ATTACHMENT 8

Technical Specifications
# TECHNICAL SPECIFICATIONS

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section No.</th>
<th>Specification Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-39 – GENERAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - 20</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>21</td>
<td>Method of Determining Percentage within Specification Limits (PWL) (FAA 110)</td>
<td>10</td>
</tr>
<tr>
<td>22</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>23</td>
<td>Removals</td>
<td>12</td>
</tr>
<tr>
<td>24</td>
<td>Watering</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td>Mobilization and Demobilization</td>
<td>4</td>
</tr>
<tr>
<td>26</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>27</td>
<td>Construction Barricades, Fencing, Markers and Signs</td>
<td>8</td>
</tr>
<tr>
<td>28</td>
<td>Location of Underground Utilities</td>
<td>4</td>
</tr>
<tr>
<td>29</td>
<td>Nuclear Gauges (FAA 120)</td>
<td>2</td>
</tr>
<tr>
<td>30</td>
<td>Temporary Air and Water Pollution, Soil Erosion, and Siltation Control (FAA P-156)</td>
<td>4</td>
</tr>
<tr>
<td>31</td>
<td>Oil Company Right-of-Way/Easement Requirements</td>
<td>12</td>
</tr>
<tr>
<td>32 - 38</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>39</td>
<td>Preconstruction Video</td>
<td>2</td>
</tr>
</tbody>
</table>

