
<tr>
<td>One fractured face</td>
</tr>
<tr>
<td>Flat and elongated particles (max by weight at 3:1, %)</td>
</tr>
<tr>
<td>Film stripping (max, %)</td>
</tr>
<tr>
<td>Durability (min)</td>
</tr>
<tr>
<td>Gradation (% passing by weight)</td>
</tr>
<tr>
<td>Cleanness value (min)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chip retention (%)</td>
<td>Vialit test method for aggregate in chip seals, French chip (Modified)(^a)</td>
<td>95</td>
</tr>
</tbody>
</table>

\(^a\)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 Asphal tic 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) Asphalitic Emulsions

Circulate asphalitic 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 asphalitic emulsion, the authorized laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saybolt Furol Viscosity, at 25 °C</td>
<td>AASHTO T 59</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>(Saybolt Furol seconds)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sieve Test (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage stability, 1 day (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue by distillation (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle chargea</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tests on Residue from Distillation Test:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration, 25 °C</td>
<td>AASHTO T 49</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Ductility</td>
<td>AASHTO T 51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solubility in trichloroethylene</td>
<td>AASHTO T 44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*aIf the result of the particle charge is inconclusive, the asphalitic emulsion must be tested for pH under ASTM E70. Grade QS1h asphalitic emulsion must have a minimum pH of 7.3. Grade CQS1h asphalitic 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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td>3/8&quot; 5/16&quot; 1/4&quot;</td>
</tr>
<tr>
<td>Sieve size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>85–100</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>0–15</td>
<td>0–50</td>
</tr>
<tr>
<td>No. 8</td>
<td>0–5</td>
<td>0–15</td>
</tr>
<tr>
<td>No. 16</td>
<td>--</td>
<td>0–5</td>
</tr>
<tr>
<td>No. 30</td>
<td>--</td>
<td>0–3</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–2</td>
<td>0–2</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>Sieve size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>85–100</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>0–15</td>
<td>0–50</td>
</tr>
<tr>
<td>No. 8</td>
<td>0–5</td>
<td>0–15</td>
</tr>
<tr>
<td>No. 16</td>
<td>--</td>
<td>0–5</td>
</tr>
<tr>
<td>No. 30</td>
<td>--</td>
<td>0–3</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–2</td>
<td>0–2</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Aggregate gradation</th>
<th>Application rate range (gal/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>0.30–0.45</td>
</tr>
<tr>
<td>5/16&quot;</td>
<td>0.25–0.35</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>0.20–0.30</td>
</tr>
</tbody>
</table>

For double asphaltic emulsion chip seals, the asphaltic emulsions must be applied within the application rates shown in the following table:

<table>
<thead>
<tr>
<th>Double chip seals</th>
<th>Application rate range (gal/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st application</td>
<td>0.30–0.45</td>
</tr>
<tr>
<td>2nd application</td>
<td>0.20–0.30</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Aggregate gradation</th>
<th>Spread rate range (lb/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>20–30</td>
</tr>
<tr>
<td>5/16&quot;</td>
<td>16–25</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>12–20</td>
</tr>
</tbody>
</table>

For double asphaltic emulsion chip seals, aggregate must be spread within the spread rate ranges shown in the following table:

### Aggregate Spread Rates

<table>
<thead>
<tr>
<th>Double chip seal</th>
<th>Spread rate range (lb/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st application</td>
<td>23–30</td>
</tr>
<tr>
<td>2nd application</td>
<td>12–20</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saybolt Furol Viscosity, at 50 °C (Saybolt Furol seconds)</td>
<td>AASHTO T 59</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Settlement, 5 days (max, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage stability test, 1 day (max, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sieve test (max, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demulsibility (min, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle charge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash content (max, %)</td>
<td>ASTM D3723</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue by evaporation (min, %)</td>
<td>California Test 331</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tests on residue from evaporation test:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration, 25 °C</td>
<td>AASHTO T 49</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Penetration, 4 °C, 200g for 60 seconds</td>
<td>AASHTO T 49</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Ductility, 25 °C (min, mm)</td>
<td>AASHTO T 51</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Torsional recovery (min, %)</td>
<td>California Test 332</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ring and Ball Softening Point (min, °F)</td>
<td>AASHTO T 53</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td></td>
<td>3/8&quot;  5/16&quot;  1/4&quot;</td>
</tr>
<tr>
<td>Sieve size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>California Test 202</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>85–100 100 100</td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>0–15 0–50 60–85</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>0–5 0–15 0–25</td>
<td></td>
</tr>
<tr>
<td>No. 8</td>
<td>-- 0–5 0–5</td>
<td></td>
</tr>
<tr>
<td>No. 16</td>
<td>-- 0–3 0–3</td>
<td></td>
</tr>
<tr>
<td>No. 30</td>
<td>0–2 0–2 0–2</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration, 4 °C, 200g for 60 seconds (min)</td>
<td>AASHTO T 49</td>
<td>6</td>
</tr>
<tr>
<td>Ring and Ball Softening Point (min, °F)</td>
<td>AASHTO T 53</td>
<td>135</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight) Sieve Size</td>
<td>California Test 202</td>
<td>3/8&quot; 5/16&quot; 1/4&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>85–100</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>0–15</td>
<td>0–50</td>
</tr>
<tr>
<td>No. 8</td>
<td>0–5</td>
<td>0–15</td>
</tr>
<tr>
<td>No. 16</td>
<td>--</td>
<td>0–5</td>
</tr>
<tr>
<td>No. 30</td>
<td>--</td>
<td>0–3</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–2</td>
<td>0–2</td>
</tr>
</tbody>
</table>

37-2.03C Construction
Polymer modified asphaltic emulsions must be applied within the application rate ranges shown in the following table:

<table>
<thead>
<tr>
<th>Aggregate gradation</th>
<th>Application rate range (gal/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>0.30–0.45</td>
</tr>
<tr>
<td>5/16&quot;</td>
<td>0.25–0.35</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>0.20–0.30</td>
</tr>
</tbody>
</table>

For double polymer modified asphaltic emulsion chip seals, polymer modified asphaltic emulsions must be applied within the application rates shown in the following table:

<table>
<thead>
<tr>
<th>Double application</th>
<th>Application rate range (gal/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st application</td>
<td>0.30–0.45</td>
</tr>
<tr>
<td>2nd application</td>
<td>0.20–0.30</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Chip seal type</th>
<th>Spread rate range (lb/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>20–30</td>
</tr>
<tr>
<td>5/16&quot;</td>
<td>16–25</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>12–20</td>
</tr>
</tbody>
</table>

For double chip seals, aggregate must be spread within spread rate ranges shown in the following table:

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:

<table>
<thead>
<tr>
<th>Asphalt Modifier for Asphalt Rubber Binder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Viscosity</td>
</tr>
<tr>
<td>Flash point</td>
</tr>
<tr>
<td>Molecular Analysis:</td>
</tr>
<tr>
<td>Asphaltenes</td>
</tr>
<tr>
<td>Aromatics</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrap tire crumb rubber gradation</td>
<td>California Test 385</td>
<td>1 per 10,000</td>
</tr>
<tr>
<td>High natural scrap tire crumb rubber gradation</td>
<td>California Test 385</td>
<td>1 per 3,400 lb</td>
</tr>
<tr>
<td>Wire in CRM</td>
<td>California Test 385</td>
<td>--</td>
</tr>
<tr>
<td>Fabric in CRM</td>
<td>California Test 385</td>
<td>--</td>
</tr>
<tr>
<td>CRM particle length</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>CRM specific gravity</td>
<td>California Test 208</td>
<td></td>
</tr>
<tr>
<td>Natural rubber content in high natural scrap tire crumb rubber</td>
<td>ASTM D297</td>
<td>1 per 3,400 lb</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Sampling location</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descending viscosity at 375 °F (Pa·s x 10^-3)</td>
<td>ASTM D7741</td>
<td>Reaction vessel</td>
<td>1 per lot&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Viscosity at 375 °F (Pa·s x 10^-3)</td>
<td>ASTM D7741</td>
<td>Distribution truck</td>
<td>15 minutes before use per lot&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cone penetration at 25 °C (0.10 mm)</td>
<td>ASTM D217</td>
<td>Distribution truck</td>
<td>1 per lot&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Resilience at 25 °C (% rebound)</td>
<td>ASTM D5329</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Softening point (°C)</td>
<td>ASTM D36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>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.

<sup>b</sup>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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity at 100 °C (m²/s x 10^-6)</td>
<td>ASTM D445</td>
<td>X ± 3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Flash point (min, °C)</td>
<td>ASTM D92</td>
<td>207</td>
</tr>
<tr>
<td>Molecular Analysis:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphaltenes (max, % by mass)</td>
<td>ASTM D2007</td>
<td>0.1</td>
</tr>
<tr>
<td>Aromatics (min, % by mass)</td>
<td>ASTM D2007</td>
<td>55</td>
</tr>
</tbody>
</table>

<sup>a</sup>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**

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire in CRM (max, %)</td>
<td>California Test 385</td>
<td>0.01</td>
</tr>
<tr>
<td>Fabric in CRM (max, %)</td>
<td>California Test 385</td>
<td>0.05</td>
</tr>
<tr>
<td>CRM particle length (max, in)</td>
<td>--</td>
<td>3/16</td>
</tr>
<tr>
<td>CRM specific gravity</td>
<td>California Test 208</td>
<td>1.1–1.2</td>
</tr>
<tr>
<td>Natural rubber content in high natural CRM (%)</td>
<td>ASTM D297</td>
<td>40.0–48.0</td>
</tr>
</tbody>
</table>

The Department accepts CRM gradation based on the requirements shown in the following table:

**Crumb Rubber Modifier Gradation Requirements**

<table>
<thead>
<tr>
<th>Gradation (% passing by weight)</th>
<th>Test method</th>
<th>Scrap tire crumb rubber</th>
<th>High natural scrap tire crumb rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve size:</td>
<td>California Test 385</td>
<td>Operating range</td>
<td>Contract compliance</td>
</tr>
<tr>
<td>No. 8</td>
<td>100</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>No. 10</td>
<td>95–100</td>
<td>90–100</td>
<td>100</td>
</tr>
<tr>
<td>No. 16</td>
<td>35–85</td>
<td>32–88</td>
<td>92–100</td>
</tr>
<tr>
<td>No. 30</td>
<td>2–25</td>
<td>1–30</td>
<td>25–95</td>
</tr>
<tr>
<td>No. 50</td>
<td>0–10</td>
<td>0–15</td>
<td>6–35</td>
</tr>
<tr>
<td>No. 100</td>
<td>0–5</td>
<td>0–10</td>
<td>0–7</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–2</td>
<td>0–5</td>
<td>0–3</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Material</th>
<th>Gradation test result</th>
<th>Deduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrap tire crumb rubber</td>
<td>Operating range &lt; TR &lt; Contract compliance</td>
<td>$250</td>
</tr>
<tr>
<td>Scrap tire crumb rubber</td>
<td>TR &gt; Contract compliance</td>
<td>$1,100</td>
</tr>
<tr>
<td>High natural scrap tire crumb rubber</td>
<td>Operating range &lt; TR &lt; Contract compliance</td>
<td>$250</td>
</tr>
<tr>
<td>High natural scrap tire crumb rubber</td>
<td>TR &gt; Contract compliance</td>
<td>$600</td>
</tr>
</tbody>
</table>

*aTest 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone penetration at 25 °C (0.10 mm)</td>
<td>ASTM D217</td>
<td>25–60</td>
</tr>
<tr>
<td>Resilience at 25 °C (% rebound)</td>
<td>ASTM D5329</td>
<td>18–50</td>
</tr>
<tr>
<td>Softening point (°C)</td>
<td>ASTM D36</td>
<td>55–88</td>
</tr>
<tr>
<td>Viscosity at 375 °F (Pa•s x 10⁻³)ᵃ</td>
<td>ASTM D7741</td>
<td>1,500–2,500</td>
</tr>
</tbody>
</table>

ᵃPrepare 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:

<table>
<thead>
<tr>
<th>Precoated Aggregate Gradation Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Characteristic</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>1/2” gradation (% passing by weight)</td>
</tr>
<tr>
<td>Sieve size:</td>
</tr>
<tr>
<td>3/4”</td>
</tr>
<tr>
<td>1/2”</td>
</tr>
<tr>
<td>3/8”</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 8</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
<tr>
<td>3/8” gradation (% passing by weight)</td>
</tr>
<tr>
<td>Sieve size:</td>
</tr>
<tr>
<td>3/4”</td>
</tr>
<tr>
<td>1/2”</td>
</tr>
<tr>
<td>3/8”</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 8</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Asphalt Modifier for Asphalt Rubber Binder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Viscosity at 100 °C (m²/s x 10⁻⁶)</td>
</tr>
<tr>
<td>Flash point (min, CL.O.C., °C)</td>
</tr>
<tr>
<td>Molecular analysis:</td>
</tr>
<tr>
<td>Asphaltenes by mass (max, %)</td>
</tr>
<tr>
<td>Aromatics by mass (min, %)</td>
</tr>
</tbody>
</table>