<p>| 40-99 – AIRFIELD CIVIL |                                                                                   |       |
| 40          | (not in used)                                                                     | --    |
| 41          | Earthwork (FAA P-152)                                                             | 20    |
| 42          | (not used)                                                                        | --    |
| 43          | Controlled Low-Strength Material (CLSM) (FAA P-153)                                | 4     |
| 44 – 49     | (not used)                                                                        | --    |
| 50          | Subbase Course (FAA P-154)                                                        | 6     |
| 51          | (not used)                                                                        | --    |
| 52          | Crushed Aggregate Base Course (FAA P-209 &amp; CALTRANS)                              | 10    |
| 53          | (not used)                                                                        | --    |
| 54          | (not used)                                                                        | --    |
| 55          | (not used)                                                                        | --    |
| 56          | (not used)                                                                        | --    |
| 57          | Processed Miscellaneous Base (PMB)                                                 | 8     |
| 58 - 59     | (not used)                                                                        | --    |
| 60          | Surface Preparation (FAA P-101)                                                    | 6     |
| 61          | (not used)                                                                        | --    |
| 62          | Hot-Mix Asphalt (HMA) Pavements – Surface and Base Course (FAA P-401 &amp; Greenbook) | 36    |</p>
<table>
<thead>
<tr>
<th>Section No.</th>
<th>Specification Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>Bituminous Prime Coat (FAA P-602) and Dust Palliative</td>
<td>6</td>
</tr>
<tr>
<td>64</td>
<td>Bituminous Tack Coat (FAA P-603)</td>
<td>4</td>
</tr>
<tr>
<td>65-69</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>70</td>
<td>Portland Cement Concrete Pavement (FAA P-501)</td>
<td>38</td>
</tr>
<tr>
<td>71</td>
<td>Concrete Repair</td>
<td>6</td>
</tr>
<tr>
<td>72</td>
<td>Compression Joint Seals for Concrete Pavements (FAA P-604)</td>
<td>8</td>
</tr>
<tr>
<td>73</td>
<td>Joint Sealing Filler (FAA P-605)</td>
<td>10</td>
</tr>
<tr>
<td>74</td>
<td>Saw Cut Grooves (FAA P-621)</td>
<td>6</td>
</tr>
<tr>
<td>75</td>
<td>Structural Bridge Modifications</td>
<td>10</td>
</tr>
<tr>
<td>76-79</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>80</td>
<td>Pipe for Storm Drain and Culverts (FAA D-701)</td>
<td>10</td>
</tr>
<tr>
<td>81-82</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>83</td>
<td>Manholes, Catch Basins, Inlets and Miscellaneous Utility System Structures (FAA D-751, D-752, and D-754)</td>
<td>14</td>
</tr>
<tr>
<td>84</td>
<td>Geotextiles</td>
<td>2</td>
</tr>
<tr>
<td>85-88</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>89</td>
<td>Jet Blast Deflector</td>
<td>6</td>
</tr>
<tr>
<td>90</td>
<td>Structural Concrete (FAA P-610)</td>
<td>12</td>
</tr>
<tr>
<td>91</td>
<td>Marking (FAA P-620)</td>
<td>12</td>
</tr>
<tr>
<td>92</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>93</td>
<td>Seeding and Topsoiling (FAA T-901 and T-905)</td>
<td>8</td>
</tr>
<tr>
<td>94</td>
<td>Traffic Signing</td>
<td>4</td>
</tr>
<tr>
<td>95-99</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>100-139</td>
<td><strong>ELECTRICAL</strong></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Basic Electrical Requirements</td>
<td>20</td>
</tr>
<tr>
<td>101</td>
<td>Grounding and Bonding</td>
<td>4</td>
</tr>
<tr>
<td>102</td>
<td>Low-Voltage Electrical Power Conductors and Cables</td>
<td>6</td>
</tr>
<tr>
<td>103</td>
<td>Equipment Wiring Systems</td>
<td>4</td>
</tr>
<tr>
<td>104</td>
<td>Hangers and Supports for Electrical Systems</td>
<td>6</td>
</tr>
<tr>
<td>105</td>
<td>Electrical Identification</td>
<td>4</td>
</tr>
<tr>
<td>106-109</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>110</td>
<td>Airfield Electrical Work</td>
<td>26</td>
</tr>
<tr>
<td>111-112</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>113</td>
<td>Underground Cable for Airports (FAA L-108)</td>
<td>12</td>
</tr>
<tr>
<td>114</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>115</td>
<td>Underground Conduit for Airports (FAA L-110)</td>
<td>14</td>
</tr>
<tr>
<td>116</td>
<td>Horizontal Directional Drilling for HDPE Conduit</td>
<td>6</td>
</tr>
<tr>
<td>Section No.</td>
<td>Specification Title</td>
<td>Pages</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>117-119</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>120</td>
<td>Adhesive Compounds, Two-Component for Sealing Wire and Lights in Pavement (FAA P-606)</td>
<td>6</td>
</tr>
<tr>
<td>121</td>
<td>Modifications to Existing Airport Lighting Control and Monitoring System</td>
<td>6</td>
</tr>
<tr>
<td>122-124</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>125</td>
<td>Installation of Runway Status Light System</td>
<td>6</td>
</tr>
<tr>
<td>126 - 129</td>
<td>(not used)</td>
<td>--</td>
</tr>
<tr>
<td>130</td>
<td>RWSL Electrical Installation Testing</td>
<td>14</td>
</tr>
<tr>
<td>131-139</td>
<td>(not used)</td>
<td>--</td>
</tr>
</tbody>
</table>

END OF TABLE OF CONTENTS
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21-1 GENERAL. This section describes the Method of Determining the Percentage Within Limits (PWL) used to calculate adjusted pay factors for pavement. PWL determination shall be made in accordance with the FAA Standard Specification 110 as included and modified herein:

SECTION 110

METHOD OF ESTIMATING PERCENTAGE OF MATERIAL WITHIN SPECIFICATION LIMITS (PWL)

110-1 GENERAL

When the specifications provide for acceptance of material based on the method of estimating percentage of material within specification limits (PWL), the PWL will be determined in accordance with this section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot that is within specification limits. The PWL is computed using the sample average \((X)\) and sample standard deviation \((S_n)\) of the specified number \((n)\) of sublots for the lot and the specification tolerance limits, \(L\) for lower and \(U\) for upper, for the particular acceptance parameter. From these values, the respective Quality index(s), \(Q_L\) for Lower Quality Index and/or \(Q_U\) for Upper Quality Index, is computed and the PWL for the lot for the specified \(n\) is determined from Table 1. All specification limits specified in the technical sections shall be absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of production material (the population) is sampled and tested. This uncertainty exists because all portions of the production material have the same probability to be randomly sampled. The Contractor’s risk is the probability that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Owner’s risk is the probability that material produced at the rejectable quality level is accepted.

It is the intent of this section to inform the Contractor that, in order to consistently offset the Contractor’s risk for material evaluated, production quality (using population average and population standard deviation) must be maintained at the acceptable quality specified or higher. In all cases, it is the responsibility of the Contractor to produce at quality levels that will meet the specified acceptance criteria when sampled and tested at the frequencies specified.

110-2 METHOD FOR COMPUTING PWL

The computational sequence for computing PWL is as follows:
a. Divide the lot into \( n \) sublots in accordance with the acceptance requirements of the specification.

b. Locate the random sampling position within the sublot in accordance with the requirements of the specification.

c. Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with the testing requirements of the specification.

d. Find the sample average (\( X \)) for all sublot values within the lot by using the following formula:

\[
X = \frac{(x_1 + x_2 + x_3 + \ldots + x_n)}{n}
\]

Where:
- \( X \) = Sample average of all sublot values within a lot
- \( x_1, x_2 \) = Individual sublot values
- \( n \) = Number of sublots

e. Find the sample standard deviation (\( S_n \)) by use of the following formula:

\[
S_n = \sqrt{\frac{(d_1^2 + d_2^2 + d_3^2 + \ldots + d_n^2)/(n-1))}{(n-1))}
\]

Where:
- \( S_n \) = Sample standard deviation of the number of sublot values in the set
- \( d_1, d_2, \ldots \) = Deviations of the individual sublot values \( x_1, x_2, \ldots \) from the average value \( X \)
- \( n \) = Number of sublots

f. For single sided specification limits (i.e., \( L \) only), compute the Lower Quality Index \( Q_L \) by use of the following formula:

\[
Q_L = \frac{(X - L)}{S_n}
\]

Where:
- \( L \) = specification lower tolerance limit

Estimate the percentage of material within limits (\( PW_L \)) by entering Table 1 with \( Q_L \), using the column appropriate to the total number (\( n \)) of measurements. If the value of \( Q_L \) falls between values shown on the table, use the next higher value of \( PW_L \).

g. For double-sided specification limits (i.e. \( L \) and \( U \)), compute the Quality Indexes \( Q_L \) and \( Q_U \) by use of the following formulas:

\[
Q_L = \frac{(X - L)}{S_n} \quad \text{and} \quad Q_U = \frac{(U - X)}{S_n}
\]
Where: \( L \) and \( U \) = specification lower and upper tolerance limits

Estimate the percentage of material between the lower \( (L) \) and upper \( (U) \) tolerance limits (PWL) by entering Table 1 separately with \( Q_L \) and \( Q_U \), using the column appropriate to the total number \( (n) \) of measurements, and determining the percent of material above \( P_L \) and percent of material below \( P_U \) for each tolerance limit. If the values of \( Q_L \) fall between values shown on the table, use the next higher value of \( P_L \) or \( P_U \). Determine the PWL by use of the following formula:

\[
PWL = (P_U + P_L) - 100
\]

Where:

\( PL = \) percent within lower specification limit

\( PU = \) percent within upper specification limit

**EXAMPLE OF PWL CALCULATION**

Project: Example Project

Test Item: Item P-401, Lot A.

\( \mathbf{a.} \) PWL Determination for Mat Density.

\( \mathbf{(1)} \) Density of four random cores taken from Lot A.