ᵃX 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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire in CRM (max, %)</td>
<td>California Test 385</td>
<td>0.01</td>
</tr>
<tr>
<td>Fabric in CRM (max, %)</td>
<td>California Test 385</td>
<td>0.05</td>
</tr>
<tr>
<td>CRM particle length (max, in)</td>
<td>--</td>
<td>3/16</td>
</tr>
<tr>
<td>CRM specific gravity</td>
<td>California Test 208</td>
<td>1.1–1.2</td>
</tr>
</tbody>
</table>

The CRM must comply with the requirements shown in the following table:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Scrap tire crumb rubber</th>
<th>High natural scrap tire crumb rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone extract (%)</td>
<td>ASTM D297</td>
<td>6.0–16.0</td>
<td>4.0–16.0</td>
</tr>
<tr>
<td>Rubber hydrocarbon (min, %)</td>
<td>ASTM D297</td>
<td>42.0–65.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Natural rubber content (%)</td>
<td>ASTM D297</td>
<td>22.0–39.0</td>
<td>40.0–48.0</td>
</tr>
<tr>
<td>Carbon black content (%)</td>
<td>ASTM D297</td>
<td>28.0–38.0</td>
<td>--</td>
</tr>
<tr>
<td>Ash content (max, %)</td>
<td>ASTM D297</td>
<td>8.0</td>
<td>--</td>
</tr>
</tbody>
</table>

Scrap tire crumb rubber gradation must comply with the gradation requirements shown in the following table:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 385</td>
<td>Gradation limit</td>
</tr>
<tr>
<td>No. 8</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No. 10</td>
<td>98–100</td>
<td>95–100</td>
</tr>
<tr>
<td>No. 16</td>
<td>45–75</td>
<td>35–85</td>
</tr>
<tr>
<td>No. 30</td>
<td>2–20</td>
<td>2–25</td>
</tr>
<tr>
<td>No. 50</td>
<td>0–6</td>
<td>0–10</td>
</tr>
<tr>
<td>No. 100</td>
<td>0–2</td>
<td>0–5</td>
</tr>
<tr>
<td>No. 200</td>
<td>0</td>
<td>0–2</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 385</td>
<td>Gradation limit</td>
</tr>
<tr>
<td>No. 10</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>No. 16</td>
<td>95–100</td>
<td>92–100</td>
</tr>
<tr>
<td>No. 30</td>
<td>35–85</td>
<td>25–95</td>
</tr>
<tr>
<td>No. 50</td>
<td>10–30</td>
<td>6–35</td>
</tr>
<tr>
<td>No. 100</td>
<td>0–4</td>
<td>0–7</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–1</td>
<td>0–3</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Asphalt Rubber Binder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>Cone penetration at 25 °C (0.10 mm)</td>
</tr>
<tr>
<td>Resilience at 25 °C (% rebound)</td>
</tr>
<tr>
<td>Softening point (°C)</td>
</tr>
<tr>
<td>Viscosity at 375 °F (Pars x 10^{-3}) (a)</td>
</tr>
</tbody>
</table>

\(a\)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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>85–90</td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>95–100</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>0–30</td>
<td></td>
</tr>
<tr>
<td>No. 8</td>
<td>70–85</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td>0–15</td>
<td></td>
</tr>
<tr>
<td>0–5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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-SURFACEINGS

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-surfaceings.

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:

<table>
<thead>
<tr>
<th>Quality Control Test Reporting Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>Los Angeles Rattler loss (max, %)</td>
</tr>
<tr>
<td>Percent of crushed particles (min, %)</td>
</tr>
<tr>
<td>Durability (min)</td>
</tr>
<tr>
<td>Resistance of fine aggregate to degradation by abrasion in the Micro-Deval Apparatus (% loss by weight)</td>
</tr>
<tr>
<td>Gradation (% passing by weight)</td>
</tr>
<tr>
<td>Sand equivalent (min)</td>
</tr>
<tr>
<td>Moisture content (%)</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Location of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Rattler loss (max, %) At 500 revolutions</td>
<td>California Test 211</td>
<td>1st day of production</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Percent of crushed particles (min, %)</td>
<td>AASHTO T 335</td>
<td>1st day of production</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Sand equivalent (min)</td>
<td>California Test 217</td>
<td>1 per working stockpile per day</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Resistance of fine aggregate to degradation by abrasion in the Micro-Deval Apparatus (% loss by weight)</td>
<td>ASTM D7428</td>
<td>1 per working stockpile per day</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td>1 per working stockpile per day</td>
<td>See California Test 125</td>
</tr>
<tr>
<td>Moisture content, from field stockpile (%)</td>
<td>AASHTO T 255a</td>
<td>1 per working stockpile per day</td>
<td>See California Test 125</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>Type I</td>
<td>Type II</td>
</tr>
<tr>
<td>Sieve Size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>100</td>
<td>94–100</td>
</tr>
<tr>
<td>No. 8</td>
<td>90–100</td>
<td>65–90</td>
</tr>
<tr>
<td>No. 16</td>
<td>60–90</td>
<td>40–70</td>
</tr>
<tr>
<td>No. 30</td>
<td>40–65</td>
<td>25–50</td>
</tr>
<tr>
<td>No. 200</td>
<td>10–20</td>
<td>5–15</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>Type I</td>
<td>Type II</td>
</tr>
<tr>
<td>Sieve size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>100</td>
<td>94–100</td>
</tr>
<tr>
<td>No. 8</td>
<td>90–100</td>
<td>65–90</td>
</tr>
<tr>
<td>No. 16</td>
<td>60–90</td>
<td>40–70</td>
</tr>
<tr>
<td>No. 30</td>
<td>40–65</td>
<td>25–50</td>
</tr>
<tr>
<td>No. 200</td>
<td>10–20</td>
<td>5–15</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)</td>
<td>AASHTO T 59</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
<tr>
<td>Sieve Test (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage stability, 1 day (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue by distillation (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle charge*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tests on Residue from Distillation Test:
- Penetration, 25 °C: AASHTO T 49
- Ductility: AASHTO T 51
- Solubility in trichloroethylene: AASHTO T 44

*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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests on emulsion:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saybolt Furol Viscosity at 25 °C</td>
<td>AASHTO T 59</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
<tr>
<td>(Saybolt Furol seconds)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sieve test (%)</td>
<td>AASHTO T 59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage stability after 1 day (%)</td>
<td>AASHTO T 59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue by evaporation (min, %)</td>
<td>California Test 331</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle charge</td>
<td>AASHTO T 59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests on residue by evaporation:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration at 25 °C</td>
<td>AASHTO T 49</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
<tr>
<td>Ductility at 25 °C (min, mm)</td>
<td>AASHTO T 51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torsional recovery (min, %)</td>
<td>California Test 332</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
<tr>
<td>Or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymer content based on residual asphalt (min, %)</td>
<td>California Test 401</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Aggregate Acceptance Criteria</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Los Angeles Rattler loss (max, %)</td>
<td>California Test 211</td>
<td>35</td>
</tr>
<tr>
<td>At 500 revolutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of crushed particles (min, %)</td>
<td>California Test 205</td>
<td>95</td>
</tr>
<tr>
<td>Durability (min)</td>
<td>California Test 229</td>
<td>55</td>
</tr>
<tr>
<td>Sand equivalent (min)</td>
<td>California Test 217</td>
<td>45</td>
</tr>
<tr>
<td>Type I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type III</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*aCalifornia 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:

<table>
<thead>
<tr>
<th>Polymer Modified Asphaltic Emulsion Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)</td>
</tr>
<tr>
<td>Sieve test (%)</td>
</tr>
<tr>
<td>Storage stability after 1 day (%)</td>
</tr>
<tr>
<td>Residue by evaporation (min, %)</td>
</tr>
<tr>
<td>Particle charge</td>
</tr>
</tbody>
</table>

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, %) | California Test 332 | 18 |
- Or
  - Polymer content based on residual asphalt (min, %) | California Test 401 | 2.5 |

37-3.02B(4) Aggregate

Aggregate must comply with the quality characteristic requirements shown in the following table:

<table>
<thead>
<tr>
<th>Aggregate Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Los Angeles Rattler loss (max, %) At 500 revolutions</td>
</tr>
<tr>
<td>Percent of crushed particles (min, %)</td>
</tr>
<tr>
<td>Durability (min)</td>
</tr>
<tr>
<td>Sand equivalent (min)</td>
</tr>
</tbody>
</table>
  - Type I | California Test 217 | 45 |
  - Type II | 55 |
  - Type III | 60 |

*aCalifornia 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method*</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency (max, mm)</td>
<td>Technical Bulletin 106</td>
<td>30</td>
</tr>
<tr>
<td>Wet stripping</td>
<td>Technical Bulletin 114</td>
<td>Pass</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Technical Bulletin 115</td>
<td>Pass*</td>
</tr>
<tr>
<td>Cohesion test, within 1 hour (min, kg-mm)</td>
<td>Technical Bulletin 139</td>
<td>200</td>
</tr>
<tr>
<td>Wet track abrasion (max, g/m²)</td>
<td>Technical Bulletin 100</td>
<td>810</td>
</tr>
</tbody>
</table>

*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:

<table>
<thead>
<tr>
<th>Slurry seal type</th>
<th>Residue range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>10–16</td>
</tr>
<tr>
<td>Type II</td>
<td>7.5–13.5</td>
</tr>
<tr>
<td>Type III</td>
<td>6.5–12.0</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Slurry Seal Spread Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slurry seal type</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Type I</td>
</tr>
<tr>
<td>Type II</td>
</tr>
<tr>
<td>Type III</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Micro-Surfacing Emulsion</th>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests on emulsion:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saybolt Furol Viscosity, at 25°C (Saybolt Furol seconds)</td>
<td>AASHTO T 59</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
<tr>
<td></td>
<td>Storage stability, 1 day (max, %)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sieve test (max, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Residue by evaporation (min, %)</td>
<td>California Test 331</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
<tr>
<td>Tests on residue from evaporation test:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Penetration at 25 °C</td>
<td>AASHTO T 49</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
<tr>
<td></td>
<td>Softening point (min, °C)</td>
<td>AASHTO T 53</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Delivery truck</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)</td>
<td>AASHTO T 59</td>
<td>15–90</td>
</tr>
<tr>
<td>Sieve test (%)</td>
<td>AASHTO T 59</td>
<td>0.30</td>
</tr>
<tr>
<td>Storage stability, 1 day (max, %)</td>
<td>AASHTO T 59</td>
<td>0–1</td>
</tr>
<tr>
<td>Settlementᵃ, 5 days (max, %)</td>
<td>ASTM D244</td>
<td>5</td>
</tr>
<tr>
<td>Residue by evaporation (min, %)</td>
<td>California Test 331</td>
<td>62</td>
</tr>
<tr>
<td>Penetration at 25 °C</td>
<td>AASHTO T 49</td>
<td>40–90</td>
</tr>
<tr>
<td>Softening point (min, °C)</td>
<td>AASHTO T 53</td>
<td>57</td>
</tr>
</tbody>
</table>

ᵃSettlement 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Rattler loss (max, %) At 500 revolutions</td>
<td>California Test 211ᵃ</td>
<td>35</td>
</tr>
<tr>
<td>Percent of crushed particles (min, %)</td>
<td>California Test 205</td>
<td>95</td>
</tr>
<tr>
<td>Durability (min)</td>
<td>California Test 229</td>
<td>65</td>
</tr>
<tr>
<td>Sand equivalent (min)</td>
<td>California Test 217</td>
<td>65</td>
</tr>
<tr>
<td>Type II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type III</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ᵃCalifornia 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tests on emulsion:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saybolt Furol Viscosity at 25 °C (Saybolt Furol seconds)</td>
<td>AASHTO T 59</td>
<td>15–90</td>
</tr>
<tr>
<td>Sieve test (%)</td>
<td>AASHTO T 59</td>
<td>0.30</td>
</tr>
<tr>
<td>Storage stability, 1 day (max, %)</td>
<td>AASHTO T 59</td>
<td>0–1</td>
</tr>
<tr>
<td>Settlement*, 5 days (max, %)</td>
<td>ASTM D244</td>
<td>5</td>
</tr>
<tr>
<td>Residue by evaporation (min, %)</td>
<td>California Test 331</td>
<td>62</td>
</tr>
<tr>
<td><strong>Tests on residue by evaporation:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration at 25 °C</td>
<td>AASHTO T 49</td>
<td>40–90</td>
</tr>
<tr>
<td>Softening point (min, °C)</td>
<td>AASHTO T 53</td>
<td>57</td>
</tr>
</tbody>
</table>

*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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Rattler loss (max, %) At 500 revolutions</td>
<td>California Test 211(^a)</td>
<td>35</td>
</tr>
<tr>
<td>Percent of crushed particles (min, %)</td>
<td>California Test 205</td>
<td>95</td>
</tr>
<tr>
<td>Durability (min)</td>
<td>California Test 229</td>
<td>65</td>
</tr>
<tr>
<td>Sand equivalent (min)</td>
<td>California Test 217</td>
<td></td>
</tr>
<tr>
<td>Type II</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>Type III</td>
<td></td>
<td>65</td>
</tr>
</tbody>
</table>

*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:

<table>
<thead>
<tr>
<th>Material</th>
<th>Proportion limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro-surfacing emulsion asphalt residual content (% of dry weight of aggregate)</td>
<td>5.5–10.5</td>
</tr>
<tr>
<td>Water and additives</td>
<td>As Required</td>
</tr>
<tr>
<td>Mineral filler (% of dry weight of aggregate)</td>
<td>0–3</td>
</tr>
</tbody>
</table>

The micro-surfacing mix design must comply with the requirements shown in the following table:
### Micro-surfacing Mix Design Requirements

<table>
<thead>
<tr>
<th>Quality characteristics</th>
<th>Test methoda</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet cohesion</td>
<td>Technical Bulletin 139</td>
<td>12</td>
</tr>
<tr>
<td>At 30 minutes (set) (min, kg-cm)</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>At 60 minutes (traffic) (min, kg-cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excess asphalt (max, g/m²)</td>
<td>Technical Bulletin 109</td>
<td>540</td>
</tr>
<tr>
<td>Wet stripping (min, %)</td>
<td>Technical Bulletin 114</td>
<td>90</td>
</tr>
<tr>
<td>Wet track abrasion loss</td>
<td>Technical Bulletin 100</td>
<td>810</td>
</tr>
<tr>
<td>6-day soak (max, g/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Displacement</td>
<td>Technical Bulletin 147A</td>
<td>5</td>
</tr>
<tr>
<td>Lateral (max, %)</td>
<td></td>
<td>2.10</td>
</tr>
<tr>
<td>Specific gravity after 1000 cycles of 57 kg (max)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification compatibility (min, grade points)</td>
<td>Technical Bulletin 144</td>
<td>(AAA, BAA) 11</td>
</tr>
<tr>
<td>Mix time at 25 °C (min)</td>
<td>Technical Bulletin 113</td>
<td>Controllable to 120 seconds</td>
</tr>
</tbody>
</table>

*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:

<table>
<thead>
<tr>
<th>Micro-surfacing type</th>
<th>Application range (lb of dry aggregate/sq yd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type II</td>
<td>10–20</td>
</tr>
<tr>
<td>Type IIIa</td>
<td>20–32</td>
</tr>
<tr>
<td>Type IIIb</td>
<td>30–32</td>
</tr>
</tbody>
</table>

*aOver asphalt concrete pavement
*bOver 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
Reserved

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test Method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saybolt Furol Viscosity, at 25°C (Saybolt Furl seconds)</td>
<td>AASHTO T 59</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Sieve Test (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage stability, 1 day (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue by distillation (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle charge&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<sup>a</sup>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**

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Location of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphaltic emulsion spread rate (gal/sq yd)</td>
<td>California Test 339</td>
<td>2 per day</td>
<td>Pavement surface</td>
</tr>
</tbody>
</table>

### 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**

<table>
<thead>
<tr>
<th>Quality Characteristic</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphaltic emulsion spread rate (gal/sq yd)</td>
<td>California Test 339</td>
<td>TV ± 10%</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Sand Quality Control</th>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Location of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td>1 per day</td>
<td>See California Test 125</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td></td>
</tr>
<tr>
<td>Sieve size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td>93–100</td>
</tr>
<tr>
<td>No. 8</td>
<td></td>
<td>61–99</td>
</tr>
<tr>
<td>No. 16</td>
<td></td>
<td>X ± 13</td>
</tr>
<tr>
<td>No. 30</td>
<td></td>
<td>X ± 12</td>
</tr>
<tr>
<td>No. 50</td>
<td></td>
<td>X ± 9</td>
</tr>
<tr>
<td>No. 100</td>
<td></td>
<td>1–15</td>
</tr>
<tr>
<td>No. 200</td>
<td></td>
<td>0–10</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td></td>
</tr>
<tr>
<td>Sieve size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td>93–100</td>
</tr>
<tr>
<td>No. 8</td>
<td></td>
<td>61–99</td>
</tr>
<tr>
<td>No. 16</td>
<td></td>
<td>X ± 13</td>
</tr>
<tr>
<td>No. 30</td>
<td></td>
<td>X ± 12</td>
</tr>
<tr>
<td>No. 50</td>
<td></td>
<td>X ± 9</td>
</tr>
<tr>
<td>No. 100</td>
<td></td>
<td>1–15</td>
</tr>
<tr>
<td>No. 200</td>
<td></td>
<td>0–10</td>
</tr>
</tbody>
</table>

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:
### Asphalitic Emulsion

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test Method</th>
<th>Minimum sampling and testing frequency</th>
<th>Sampling location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saybolt Furol Viscosity, at 25 °C (Saybolt Furol seconds)</td>
<td>AASHTO T 59</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Sieve Test (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage stability, 1 day (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue by distillation (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle charge&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests on Residue from Distillation Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration, 25 °C</td>
<td>AASHTO T 49</td>
<td>Minimum 1 per day per delivery truck</td>
<td>Distributor truck</td>
</tr>
<tr>
<td>Ductility</td>
<td>AASHTO T 51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solubility in trichloroethylene</td>
<td>AASHTO T 44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>If the result of the particle char is inconclusive, the asphalitic emulsion must be tested for pH under ASTM E70. Grade QS1h asphalitic emulsion must have a minimum pH of 7.3. Grade CQS1h asphalitic 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Minimum sampling and testing frequency</th>
<th>Location of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td>One per project</td>
<td>See California Test 125</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass per liter (kg)</td>
<td>ASTM D244</td>
<td>One per project</td>
</tr>
<tr>
<td>Cone penetration (mm)</td>
<td>California Test 413</td>
<td></td>
</tr>
<tr>
<td>Nonvolatile (%)</td>
<td>ASM D2042&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Nonvolatile soluble in trichloroethylene (%)</td>
<td>ASTM D3910</td>
<td></td>
</tr>
<tr>
<td>Wet track abrasion (g/m²)</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Dried film color</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity (KU)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>ASTM D562</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>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.

<sup>b</sup>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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass per liter (min, kg)</td>
<td>ASTM D244</td>
<td>1.1</td>
</tr>
<tr>
<td>Cone penetration (mm)</td>
<td>California Test 413</td>
<td>340–700</td>
</tr>
<tr>
<td>Nonvolatile (min, %)</td>
<td>ASTM D2042</td>
<td>50</td>
</tr>
<tr>
<td>Nonvolatile soluble in trichloroethylene (%)</td>
<td>ASTM D2042</td>
<td>10–35</td>
</tr>
<tr>
<td>Wet track abrasion (max, g/m²)</td>
<td>ASTM D3910</td>
<td>380</td>
</tr>
<tr>
<td>Dried film color</td>
<td>--</td>
<td>Black</td>
</tr>
<tr>
<td>Viscosity (min, KU)b</td>
<td>ASTM D562</td>
<td>75</td>
</tr>
</tbody>
</table>

*aWeigh 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.

bKrebs 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:
<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass per liter (min, kg)</td>
<td>ASTM D244</td>
<td>1.1</td>
</tr>
<tr>
<td>Cone penetration (mm)</td>
<td>California Test 413</td>
<td>340–700</td>
</tr>
<tr>
<td>Nonvolatile (min, %)</td>
<td>ASTM D2042</td>
<td>50</td>
</tr>
<tr>
<td>Nonvolatile soluble in trichloroethylene (%)</td>
<td>ASTM D2042a</td>
<td>10–35</td>
</tr>
<tr>
<td>Wet track abrasion (max, g/m²)</td>
<td>ASTM D3910</td>
<td>380</td>
</tr>
<tr>
<td>Dried film color</td>
<td>--</td>
<td>Black</td>
</tr>
<tr>
<td>Viscosity (min, KU)</td>
<td>ASTM D562</td>
<td>75</td>
</tr>
</tbody>
</table>

*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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type 1</td>
</tr>
<tr>
<td>Softening point (min, °C)</td>
<td>ASTM D36</td>
<td>102</td>
</tr>
<tr>
<td>Cone penetration at 77 °F (max)</td>
<td>ASTM D5329</td>
<td>35</td>
</tr>
<tr>
<td>Resilience at 77 °F, unaged (%)</td>
<td>ASTM D5329</td>
<td>20–60</td>
</tr>
<tr>
<td>Flexibility (°C)c</td>
<td>ASTM D3111</td>
<td>0</td>
</tr>
<tr>
<td>Tensile adhesion (min, %)</td>
<td>ASTM D5329</td>
<td>300</td>
</tr>
<tr>
<td>Specific gravity (max)</td>
<td>ASTM D70</td>
<td>1.25</td>
</tr>
<tr>
<td>Asphalt compatibility</td>
<td>ASTM D5329</td>
<td>Pass</td>
</tr>
<tr>
<td>Sieve test (% passing)</td>
<td>See note d</td>
<td>100</td>
</tr>
</tbody>
</table>

- Cold-applied crack treatment material residue collected under ASTM D6943, Method B and sampled under ASTM D140 must comply with the grade specified.
- 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.
- 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.
- 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

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type 1</td>
</tr>
<tr>
<td><strong>Softening point (min, °C)</strong></td>
<td>ASTM D36</td>
<td>102</td>
</tr>
<tr>
<td><strong>Cone penetration at 77 °F (max)</strong>*</td>
<td>ASTM D5329</td>
<td>35</td>
</tr>
<tr>
<td><strong>Flexibility (°C)</strong></td>
<td>ASTM D3111</td>
<td>0</td>
</tr>
<tr>
<td><strong>Tensile adhesion (min, %)</strong></td>
<td>ASTM D5329</td>
<td>300</td>
</tr>
<tr>
<td><strong>Specific gravity (max)</strong></td>
<td>ASTM D70</td>
<td>1.25</td>
</tr>
<tr>
<td><strong>Asphalt compatibility</strong></td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td><strong>Sieve test (% passing)</strong></td>
<td>See note d</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality characteristica</th>
<th>Test methodb</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type 1</td>
</tr>
<tr>
<td><strong>Gradation (% passing by weight)</strong></td>
<td>California Test 202</td>
<td>100</td>
</tr>
<tr>
<td><strong>Sieve size:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*aCold-applied crack treatment material residue collected under ASTM D6943, Method B and sampled under ASTM D140 must comply with the grade specifications.*

*bExcept 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.*

*cFor 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.*

*dFor 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.*

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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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Test method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation (% passing by weight)</td>
<td>California Test 202</td>
<td>100</td>
</tr>
<tr>
<td>Sieve size:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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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

Replace SP-2 at each occurrence in section 39 with:

MS-2

Replace the 3rd paragraph of section 39-2.01A(1) with:

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):

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.
Add to the table in the 4th paragraph of section 39-2.01A(1):


Add to item 8 in the 4th paragraph of section 39-2.01A(3)(b)(i):

, except lime supplier and source

Replace the headings and paragraphs of section 39-2.01A(3)(i) with:

39-2.01A(3)(i) Reserved

Replace the 2nd sentence in the 3rd paragraph of section 39-2.01A(4)(b) with:

Submit 3 parts and keep 1 part.

Replace AASHTO Materials Reference Laboratory in the paragraph of section 39-2.01A(4)(f)(i) with:

AASHTO re:source

Add between single and test in the 7th paragraph of section 39-2.01A(4)(i)(i):

aggregate or HMA

Replace AASHTO Materials Reference Laboratory in the 2nd paragraph of section 39-2.01A(4)(i)(iv) with:

AASHTO re:source

Replace the 1st paragraph of section 39-2.01B(2)(b) with:

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):

blend
Replace the 9th through 11th paragraphs of section 39-2.01B(8)(a) with:

HMA must be produced at the temperatures shown in the following table:

<table>
<thead>
<tr>
<th>HMA Production Temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA compaction</td>
</tr>
<tr>
<td>HMA</td>
</tr>
<tr>
<td>Density based Method</td>
</tr>
<tr>
<td>Density based Method</td>
</tr>
<tr>
<td>HMA with WMA technology</td>
</tr>
<tr>
<td>Density based Method</td>
</tr>
<tr>
<td>Density based Method</td>
</tr>
</tbody>
</table>

Delete the 1st paragraph of section 39-2.01B(11).

Add after the 2nd paragraph of section 39-2.01B(11):

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. 1/2-inch 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. 6.40 percent for 1/2-inch dike mix aggregate gradation

If you request and the Engineer authorizes, you may reduce the minimum asphalt binder content.

Aggregate gradation for 1/2-inch dike mix must be within the TV limits for the specified sieve size shown in the following table:

<table>
<thead>
<tr>
<th>Aggregate Gradation for 1/2-inch Dike Mix (Percentage Passing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve size</td>
</tr>
<tr>
<td>3/4&quot;</td>
</tr>
<tr>
<td>1/2&quot;</td>
</tr>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 8</td>
</tr>
<tr>
<td>No. 50</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>

Replace item 4 in the 2nd paragraph of section 39-2.01C(1) with:

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
Delete item 3 in the 8th paragraph of section 39-2.01C(1). 07-15-16

Replace 39-2.01A(3)(m)(iv) in the 6th paragraph of section 39-2.01C(3)(e) with:

36-3.01C(3) 01-15-16

Replace 2.06 in the 4th paragraph of section 39-2.01C(3)(f) with:

2.05 07-15-16

Add to the end of section 39-2.01C(15)(b):

The compacted lift thickness must not exceed 0.25 foot. 07-15-16

Add between rectangles and with in the 4th paragraph of section 39-2.01C(16):

, half the lane width, 04-15-16

Add between to and the in item 1 of the 4th paragraph of section 39-2.01C(16):

and along 04-15-16

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:

37-4.02 07-15-16

Replace section 39-2.02A(3)(b) with:

The JMF must be based on the superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute. 01-15-16

Add between the 1st and 2nd paragraphs of section 39-2.02C:

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. 07-15-16
Replace the table in the 2nd paragraph of section 39-2.02C with:

<table>
<thead>
<tr>
<th>Lift thickness (feet)</th>
<th>Ambient air (°F)</th>
<th>Surface (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unmodified asphalt binder</td>
<td>Modified asphalt binder</td>
</tr>
<tr>
<td>Type A HMA and Type A HMA produced with WMA water injection technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;0.15</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>≥0.15</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Type A HMA produced with WMA additive technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;0.15</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>≥0.15</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

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:

and Type A HMA produced with WMA water injection technology

Add between the 4th and the 5th paragraphs of section 39-2.02C:

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:

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:

18.0-23.0

01-15-16

Add before the 1st paragraph of section 39-2.03A(4)(e)(ii)(C):

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.

04-15-16

Replace the row for **Hamburg wheel track** in the table in section 39-2.03B(2) with:

<table>
<thead>
<tr>
<th>Hamburg wheel track (min, number of passes at the inflection point)</th>
<th>AASHTO T 324 (Modified)(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binder grade:</td>
<td></td>
</tr>
<tr>
<td>PG 58</td>
<td>10,000</td>
</tr>
<tr>
<td>PG 64</td>
<td>12,500</td>
</tr>
<tr>
<td>PG 70</td>
<td>15,000</td>
</tr>
</tbody>
</table>

01-15-16

Replace **RHMA-G** in the 3rd and 5th paragraphs of section 39-2.03C with:

RHMA-G and RHMA-G produced with WMA water injection technology

07-15-16

Add between the 3rd and 4th paragraphs of section 39-2.03C:

Spread and compact RHMA-G produced with WMA additive technology at an ambient air temperature of at least 50 degrees F and a surface temperature of at least 50 degrees F.

01-20-17

Add between the 5th and 6th paragraphs of section 39-2.03C:

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

07-15-16

Replace 39-2.03A(4)(b)(ii) in the 1st sentence of section 39-2.04A(4)(b)(ii) with:

39-2.03A(4)(c)(ii)

01-20-17
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.

For RHMA-O produced with WMA water injection technology, and RHMA-O-HB and RHMA-O-HB produced with WMA water injection 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

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

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:

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:

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:

MS-2 Asphalt Mix Design Methods

Replace 39-3.05 in the 1st paragraph of section 39-3.04A with:

39-3.04

Add to the end of section 39-3.04A:

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.

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:

39-3.05

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:

, Types WF and AN,
Add to the end of section 40-2.02D:
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:
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.

Add to the end of section 40-2.03D:
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):
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:

Do not store grooving or grinding residue within the highway.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

DIVISION VI  STRUCTURES
47 EARTH RETAINING SYSTEMS
07-15-16
Replace the 6th paragraph in section 47-2.02A with:

Rock for rock slope protection at drain pipe outlets must be small-rock slope protection and must comply with the gradation specified for 7-inch-thick layer in section 72-4.02.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

48 TEMPORARY STRUCTURES
01-20-17
Add between the 5th and 6th paragraphs of section 48-2.01C(2):

For multi-frame bridges, submit a separate shop drawing for each frame.
Replace section 48-6 with:

48-6 TEMPORARY WOOD POLES

48-6.01 GENERAL
48-6.01A Summary
Section 48-6 includes specifications for constructing, maintaining, and removing temporary wood poles for the support of electrical systems.

Temporary wood poles include attached wire components.

48-6.01B Definitions
Reserved

48-6.01C Submittals
48-6.01C(1) General
Submit a letter of certification that certifies all components of the manufactured assemblies are used in compliance with the manufacturer's recommendations. If requested, (1) submit manufacturer's data for manufactured assemblies to verify manufacturer's recommendations or (2) perform tests demonstrating adequacy of the proposed assemblies and submit the test results.

Submit the letter before installing messenger wires, tether wires, or self-supporting conductors or cables.

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
3. Be safely supported at least 6 inches off the ground in a horizontal position on at least 2 support blocks. If requested, rotate the piles on the blocks.
4. Be positioned such that the Department has safe access to the entire pile length and circumference for the installation of anchorages and control marks for monitoring.

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):

3. Cut pile to the specified cut-off elevation after bearing acceptance criteria is provided by the Department

Delete the 3rd paragraph of section 49-1.03.

Delete the 2nd paragraph of section 49-1.04.

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:

3. CISS concrete piles

Add between undisturbed material and in a dry in the 1st paragraph of section 49-3.01C:

, casing, or steel shell

Replace the 2nd and 3rd paragraphs of section 49-3.01C with:

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:

drilled

Add to section 49-3.02A(1):

Permanent steel casing and driven steel shell must comply with section 49-2.02.
Replace the paragraph of section 49-3.02A(2) with:

**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:

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 *1 business day* in the paragraph of section 49-3.02A(3)(d) with:

2 business days

Add to section 49-3.02A(3)(d):

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):

Allow 10 days for the review.

Replace the 3rd sentence in the paragraph of section 49-3.02A(3)(f) with:

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):

to be mitigated
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:

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:

Allow 10 days for the review.

Add to section 49-3.02A(3):

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.

Add after excavated hole in the 1st sentence in the 3rd paragraph of section 49-3.02A(4)(c):

lined with plastic

Replace the 1st paragraph of section 49-3.02A(4)(d)(i) with:

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:

GGL

Replace the 1st sentence in the 3rd paragraph of section 49-3.02A(4)(d)(i) with:

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:

GGL

Replace the 3rd and 4th paragraphs of section 49-3.02A(4)(d)(iii) with:

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.

**Delete the 8th paragraph of section 49-3.02A(4)(d)(iii).**

**Add to the end of section 49-3.02A(4)(d)(iii):**

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):**

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:**

49-3.02B(4) **Reserved**

**Replace near in the 3rd, 4th, and 5th paragraphs of section 49-3.02B(6)(b) with:**

within 2 feet of

**Replace twice per shift in item 2 in the 3rd paragraph of section 49-3.02B(6)(b) with:**

every 4 hours

**Delete the 7th and 8th paragraphs of section 49-3.02B(6)(b).**

**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:**

within 2 feet of

**Replace item 5 in the 4th paragraph of section 49-3.02B(6)(c) with:**

5. After final cleaning and immediately before placing concrete.
Replace section 49-3.02B(9) with:

**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):**

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:**

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:**

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:**

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:**

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:**

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:

For acceptance testing, install and test vertical inspection pipes as follows:

1. Log the location of the inspection pipe 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 be 1-1/4-inch diameter by 4.5-foot long, weigh 12 pounds or less, and 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.

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.

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Replace item 2 in the list in the 2nd paragraph of section 49-3.02C(7) with:

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):

49-3.02C(9)(a) General

Replace the 2nd sentence of the 3rd paragraph of section 49-3.02C(9) with:

Do not vibrate the concrete.

Add after concrete pump in the 8th paragraph of section 49-3.02C(9):

and slurry pump

Replace item 3 in the list in the 11th paragraph of section 49-3.02C(9) with:

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:

Maintain a log of concrete placement for each drilled hole.

Replace 14th and 15th paragraphs of section 49-3.02C(9) with:

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):

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:

CAST-IN-STEEL SHELL CONCRETE PILING

Replace the 1st paragraph of section 49-3.03A(1) with:

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):

CISS concrete piles include Class 90 Alternative V and Class 140 Alternative V piles.

Add to section 49-3.03A(3):

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:

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:

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
07-15-16
Add to the end of section 50-1.01C:

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:

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
Each jack used to pretension prestressing steel must be calibrated, equipped with its gauges, by a laboratory on the Authorized Laboratory List within 1 year of use and after each repair.

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.

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51 CONCRETE STRUCTURES
01-20-17
Replace the 7th item in the list in the 2nd paragraph of section 51-1.01A with:

7. Pipe culvert headwalls, endwalls, and wingwalls

Add to the list in the 2nd paragraph of section 51-1.01A:

8. Pile extensions
9. Drainage inlets

Add to the list in the 6th paragraph of section 51-1.01A:

7. Drainage inlets
8. Pipe culvert headwalls and endwalls for a pipe with a diameter of less than 5 feet

Delete the 1st paragraph of section 51-1.01C(5).
Delete the 5th item in the list in the 4th paragraph of section 51-1.01C(5).

Replace the 1st sentence in the 3rd paragraph of section 51-1.01D(3)(b)(iii) with:
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:
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:
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):
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):
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.

Replace the 1st paragraph of section 51-1.03E(5) with:
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):
4. Interior and top surfaces of drainage inlets

Replace the paragraphs of section 51-1.03F(5)(b)(i) with:
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:

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:

Grooves must be from 1/8 to 3/16 inch deep after concrete has hardened.

Add to section 51-1.04:

The payment quantity for structural concrete, drainage inlet is the volume determined from the dimensions shown for CIP drainage inlets.

Add to section 51-4.01C(1):

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):

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):

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:

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:

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:

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):

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 51-5.04:
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:
Minor structures include structures described as minor structures.

Delete the 4th paragraph of section 51-7.01B.

Delete the 1st and 3rd paragraphs of section 51-7.01C.

Delete the heading and paragraph of section 51-7.02.

52 REINFORCEMENT

Add to section 52-1.02:

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 the 3rd paragraph of section 52-6.03B with:
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

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53  SHOTCRETE

Replace 632 in item 1 in the list in the 3rd paragraph of section 53-1.02 with:

675

Replace item 2 in the list in the 3rd paragraph of section 53-1.02 with:

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:

concrete

56  OVERHEAD SIGN STRUCTURES, STANDARDS, AND POLES

Replace section 56-1.01 with:

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:
<table>
<thead>
<tr>
<th>Weld location</th>
<th>Weld type</th>
<th>Minimum required NDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circumferential splices around the perimeter of tubular sections, poles, and arms</td>
<td>CJP groove weld with backing ring</td>
<td>100% UT or RT</td>
</tr>
<tr>
<td>Longitudinal seam</td>
<td>CJP or PJP groove weld</td>
<td>Random 25% MT</td>
</tr>
<tr>
<td>Longitudinal seam within 6 inches of a circumferential splice</td>
<td>CJP groove weld</td>
<td>100% UT or RT</td>
</tr>
</tbody>
</table>
| 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  
< 5/16 inch: 100% MT after root weld pass and final weld pass |
| 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

<table>
<thead>
<tr>
<th>Weld location</th>
<th>Weld type</th>
<th>Minimum required NDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base plate to post</td>
<td>CJP groove weld with backing ring and reinforcing fillet</td>
<td>100% UT and 100% MT</td>
</tr>
<tr>
<td>Base plate to gusset plate</td>
<td>CJP groove weld</td>
<td>100% UT</td>
</tr>
<tr>
<td>Circumferential splices of pipe or tubular sections</td>
<td>CJP groove weld with backing ring</td>
<td>100% UT or RT</td>
</tr>
<tr>
<td>Split post filler plate welds</td>
<td>CJP groove weld with backing ring</td>
<td>100% UT or RT</td>
</tr>
<tr>
<td>Longitudinal seam weld for pipe posts</td>
<td>CJP groove weld</td>
<td>t &lt; 1/4 inch: 100% MT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>t ≥ 1/4 inch: 100% UT or RT</td>
</tr>
<tr>
<td></td>
<td>PJP groove weld</td>
<td>Random 25% RT</td>
</tr>
<tr>
<td>Chord angle splice weld</td>
<td>CJP groove weld with backing bar</td>
<td>100% UT or RT</td>
</tr>
<tr>
<td>Truss vertical, diagonal, and wind angles to chord angles</td>
<td>Fillet weld</td>
<td>Random 25% MT</td>
</tr>
<tr>
<td>Upper junction plate to chord (cantilever type truss)</td>
<td>Fillet weld</td>
<td>Random 25% MT</td>
</tr>
<tr>
<td>Bolted field splice plates (tubular frame type)</td>
<td>CJP groove weld</td>
<td>100% UT and 100% MT</td>
</tr>
<tr>
<td>Cross beam connection plates (lightweight extinguishable message sign)</td>
<td>Fillet weld</td>
<td>Random 25% MT</td>
</tr>
<tr>
<td>Arm connection angles (lightweight extinguishable message sign)</td>
<td>Fillet weld</td>
<td>100% MT</td>
</tr>
<tr>
<td>Mast arm to arm plate (lightweight extinguishable message sign)</td>
<td>CJP groove weld with backing ring</td>
<td>t ≥ 5/16 inch: 100% UT and 100% MT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>t &lt; 5/16 inch: 100% MT after root weld pass and final weld pass</td>
</tr>
<tr>
<td>Post angle to post (lightweight extinguishable message sign)</td>
<td>Fillet weld</td>
<td>100% MT</td>
</tr>
<tr>
<td>Hand holes and other appurtenances</td>
<td>Fillet and PJP welds</td>
<td>MT full length on random 25% of all sign structures</td>
</tr>
</tbody>
</table>

**NOTE:** t = pole or arm thickness

### 56-1.01D(2)(b)(ii) Ultrasonic Testing

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 6.13.3.1 of AWS D1.1.

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:
Reserved

Replace the 2nd sentence of the 1st paragraph of section 56-2.02F with:
Manufactured pipe posts must comply with one of the following:

Add to the list in the 1st paragraph of section 56-2.02F:

4. ASTM A1085, Grade A

Replace the 2nd paragraph of section 56-2.02F with:
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.

Delete the last sentence in the 1st paragraph of section 56-2.02K(2).

Delete the 3rd paragraph of section 56-2.02K(2).

Replace the 2nd paragraph of section 56-2.02K(4) with:
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:
The edges of handholes and other large post and arm openings must be ground smooth.

Replace the heading of section 56-3 with:

56-3 STANDARDS, POLES, PEDESTALS, AND POSTS

Replace the paragraph in section 56-3.01A with:
Section 56-3 includes general specifications for fabricating and installing standards, poles, pedestals, and posts.
Replace section 56-3.01B(2)(b) with:

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:

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:

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:

Except when located on a structure, construct foundations monolithically.

Replace the 13th paragraph of section 56-3.01C(2)(a) with:

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:

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:

If shown, use sleeve nuts on Type 1 standards.
Add to section 56-3.01C(2)(b):

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:

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:

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):

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:

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 2nd sentence of the 9th paragraph of section 56-3.02B(2) with:

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):

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):

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:

<table>
<thead>
<tr>
<th>Slip Base Bolt Tightening Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard type</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>15-SB</td>
</tr>
<tr>
<td>15-SBF</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>31</td>
</tr>
</tbody>
</table>

Replace the 1st sentence of the 2nd paragraph of section 56-3.02C with:

Bolted connections attaching signal or luminaire arms to standards, poles, and posts are considered slip critical.

Add to section 56-3.06B:

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.

Delete the 2nd paragraph of section 56-3.06C.

Replace the 1st sentence of the 3rd paragraph of section 56-3.06C with:

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.

59 STRUCTURAL STEEL COATINGS

Replace Type S in the 2nd paragraph of section 59-1.02A with:

Type M or Type S

Add to the list in the 2nd paragraph of section 59-1.02B:

5. Manufactured abrasives.
Replace Mineral and slag in the 3rd paragraph of section 59-1.02B with:

Mineral, manufactured, and slag

Delete the 4th paragraph of section 59-2.01C(1).

60 EXISTING STRUCTURES

Delete the 2nd sentence in the 11th paragraph of section 60-3.04B(3)(c).

64 PLASTIC PIPE

Replace Reserved in section 64-3 with:

64-3.01 GENERAL
64-3.01A Summary
Section 64-3 includes specifications for constructing slotted plastic pipe.

Slotted plastic pipe includes structure excavation, concrete backfill, connecting new pipe to new or existing facilities, concrete collars, reinforcement, and other connecting devices.

64-3.01B Definitions
Reserved

64-3.01C Submittals
If an or equal slotted plastic pipe is being considered, it must be submitted 30 days before installation for approval.

If RSC is used for concrete backfill for slotted plastic pipe, submit the concrete mix design and test data from an authorized laboratory 10 days before excavating the pipe trench. The laboratory must specify the cure time required for the concrete mix to attain 2,000 psi compressive strength when tested under California Test 521.

Heel-resistant grates if specified must be submitted 30 days before installation for approval. Anchorage details must be included in the submittal.

64-3.01D Quality Assurance
Reserved

64-3.02 MATERIALS
64-3.02A General
Not Used

64-3.02B Slotted Plastic Pipes
Slotted plastic pipe must be one of the following or equal:
Slotted Plastic Pipe

<table>
<thead>
<tr>
<th>12&quot; diameter</th>
<th>18&quot; diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zurn Z888-12</td>
<td>Zurn Z888-18</td>
</tr>
<tr>
<td>ACO Qmax 350</td>
<td>ACO Qmax 365</td>
</tr>
<tr>
<td>ADS Duraslot-12</td>
<td>ADS Duraslot-18</td>
</tr>
</tbody>
</table>

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.

DIVISION VII DRAINAGE FACILITIES

70 MISCELLANEOUS DRAINAGE FACILITIES

01-20-17

Replace section 70-6 with:

01-20-17

70-6 GRATED LINE DRAIN

70-6.01 GENERAL

70-6.01A Summary

Section 70-6 includes specifications for constructing grated line drains.

Unless a specific type of grated line drain (GLD) is shown, select one of the following:
1. NDS Filcoten
2. ABT Poly Drain
3. Zum Perma-Trench
4. ACO Power Drain
5. Hubbell Polycast

You may use a poured-in-place GLD or equal based on:

1. Minimum slope
2. Required channel discharge capacity \( Q \)

Clear opening of channel width must be no smaller than 4 inches and not to exceed 9 inches. Internal depth of GLD is not limited, unless shown.

70-6.01B Definitions
Reserved

70-6.01C Submittals
You must submit:

1. Calculations with manufacturer’s design documentation verifying that the GLD will meet the discharge capacity required by the data shown for each drainage system location. Calculations must be:
   1.1 Based on Manning’s equation for discharge capacity using a roughness coefficient \( n \) value of 0.013.
   1.2 Sealed and signed by an engineer who is registered as a civil engineer in the State. When grate hold down mechanisms are in the discharge channel, only the unobstructed channel area beneath the hold down will be considered for capacity calculations. If there are more than one drainage system location, a summary table specifying the location, discharge capacity, slope and depth constraints showing that the GLD has sufficient discharge capacity must be submitted with calculations.
2. Certificate of compliance for the GLD frame and grate. If grates are designated for placement within a pedestrian path of travel, the certificate of compliance must also verify compliance with the Americans with Disabilities Act (ADA) with grate spacing no more than 1/2 inch.
3. Method of repair when deficiencies are noted in GLD.
4 Written report of GLD quality control that includes video or photos of GLD.

70-6.01D Quality Assurance

70-6.01D(1) General
Reserved

70-6.01D(2) Quality Control
Before contract acceptance, inspect the entire length of the GLD and submit a written report that includes video or photos at intervals of not less than 20 feet per length of GLD. Allow 10 days for the Engineer’s review.

70-6.02 MATERIALS

70-6.02A General
Epoxy must comply with ASTM C881.
End caps must be commercial quality as furnished by the GLD manufacturer.
Joint filler material must comply with section 40-1.02E.
Joint seal material must comply with section 41-5.02.
Shear stud must comply with ASTM A1044.
Steel plate must comply with ASTM A36 and be galvanized under section 75-1.02B.
High strength mechanical rebar connection device must be commercial-quality double-sleeve type that allows overlap of rebar to connect with friction locking screws. Sleeve must be designed to be used with Grade 60 rebar.

70-6.02B Frames and Grates
Frames and grates must be supplied by the same manufacturer as the GLD channel. GLD formed by using concrete must have a frame and grate that matches the width of the drain being provided.

70-6.02C Reinforcement
Dowels must comply with section 40.
Reinforcing bars must be Grade 60, complying with section 52.

70-6.02D Concrete Backfill
Concrete backfill must comply with section 61-5, except minor concrete must contain a minimum of 505 pounds of cementitious material per cubic yard.

70-6.02E Storage and Handling
GLD channels must be stored on a flat surface in their original shipping pallets until installation.

70-6.03 CONSTRUCTION
70-6.03A General
Where isolation joint is designated, installation must comply with section 40.
If repairs are necessary; submit the procedure for approval.

70-6.03B Preparation
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.

70-6.03C Installation
Grates must fit securely into the frames without rocking.
Grates installed within designated pedestrian paths must be certified as complying with the requirements of the ADA. Designated pedestrian grates must accept inflow of runoff through openings consisting of a minimum of 30 percent of the total top surface area of the grate, with individual openings or slots having a dimension not greater than 0.5 inch measured in the direction of pedestrian travel.
Grated line drains must comply with the manufacturer’s joint installation recommendations for overlap. Joints for GLD sections must be closely jointed and secured to ensure no separation during backfilling. With overlapping joints, the upstream segment or section must fit over the top of the downstream one and allow for the required movement without allowing the concrete backfill to leak into the channel. With exterior sleeve joints, the separate sections must be placed to allow for thermal expansion and contraction such that the external sleeve provides sufficient coverage to accommodate joint movement without allowing any leakage during the concrete backfill placement. Exterior sleeves must be centered over each joint.
Sections must not have sidewall extensions. The GLD interior surface, below the level of the frame and grate and associated connections, must be smooth. Environmentally hazardous materials or solvents must not be used to clean any channel segments.
The frame or grate of the GLD must not extend above the level of the surrounding concrete backfill.
Use manufacturer’s end caps to prevent concrete backfill from entering the grated line drain. Where no end caps are available, construct and compact earth plugs at the ends of the concrete backfill to contain the concrete within the trench.
Connect grated line drains to new or existing drainage facilities as shown. Drill rebar dowel holes, at least 1/16 inch larger than the dowel diameter, into existing drainage facilities or place dowels into new
drainage wall at cast-in-place inlet connection. Use epoxy to secure dowels to existing inlet wall. Install epoxy under the epoxy manufacturer’s instructions. Connect rebar with a double barrel mechanical coupler at overlap. Install mechanical coupler under the manufacturer’s instructions. Rebuild the removed drainage inlet wall with minor concrete.

For a cast-in-place GLD, all forms must be removed after concrete has cured a minimum of 72 hours. Earlier form removal will be allowed if authorized. Remove forms by methods that will not gouge or mar the concrete surfaces. Any damage during form removal must be repaired.

When connecting to an existing drainage facility, remove concrete as shown. Clean existing concrete to receive new concrete. Place steel plate with reinforcing as shown and backfill with concrete. All existing concrete wall surface must have a smooth surface, either by saw cutting or patching with mortar.

Environmentally hazardous materials or other solvents must not be used to remove interior forms, and release agents must be nontoxic and biodegradable.

**70-6.03D Concrete Backfill**
Concrete backfill must be placed under section 61-5.

You must:

1. Place a minimum 6-inch concrete backfill monolithically against undisturbed material at the sides and bottom of the trench. During concrete backfill placement, the GLD must be constrained in a way to prevent floating or shifting.
2. Place the weakened plane and expansion joints under section 73-1.03.
3. Place a 1/2-inch isolation joint where grated line drains are placed in PCC pavement.
4. Remove all foreign matter before concrete backfill is placed in trench.
5. Construct earth plugs and compact at the ends of the planned concrete backfill to contain concrete within the trench, if needed.
6. Maintain a maximum 5 percent of the nominal trench width for the inward or outward GLD sidewall deflection after concrete backfill placement.

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.

**70-6.04 PAYMENT**
Not Used

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**71 EXISTING DRAINAGE FACILITIES**

01-15-16

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 the 2nd heading in section 71-5.03 with:

71-5.03B Frames, Covers, Grates, and Manholes

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DIVISION VIII MISCELLANEOUS CONSTRUCTION

72 SLOPE PROTECTION

07-15-16

Replace the 1st and 2nd paragraphs of section 72-2.02B with:

For method A and B placement and the class of RSP described, comply with the rock gradation shown in the following table:

<table>
<thead>
<tr>
<th>Nominal RSP class by median particle diametera</th>
<th>Nominal median particle weight W50c,d</th>
<th>d15c (inches)</th>
<th>d50c (inches)</th>
<th>d100c (inches)</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Diameter</td>
<td>Min</td>
<td>Max</td>
<td>Min</td>
<td>Max</td>
<td>Max</td>
</tr>
<tr>
<td>I 6</td>
<td>20 lb</td>
<td>3.7</td>
<td>5.2</td>
<td>5.7</td>
<td>6.9</td>
</tr>
<tr>
<td>II 9</td>
<td>60 lb</td>
<td>5.5</td>
<td>7.8</td>
<td>8.5</td>
<td>10.5</td>
</tr>
<tr>
<td>III 12</td>
<td>150 lb</td>
<td>7.3</td>
<td>10.5</td>
<td>11.5</td>
<td>14.0</td>
</tr>
<tr>
<td>IV 15</td>
<td>300 lb</td>
<td>9.2</td>
<td>13.0</td>
<td>14.5</td>
<td>17.5</td>
</tr>
<tr>
<td>V 18</td>
<td>1/4 ton</td>
<td>11.0</td>
<td>15.5</td>
<td>17.0</td>
<td>20.5</td>
</tr>
<tr>
<td>VI 21</td>
<td>3/8 ton</td>
<td>13.0</td>
<td>18.5</td>
<td>20.0</td>
<td>24.0</td>
</tr>
<tr>
<td>VII 24</td>
<td>1/2 ton</td>
<td>14.5</td>
<td>21.0</td>
<td>23.0</td>
<td>27.5</td>
</tr>
<tr>
<td>VIII 30</td>
<td>1 ton</td>
<td>18.5</td>
<td>26.0</td>
<td>28.5</td>
<td>34.5</td>
</tr>
<tr>
<td>IX 36</td>
<td>2 ton</td>
<td>22.0</td>
<td>31.5</td>
<td>34.0</td>
<td>41.5</td>
</tr>
<tr>
<td>X 42</td>
<td>3 ton</td>
<td>25.5</td>
<td>36.5</td>
<td>40.0</td>
<td>48.5</td>
</tr>
<tr>
<td>XI 46</td>
<td>4 ton</td>
<td>28.0</td>
<td>39.4</td>
<td>43.7</td>
<td>53.1</td>
</tr>
</tbody>
</table>

aFor RSP Classes I–VIII, use Class 8 RSP fabric. For RSP Classes IX–XI, use Class 10 RSP fabric.
bIntermediate 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.
dValues 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:

<table>
<thead>
<tr>
<th>Fabric Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>
Replace the table in the 1st paragraph of section 72-3.02C with:

**Concreted-Rock Gradation**

<table>
<thead>
<tr>
<th>Class</th>
<th>Size (inches)</th>
<th>Nominal RSP class by median particle diameterb</th>
<th>Nominal median particle weight W50,c,d</th>
<th>d15c</th>
<th>d50c</th>
<th>d100c</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>6</td>
<td>20 lb</td>
<td>3.7</td>
<td>5.2</td>
<td>5.7</td>
<td>6.9</td>
</tr>
<tr>
<td>II</td>
<td>9</td>
<td>60 lb</td>
<td>5.5</td>
<td>7.8</td>
<td>8.5</td>
<td>10.5</td>
</tr>
<tr>
<td>III</td>
<td>12</td>
<td>150 lb</td>
<td>7.3</td>
<td>10.5</td>
<td>11.5</td>
<td>14.0</td>
</tr>
<tr>
<td>V</td>
<td>18</td>
<td>1/4 ton</td>
<td>11.0</td>
<td>15.5</td>
<td>17.0</td>
<td>20.5</td>
</tr>
<tr>
<td>VII</td>
<td>24</td>
<td>1/2 ton</td>
<td>14.5</td>
<td>21.0</td>
<td>23.0</td>
<td>27.5</td>
</tr>
</tbody>
</table>

a Use Class 8 RSP fabric.
b Intermediate or B dimension (i.e., width) where A dimension is length and C dimension is thickness.
cd%, 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:

**Minimum Concrete Penetration**

<table>
<thead>
<tr>
<th>Rock class</th>
<th>VII</th>
<th>V</th>
<th>III</th>
<th>II</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration (inches)</td>
<td>18</td>
<td>14</td>
<td>10</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

Replace section 73-3.01A with:

Section 73-3 includes specifications for constructing sidewalks, gutter depressions, island paving, curb ramps, and driveways.

Replace 87-1.03K in the 4th paragraph of section 74-3.03B(2) with:
80 FENCES
07-15-16
Replace section 80-4 with:

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

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DIVISION IX TRAFFIC CONTROL DEVICES
83 RAILINGS AND BARRIERS
04-15-16

Delete to in the 4th paragraph of section 83-1.02B.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

84 MARKINGS
07-15-16
Add to the beginning of section 84-8.03A:

Select the method and equipment for constructing ground-in indentations.

Replace the 1st paragraph of section 84-8.03A with:

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:

Modify rumble strip spacing to avoid locating a groove on a concrete pavement joint.

Replace the 3rd paragraph of section 84-8.03A with:

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:

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.

Delete new in the 1st paragraph of section 84-8.03B.

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:

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:

Dispose of the removed material.

Delete the 2nd paragraph of section 84-8.03C.

Replace 37-2 in the 3rd paragraph of section 84-8.03C with:

37-4.02

Replace section 84-8.04 with:

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:

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:

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
cement concrete pavement.

Delete materially in the 1st paragraph of section 84-9.03D.

DIVISION X  ELECTRICAL WORK
Replace section 86 with:

86  GENERAL

86-1.01  GENERAL

86-1.01A  Summary
Section 86 includes general specifications for furnishing electrical equipment and materials.

Electrical equipment and materials must comply with part 4 of the California MUTCD and 8 CA Code of
Regs, chapter 4, subchapter 5, "Electrical Safety Orders."

Galvanized equipment and materials must comply with section 75-1.02B.

86-1.01B  Definitions

accessible pedestrian signal: Accessible pedestrian signal as defined in the California MUTCD.

accessible walk indication: Activated audible and vibrotactile action during the walk interval.

actuation: Actuation as defined in the California MUTCD.

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.

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.

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.

National Voluntary Laboratory Accreditation Program: U.S. Department of Energy program that accredits independent testing laboratories.

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.

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.

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

#### 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

Submit load-rating test reports for pull boxes from a NRTL.
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:

<table>
<thead>
<tr>
<th>Type</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>Must be Type A, extruded, rigid PVC conduit complying with UL 651 or must be HDPE conduit complying with UL 651A.</td>
</tr>
<tr>
<td>4</td>
<td>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.</td>
</tr>
<tr>
<td>5</td>
<td>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.</td>
</tr>
</tbody>
</table>

Bonding bushings installed on metal conduit must be insulated and either a galvanized or zinc-alloy type.

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
Pull box cover must have a marking on the top that is:

1. Clearly defined
2. Uniform in depth
3. Parallel to either side
4. 1 to 3 inches in height

Cover marking must be:

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

The load rating must be stenciled on the inside and outside of the pull box and 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 with 18 percent chromium and 8 percent nickel content.

**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.

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.

The bolts, nuts, and washers must be a captive design and galvanized. 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.

**86-1.02C(3) Traffic Pull Boxes**

A traffic pull box and cover must comply with ASTM C857 for HS20-44 loading.

The frame must be anchored to the box with 2-1/4-inch-long concrete anchors with a 1/4 inch diameter. A
no. 3-1/2(T) pull box must have 4 concrete anchors, one placed in each corner. No. 5(T) and no. 6(T) pull
boxes must have 6 concrete anchors, one placed in each corner and one near the middle of each of the
longer sides.

Nuts must be vibration-resistant, zinc-plated, carbon steel and have a wedge ramp at the root of the
thread.

Before galvanizing a steel or cast iron 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.

The steel cover must be countersunk approximately 1/4 inch to accommodate the bolt head. When
tightened, the bolt head must be no more than 1/8 inch above the top of the cover.
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.

86-1.02F Conductors and Cables
86-1.02F(1) Conductors
86-1.02F(1)(a) General
Copper wire must comply with ASTM B3 and B8.
Conductor must be clearly and permanently marked the entire length of its 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.

A conductor must be UL listed or NRTL certified and rated for 600 V(ac).

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.

Conductors must be identified as shown in the following table:
<table>
<thead>
<tr>
<th>Circuit</th>
<th>Signal phase or function</th>
<th>Identification</th>
<th>Insulation color</th>
<th>Band symbols</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signals (vehicle)</strong></td>
<td>2, 6</td>
<td></td>
<td>Red, yel, brn</td>
<td>Blk</td>
<td>2, 6</td>
</tr>
<tr>
<td></td>
<td>4, 8</td>
<td></td>
<td>Red, yel, brn</td>
<td>Ora</td>
<td>4, 8</td>
</tr>
<tr>
<td></td>
<td>1, 5</td>
<td></td>
<td>Red, yel, brn</td>
<td>None</td>
<td>1, 5</td>
</tr>
<tr>
<td></td>
<td>3, 7</td>
<td></td>
<td>Red, yel, brn</td>
<td>Pur</td>
<td>3, 7</td>
</tr>
<tr>
<td></td>
<td>Ramp meter 1</td>
<td></td>
<td>Red, yel, brn</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td></td>
<td>Ramp meter 2</td>
<td></td>
<td>Red, yel, brn</td>
<td>Blk</td>
<td>NBR</td>
</tr>
<tr>
<td><strong>Pedestrian signals</strong></td>
<td>2p, 6p</td>
<td></td>
<td>Red, brn</td>
<td>Blk</td>
<td>2p, 6p</td>
</tr>
<tr>
<td></td>
<td>4p, 8p</td>
<td></td>
<td>Red, brn</td>
<td>Ora</td>
<td>4p, 8p</td>
</tr>
<tr>
<td></td>
<td>1p, 5p</td>
<td></td>
<td>Red, brn</td>
<td>None</td>
<td>1p, 5p</td>
</tr>
<tr>
<td></td>
<td>3p, 7p</td>
<td></td>
<td>Red, brn</td>
<td>Pur</td>
<td>3p, 7p</td>
</tr>
<tr>
<td><strong>Pedestrian push buttons</strong></td>
<td>2p, 6p</td>
<td></td>
<td>Blu</td>
<td>Blk</td>
<td>P-2, P-6</td>
</tr>
<tr>
<td></td>
<td>4p, 8p</td>
<td></td>
<td>Blu</td>
<td>Ora</td>
<td>P-4, P-8</td>
</tr>
<tr>
<td></td>
<td>1p, 5p</td>
<td></td>
<td>Blu</td>
<td>None</td>
<td>P-1, P-5</td>
</tr>
<tr>
<td></td>
<td>3p, 7p</td>
<td></td>
<td>Blu</td>
<td>Pur</td>
<td>P-3, P-7</td>
</tr>
<tr>
<td><strong>Traffic signal controller cabinet</strong></td>
<td>Ungrounded circuit conductor</td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>CON-1</td>
</tr>
<tr>
<td></td>
<td>Grounded circuit conductor</td>
<td></td>
<td>Wht</td>
<td>None</td>
<td>CON-2</td>
</tr>
<tr>
<td><strong>Highway lighting pull box to luminaire</strong></td>
<td>Ungrounded - line 1</td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td></td>
<td>Ungrounded - line 2</td>
<td></td>
<td>Red</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td></td>
<td>Grounded</td>
<td></td>
<td>Wht</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td><strong>Multiple highway lighting</strong></td>
<td>Ungrounded - line 1</td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>ML1</td>
</tr>
<tr>
<td></td>
<td>Ungrounded - line 2</td>
<td></td>
<td>Red</td>
<td>None</td>
<td>ML2</td>
</tr>
<tr>
<td><strong>Lighting control</strong></td>
<td>Ungrounded - PEU</td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>C1</td>
</tr>
<tr>
<td></td>
<td>Switching leg from PEU unit or SM transformer</td>
<td></td>
<td>Red</td>
<td>None</td>
<td>C2</td>
</tr>
<tr>
<td><strong>Service</strong></td>
<td>Ungrounded - line 1</td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td></td>
<td>Ungrounded - line 2</td>
<td></td>
<td>Red</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td><strong>Sign lighting</strong></td>
<td>Ungrounded - line 1</td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>SL-1</td>
</tr>
<tr>
<td></td>
<td>Ungrounded - line 2</td>
<td></td>
<td>Red</td>
<td>None</td>
<td>SL-2</td>
</tr>
<tr>
<td><strong>Flashing beacons</strong></td>
<td>Ungrounded between flasher and beacons</td>
<td></td>
<td>Red or yel</td>
<td>None</td>
<td>F-Loc.</td>
</tr>
<tr>
<td><strong>Grounded circuit conductor</strong></td>
<td>Pedestrian push buttons</td>
<td></td>
<td>Wht</td>
<td>Blk</td>
<td>NBR</td>
</tr>
<tr>
<td></td>
<td>Signals and multiple lighting</td>
<td></td>
<td>Wht</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td></td>
<td>Flashing beacons and sign lighting</td>
<td></td>
<td>Wht</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td></td>
<td>Lighting control</td>
<td></td>
<td>Wht</td>
<td>None</td>
<td>C-3</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td></td>
<td>Wht</td>
<td>None</td>
<td>NBR</td>
</tr>
<tr>
<td><strong>Railroad preemption</strong></td>
<td></td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>R</td>
</tr>
<tr>
<td><strong>Spares</strong></td>
<td></td>
<td></td>
<td>Blk</td>
<td>None</td>
<td>NBR</td>
</tr>
</tbody>
</table>

NBR = No band required
PEU=Photoelectric unit

\( ^a\)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.

\( ^d\)Color Code: Yel-Yellow, Brn-Brown, Blu-Blue, Blk-Black, Wht-White, Ora-Orange, Pur-Purple
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.

86-1.02F(1)(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(1)(c)(iii) Inductive Loop Conductors
Inductive loop conductor must comply with the requirements shown in the following table:

<table>
<thead>
<tr>
<th>Loop wire</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>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.</td>
</tr>
<tr>
<td>Type 2</td>
<td>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 °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.</td>
</tr>
</tbody>
</table>

86-1.02F(1)(d) Reserved
Reserved

86-1.02F(2) Cables
86-1.02F(2)(a) General
Reserved

86-1.02F(2)(b) Reserved
Reserved

86-1.02F(2)(c) Reserved

86-1.02F(2)(d) Copper Cables
86-1.02F(2)(d)(i) General
The conductor wire size for a detector lead-in cable must comply with the requirements of ASTM B286. Cable, except a detector lead-in cable, must be clearly and permanently marked the entire length of its 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

86-1.02F(2)(d)(ii) Conductors Signal Cables
A conductors 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:
<table>
<thead>
<tr>
<th>Cable type&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Conductor quantity and type</th>
<th>Cable jacket thickness (mils)</th>
<th>Maximum nominal outside diameter (inch)</th>
<th>Conductor color code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td>Minimum</td>
<td></td>
</tr>
<tr>
<td>3CSC</td>
<td>3 no. 14</td>
<td>44</td>
<td>36</td>
<td>0.40</td>
</tr>
<tr>
<td>5CSC</td>
<td>5 no. 14</td>
<td>44</td>
<td>36</td>
<td>0.50</td>
</tr>
<tr>
<td>9CSC</td>
<td>8 no. 14</td>
<td>60</td>
<td>48</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td>1 no. 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12CSC</td>
<td>11 no. 14</td>
<td>60</td>
<td>48</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>1 no. 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28CSC</td>
<td>27 no. 14</td>
<td>80</td>
<td>64</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>1 no. 10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**76-1.02F(2)(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 must comply with the requirements shown in the following table:
Conductor Requirements for Loop Detector Lead-In Cables

<table>
<thead>
<tr>
<th>Lead-in cable</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type B</td>
<td>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.</td>
</tr>
<tr>
<td>Type C</td>
<td>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.</td>
</tr>
</tbody>
</table>

86-1.02F(2)(d)(iv) Reserved

86-1.02F(2)(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(2)(e) Reserved

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.

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrinkage ratio of supplied diametera (max, %)</td>
<td>33</td>
</tr>
<tr>
<td>Dielectric strength (min, kV/in)</td>
<td>350</td>
</tr>
<tr>
<td>Resistivity (min, Ω/in)</td>
<td>$25 \times 10^{13}$</td>
</tr>
<tr>
<td>Tensile strength (min, psi)</td>
<td>2,000</td>
</tr>
<tr>
<td>Operating temperature (°C)</td>
<td>-40–90 (135 °C in emergency)</td>
</tr>
<tr>
<td>Water absorption (max, %)</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*aWhen heated to 125 °C and allowed to cool to 25 °C

86-1.02I Connectors and Terminals
A connector and terminal must comply with SAE-AS7928 and be a crimp type, rated for 600 V(ac) and either UL listed or NRTL certified.

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.

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:

<table>
<thead>
<tr>
<th>Quality characteristic</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial lumens (lm)</td>
<td>33,000</td>
</tr>
<tr>
<td>Rated average life at 10 h/start (h)</td>
<td>18,000</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Photoelectric Control Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control type</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
</tr>
<tr>
<td>III</td>
</tr>
<tr>
<td>IV</td>
</tr>
<tr>
<td>V</td>
</tr>
</tbody>
</table>

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 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
The doors of a telephone demarcation cabinet must be attached using continuous stainless steel piano hinges.

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
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
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:

<table>
<thead>
<tr>
<th>Material</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheet aluminum</td>
<td>Inside and outside of housing</td>
</tr>
<tr>
<td>Galvanized steel</td>
<td>Inside of housing</td>
</tr>
<tr>
<td>Cast aluminum</td>
<td>Outside of housing</td>
</tr>
</tbody>
</table>

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**


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 \textit{U} with an arrow on the left end.

A lane control section must be a combination module with a red \textit{X} and green arrow. The conductor function and color code must be as shown in the following table:

<table>
<thead>
<tr>
<th>Conductor Function and Color Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
</tr>
<tr>
<td>Neutral</td>
</tr>
<tr>
<td>Red \textit{X}</td>
</tr>
<tr>
<td>Green arrow</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Maximum Power Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED signal module type</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>8-inch circular</td>
</tr>
<tr>
<td>12-inch circular</td>
</tr>
<tr>
<td>12-inch arrow</td>
</tr>
<tr>
<td>12-inch U-turn</td>
</tr>
<tr>
<td>Bicycle</td>
</tr>
<tr>
<td>Programmed visibility</td>
</tr>
<tr>
<td>Lane control (X)</td>
</tr>
<tr>
<td>Lane control (Arrow)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Angle (v,h)</th>
<th>8-inch</th>
<th>12-inch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Red</td>
<td>Yellow</td>
</tr>
<tr>
<td>2.5, ±2.5</td>
<td>133</td>
<td>267</td>
</tr>
<tr>
<td>2.5, ±7.5</td>
<td>97</td>
<td>194</td>
</tr>
<tr>
<td>2.5, ±12.5</td>
<td>57</td>
<td>113</td>
</tr>
<tr>
<td>2.5, ±17.5</td>
<td>25</td>
<td>48</td>
</tr>
<tr>
<td>7.5, ±2.5</td>
<td>101</td>
<td>202</td>
</tr>
<tr>
<td>7.5, ±7.5</td>
<td>89</td>
<td>178</td>
</tr>
<tr>
<td>7.5, ±12.5</td>
<td>65</td>
<td>129</td>
</tr>
<tr>
<td>7.5, ±17.5</td>
<td>41</td>
<td>81</td>
</tr>
<tr>
<td>7.5, ±22.5</td>
<td>18</td>
<td>37</td>
</tr>
<tr>
<td>7.5, ±27.5</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>12.5, ±2.5</td>
<td>37</td>
<td>73</td>
</tr>
<tr>
<td>12.5, ±7.5</td>
<td>32</td>
<td>65</td>
</tr>
<tr>
<td>12.5, ±12.5</td>
<td>28</td>
<td>57</td>
</tr>
<tr>
<td>12.5, ±17.5</td>
<td>20</td>
<td>41</td>
</tr>
<tr>
<td>12.5, ±22.5</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>12.5, ±27.5</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>17.5, ±2.5</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>17.5, ±7.5</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>17.5, ±12.5</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>17.5, ±17.5</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>17.5, ±22.5</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>17.5, ±27.5</td>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>

### Minimum Maintained Luminance for Indications

<table>
<thead>
<tr>
<th>Indication type</th>
<th>Luminance (fL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrow</td>
<td>1,610 3,210 3,210</td>
</tr>
<tr>
<td>U-turn</td>
<td>1,610 3,210 3,210</td>
</tr>
<tr>
<td>Bicycle</td>
<td>1,610 1,610 1,610</td>
</tr>
<tr>
<td>Lane control (X)</td>
<td>1,610 -- --</td>
</tr>
<tr>
<td>Lane control (Arrow)</td>
<td>-- -- 1,610</td>
</tr>
</tbody>
</table>

### Minimum Maintained Luminance for Programmed Visibility Indications

<table>
<thead>
<tr>
<th>Indication type</th>
<th>Luminance (cd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV at angle v=2.5, h=±2.5</td>
<td>314 314 314</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>PSF module symbol</th>
<th>Luminance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upraised hand and 2-digit countdown timer (fL)</td>
<td>1,094</td>
</tr>
<tr>
<td>Walking person (IL)</td>
<td>1,547</td>
</tr>
</tbody>
</table>

The module must not exceed the power consumption requirements shown in the following table:

<table>
<thead>
<tr>
<th>PSF module display</th>
<th>At 24 °C</th>
<th>At 74 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upraised Hand</td>
<td>10.0 W</td>
<td>12.0 W</td>
</tr>
<tr>
<td>Walking Person</td>
<td>9.0 W</td>
<td>12.0 W</td>
</tr>
<tr>
<td>2-digit countdown timer</td>
<td>6.0 W</td>
<td>8.0 W</td>
</tr>
</tbody>
</table>

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:

1. Audible speech message that plays when the push button is actuated. The message must include the name of the street to be crossed. The accessible pedestrian signal must have at least 5 audible message options.
2. Push button locator tone that clicks or beeps.
3. Feature that activates the pedestrian phase during a failure of the audible message, locator tone, or vibrotactile device.

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
4. Have a switch for a push button
5. Have a vibrotactile device on the push button or on the arrow
6. 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.
The conductor cable between the accessible pedestrian signal assembly and the pedestrian signal head must be a 9 no. 20 conductor cable complying with MIL-W-16878D.

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. Asphalitic emulsion
2. Elastomeric sealant
3. Epoxy sealant for inductive loops
4. Hot-melt rubberized asphalt

86-1.02W(2)  Asphalitic Emulsion Sealant
Asphalitic 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:

<table>
<thead>
<tr>
<th>Cured Elastomeric Sealant Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Hardness</td>
</tr>
<tr>
<td>Tensile strength (min, MPa)</td>
</tr>
<tr>
<td>Elongation (min, %)</td>
</tr>
<tr>
<td>Flex at -40 °C&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Weathering resistance</td>
</tr>
<tr>
<td>Salt spray resistance:</td>
</tr>
<tr>
<td>Tensile strength (min, MPa)</td>
</tr>
<tr>
<td>Elongation (min, %)</td>
</tr>
<tr>
<td>Dielectric constant (%)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Indentation at 25 °C and 50% relative humidity (Rex. Type A, Model 1700 only)
<sup>b</sup> Die C pulled at 508 mm/minute
<sup>c</sup> 0.6-mm free film bend (180°) over 13-mm mandrel
<sup>d</sup> Weatherometer 350 h, cured 7 days at 25 °C and 50% relative humidity
<sup>e</sup> 28 days at 38 °C with 5% NaCl, Die C, and pulled at 508 mm/minute
<sup>f</sup> 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:

<table>
<thead>
<tr>
<th>Cured Hot-Melt Rubberized Asphalt Sealant Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Cone penetration (max, 1/10 mm)</td>
</tr>
<tr>
<td>Flow (max, mm)</td>
</tr>
<tr>
<td>Resilience (min, %)</td>
</tr>
<tr>
<td>Softening point (min, °C)</td>
</tr>
<tr>
<td>Ductility (min, cm)</td>
</tr>
<tr>
<td>Flash point, Cleveland Open Cup (min, °C)</td>
</tr>
<tr>
<td>Viscosity (Pa·s)</td>
</tr>
</tbody>
</table>

<sup>a</sup> At 25 °C, 150 g, 5 s
<sup>b</sup> At 60 °C
<sup>c</sup> At 25 °C
<sup>d</sup> At 25 °C, 5 cm/minute
<sup>e</sup> Brookfield Thermosel, no. 27 spindle, 20 rpm, 190 °C

86-1.02X Reserved
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:

<table>
<thead>
<tr>
<th>Transformer Electrical Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality characteristic</td>
</tr>
<tr>
<td>Rating (V(ac))</td>
</tr>
<tr>
<td>Efficiency (%)</td>
</tr>
<tr>
<td>Secondary voltage regulation and tolerance from half load to full load (%)</td>
</tr>
</tbody>
</table>

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
87 ELECTRICAL SYSTEMS

87-1 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

87-1.01D(2) Quality Control
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:

<table>
<thead>
<tr>
<th>Electrical Material Sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract quantity</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>1–8</td>
</tr>
<tr>
<td>9–15</td>
</tr>
<tr>
<td>16–25</td>
</tr>
<tr>
<td>26–90</td>
</tr>
<tr>
<td>91–150</td>
</tr>
<tr>
<td>151–280</td>
</tr>
<tr>
<td>281–500</td>
</tr>
<tr>
<td>501–1200</td>
</tr>
</tbody>
</table>

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. The insulation resistance must be a minimum of 10 MΩ on circuits, except it must be a minimum of 100 MΩ for inductive loop detector circuits.

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.

87-1.02 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.

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.

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.

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:

<table>
<thead>
<tr>
<th>Shop-Cut Thread Corrosion Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduit Standard</td>
</tr>
<tr>
<td>Types 1 and 2</td>
</tr>
<tr>
<td>Type 5</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Conduit-Bending Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

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:
   1.1. Epoxy adhesive for bonding freshly-mixed concrete to hardened concrete.
   1.2. Rapid-set epoxy adhesive for pavement markers.
   1.3. 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.

Install conduit under existing pavement by the jacking or drilling methods. 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

Do not use the trench-in-pavement method for conduit installations under freeway lanes or freeway-to-freeway connector ramps.

87-1.03B(3)(c) Reserved

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.

87-1.03B(4) Reserved

87-1.03B(5) Conduit Installation by the Jacking or Drilling Method
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
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.
Where a nontraffic pull box is adjacent to a post or standard, place the box within 5 feet upstream from traffic if practical.
If you replace the cover on a nontraffic pull box, anchor it to the box.

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.

87-1.03D  Reserved

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
Dig a trench for the electrical conduits or direct burial cables. Do not excavate until the conduit or direct burial cable will be installed.

Place excavated material in a location that will not interfere with traffic or surface drainage.

After placing the conduit or direct burial cable, backfill the trench with the excavated material. Compact the backfill placed outside the hinge point of slopes and not under pavement to a minimum relative compaction of 90 percent.

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.

87-1.03F(2) Cables
87-1.03F(2)(a) General
Reserved
87-1.03F(2)(b) Reserved
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.

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:
<table>
<thead>
<tr>
<th>Color code</th>
<th>Termination</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Red signal</td>
<td>2, 4, 6, or 8</td>
</tr>
<tr>
<td>Yellow</td>
<td>Yellow signal</td>
<td>2, 4, 6, or 8</td>
</tr>
<tr>
<td>Brown</td>
<td>Green signal</td>
<td>2, 4, 6, or 8</td>
</tr>
<tr>
<td>Red/black stripe</td>
<td>Red signal</td>
<td>1, 3, 5, or 7</td>
</tr>
<tr>
<td>Yellow/black stripe</td>
<td>Yellow signal</td>
<td>1, 3, 5, or 7</td>
</tr>
<tr>
<td>Brown/black stripe</td>
<td>Green signal</td>
<td>1, 3, 5, or 7</td>
</tr>
<tr>
<td>Black/red stripe</td>
<td>Spare or as required for red or DONT WALK</td>
<td>--</td>
</tr>
<tr>
<td>Black/white stripe</td>
<td>Spare or as required for yellow</td>
<td>--</td>
</tr>
<tr>
<td>Black</td>
<td>Spare or as required for green or WALK</td>
<td>--</td>
</tr>
<tr>
<td>Red/white stripe</td>
<td>Pedestrian signal DONT WALK</td>
<td>--</td>
</tr>
<tr>
<td>Brown/white stripe</td>
<td>Pedestrian signal WALK</td>
<td>--</td>
</tr>
<tr>
<td>White</td>
<td>Terminal block</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Color code</th>
<th>Termination</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red/black stripe</td>
<td>Red signal</td>
<td>2 or 6</td>
</tr>
<tr>
<td>Yellow/black stripe</td>
<td>Yellow signal</td>
<td>2 or 6</td>
</tr>
<tr>
<td>Brown/black stripe</td>
<td>Green signal</td>
<td>2 or 6</td>
</tr>
<tr>
<td>Red/orange stripe</td>
<td>Red signal</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Yellow/orange stripe</td>
<td>Yellow signal</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Brown/orange stripe</td>
<td>Green signal</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Red/silver stripe</td>
<td>Red signal</td>
<td>1 or 5</td>
</tr>
<tr>
<td>Yellow/silver stripe</td>
<td>Yellow signal</td>
<td>1 or 5</td>
</tr>
<tr>
<td>Brown/silver stripe</td>
<td>Green signal</td>
<td>1 or 5</td>
</tr>
<tr>
<td>Red/purple stripe</td>
<td>Red signal</td>
<td>3 or 7</td>
</tr>
<tr>
<td>Yellow/purple stripe</td>
<td>Yellow signal</td>
<td>3 or 7</td>
</tr>
<tr>
<td>Brown/purple stripe</td>
<td>Green signal</td>
<td>3 or 7</td>
</tr>
<tr>
<td>Red/2 black stripes</td>
<td>Pedestrian signal</td>
<td>2 or 6</td>
</tr>
<tr>
<td>Brown/2 black stripes</td>
<td>Pedestrian signal</td>
<td>2 or 6</td>
</tr>
<tr>
<td>Red/2 orange stripes</td>
<td>Pedestrian signal</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Brown/2 orange stripes</td>
<td>Pedestrian signal</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Red/2 silver stripes</td>
<td>Overlap A, C</td>
<td>OLAc, OLCr</td>
</tr>
<tr>
<td>Brown/2 silver stripes</td>
<td>Overlap A, C</td>
<td>OLAc, OLCr</td>
</tr>
<tr>
<td>Red/2 purple stripes</td>
<td>Overlap B, D</td>
<td>OLb, OLd</td>
</tr>
<tr>
<td>Brown/2 purple stripes</td>
<td>Overlap B, D</td>
<td>OLb, OLd</td>
</tr>
<tr>
<td>Blue/black stripe</td>
<td>Pedestrian push button</td>
<td>2 or 6</td>
</tr>
<tr>
<td>Blue/orange stripe</td>
<td>Pedestrian push button</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Blue/silver stripe</td>
<td>Overlap A, C</td>
<td>OLAb, OLAc</td>
</tr>
<tr>
<td>Blue/purple stripe</td>
<td>Overlap B, D</td>
<td>OLb, OLc</td>
</tr>
<tr>
<td>White/black stripe</td>
<td>Pedestrian push button common</td>
<td>--</td>
</tr>
<tr>
<td>Black/red stripe</td>
<td>Railroad preemption</td>
<td>--</td>
</tr>
<tr>
<td>Black</td>
<td>Spare</td>
<td>--</td>
</tr>
<tr>
<td>White</td>
<td>Terminal block</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

OL = Overlap; A, B, C, and D = Overlapping phase designation

* For red phase designation
* For yellow phase designation
* 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:

<table>
<thead>
<tr>
<th>Location</th>
<th>Slack (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal standard</td>
<td>1</td>
</tr>
<tr>
<td>Lighting standard</td>
<td>1</td>
</tr>
<tr>
<td>Signal and lighting standard</td>
<td>1</td>
</tr>
<tr>
<td>Pull box</td>
<td>3</td>
</tr>
<tr>
<td>Splice</td>
<td>3</td>
</tr>
<tr>
<td>Standards with slip base</td>
<td>0</td>
</tr>
</tbody>
</table>

**87-1.03F(3)(b) Reserved**

**87-1.03F(3)(c) Copper Conductors**

**87-1.03F(3)(c)(i) General**

Install a minimum no. 8, insulated, grounding copper conductor in conduit and connect it to all-metal components.

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.

**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.

**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

Solder all splices using the hot iron, pouring, or dipping method. Do not perform open-flame soldering.

**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.
2. Apply 3 layers of half-lapped, 80-mils, PVC tape.
3. Apply 2 layers of 120-mils, butyl-rubber, stretchable tape with liner.
4. Apply 3 layers of half-lapped, 6-mils, PVC, pressure-sensitive, adhesive tape.
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.
- Solder no. 8 and smaller conductors to connectors and terminal lugs.

**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.

**87-1.03K Reserved**

**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
Install a fuse splice connector in each ungrounded conductor for luminaires mounted on standards. The connector must be located in the pull box adjacent to the standard.

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
Construct 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 or TFFN insulation.

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:

1. Saw cut slots at least 1-1/4 inches wide into the existing pavement.
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

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**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:

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat lens</td>
<td>Heat-resistant glass</td>
</tr>
<tr>
<td>Convex lens</td>
<td>Heat-resistant, high-impact-resistant tempered glass</td>
</tr>
<tr>
<td>Refractor</td>
<td>Borosilicate heat-resistant glass</td>
</tr>
</tbody>
</table>

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
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

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

87-4.01D(2)(b)  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.

87-4.02  MATERIALS
87-4.02A  General
Reserved

87-4.02B  Battery Backup System
A battery backup system includes the cabinet, batteries, and the Department-furnished electronics assembly.

The electronics assembly includes the inverter/charger unit, power transfer relay, and the battery harness.

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 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" nylon-insulated, steel chase nipple
2. 2" steel sealing locknut
3. 2" 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.

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

**87-8–87-11 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
4. Conductors
5. Service equipment enclosure
6. Department-furnished controller cabinet
7. Department-furnished changeable message sign
8. Department-furnished wiring harness
9. Service equipment enclosure
10. Sign disconnect

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.
87-18.01 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

87-19 RESERVED

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.

Temporary wood poles must comply with section 48-6.

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
Section 87-21.02B(2) applies if a bid item for maintaining existing traffic management system elements during construction is shown on the Bid Item List.

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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DIVISION XI MATERIALS

90 CONCRETE

Replace Method 1 in the 4th paragraph of section 90-1.01D(5)(a) with:

Method 2

Add to section 90-4.01C(1):

Submit daily temperature data for internally monitored tier 1 PC concrete members each week as an informational submittal.

Add between the 2nd and 3rd paragraphs of section 90-4.01C(3):

For internally monitored tier 1 PC bridge components, include the following as part of the QC plan:

1. Authorized mix design
2. Duration and method of curing
3. Concrete temperature monitoring and recording system details
4. Temperature sensor types and locations
5. Measures to ensure compliance with maximum temperature and temperature gain requirements, including maximum concrete temperature at discharge and controlling enclosure temperature

Replace the list in the 3rd paragraph of section 90-4.01C(3) with:

1. Concrete plants
2. Material sources
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):

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:

Temperature at time of mixing

Add to section 90-4.01D(2):

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:

<table>
<thead>
<tr>
<th>Component</th>
<th>Steam curing</th>
<th>Other curing methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1 PC bridge components except piling and deck panels</td>
<td>1 internal temperature sensor for each individually cast member; 1 internal temperature sensor for every 100 feet of bed length for continuously cast elements&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1 internal temperature sensor for each individually cast member; 1 internal temperature sensor for every 100 feet of bed length for continuously cast elements&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PC piling, deck panels, and PS pavement</td>
<td>1 enclosure temperature sensor for every 200 feet of bed length for continuously cast elements</td>
<td>Not required</td>
</tr>
<tr>
<td>Other PC components</td>
<td>1 enclosure temperature sensor for every 200 feet of bed length for continuously cast elements</td>
<td>Not required</td>
</tr>
</tbody>
</table>

<sup>a</sup>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

<table>
<thead>
<tr>
<th>PC component</th>
<th>Sensor location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide flange, 'I', and bulb tee girders</td>
<td>6–8 inches below top surface along center line at midpoint</td>
</tr>
<tr>
<td>Other girder shapes</td>
<td>6–8 inches below top surface along center line of stem at midpoint</td>
</tr>
<tr>
<td>Deck slabs</td>
<td>Center of element at mid-depth</td>
</tr>
<tr>
<td>Other elements</td>
<td>Position sensor to provide maximum concrete cover</td>
</tr>
</tbody>
</table>

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):

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:

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:

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:

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.
Delete the 5th item in the list in the 2nd paragraph of section 90-4.03.

Add to section 90-4.03:

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:

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
Replace the 4th paragraph of section 92-1.02B with:
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.

Replace product name, manufacturing source, and date of manufacture in the 2nd sentence of the 1st paragraph of section 96-1.01D with:
manufacturing source code

Replace Apparent opening size, (min, inches) in the table in the 2nd paragraph of section 96-1.02O with:
Apparent opening size, (max, inches)