- A-1 96.60
- A-2 97.55
- A-3 99.30
- A-4 98.35

\( n = 4 \)

\( \mathbf{(2)} \) Calculate average density for the lot.

\[
X = \frac{(x_1 + x_2 + x_3 + \ldots + x_n)}{n}
\]

\[
X = \frac{(96.60 + 97.55 + 99.30 + 98.35)}{4}
\]

\( X = 97.95 \) percent density

\( \mathbf{(3)} \) Calculate the standard deviation for the lot.

\[
Sn = \left[\left(\frac{(96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2)}{4 - 1}\right)\right]^{1/2}
\]

\[
Sn = \left[\left(1.82 + 1.82 + 1.82 + 1.82\right) / 3\right]^{1/2}
\]
(4) Calculate the Lower Quality Index $Q_L$ for the lot. ($L=96.3$)

$$Q_L = \frac{X - L}{Sn}$$

$$Q_L = \frac{97.95 - 96.30}{1.15}$$

$$Q_L = 1.4348$$

(5) Determine $PWL$ by entering Table 1 with $Q_L = 1.44$ and $n = 4$.

$PWL = 98$

b. PWL Determination for Air Voids.

(1) Air Voids of four random samples taken from Lot A.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Air Voids</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>5.00</td>
</tr>
<tr>
<td>A-2</td>
<td>3.74</td>
</tr>
<tr>
<td>A-3</td>
<td>2.30</td>
</tr>
<tr>
<td>A-4</td>
<td>3.25</td>
</tr>
</tbody>
</table>

(2) Calculate the average air voids for the lot.

$$X = \frac{(x_1 + x_2 + x_3 + ... + x_n)}{n}$$

$$X = \frac{(5.00 + 3.74 + 2.30 + 3.25)}{4}$$

$$X = 3.57 \text{ percent}$$

(3) Calculate the standard deviation $Sn$ for the lot.

$$Sn = \sqrt{\frac{[(3.57 - 5.00)^2 + (3.57 - 3.74)^2 + (3.57 - 2.30)^2 + (3.57 - 3.25)^2)}{(4 - 1)}}^{1/2}$$

$$Sn = \sqrt{(2.04 + 0.03 + 1.62 + 0.10)/3}^{1/2}$$

$$Sn = 1.12$$

(4) Calculate the Lower Quality Index $Q_L$ for the lot. ($L= 2.0$)

$$Q_L = \frac{(X - L)}{Sn}$$

$$Q_L = \frac{3.57 - 2.00}{1.12}$$

$$Q_L = 1.3992$$

(5) Determine $P_L$ by entering Table 1 with $Q_L = 1.41$ and $n = 4$. 

\[ Sn = 1.15 \]
PL = 97

(6) Calculate the Upper Quality Index QU for the lot. (U= 5.0)

\[ QU = \frac{(U - X)}{S_n} \]

\[ QU = \frac{(5.00 - 3.57)}{1.12} \]

\[ QU = 1.2702 \]

(7) Determine PU by entering Table 1 with QU = 1.29 and n = 4.

PU = 93

(8) Calculate Air Voids PWL

\[ PWL = (PL + PU) - 100 \]

\[ PWL = (97 + 93) - 100 = 90 \]

EXAMPLE OF OUTLIER CALCULATION (Reference ASTM E 178)

Project: Example Project

Test Item: Item P-401, Lot A.

a. Outlier Determination for Mat Density.

(1) Density of four random cores taken from Lot A. arranged in descending order.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>A-3</td>
<td>99.30</td>
</tr>
<tr>
<td>A-4</td>
<td>98.35</td>
</tr>
<tr>
<td>A-2</td>
<td>97.55</td>
</tr>
<tr>
<td>A-1</td>
<td>96.60</td>
</tr>
</tbody>
</table>

(2) Use n=4 and upper 5 percent significance level of to find the critical value for test criterion = 1.463.

(3) Use average density, standard deviation, and test criterion value to evaluate density measurements.

b. For measurements greater than the average:

If: \[(\text{measurement} - \text{average})/(\text{standard deviation})\] is less than test criterion,

Then: the measurement is not considered an outlier
for A-3  Check if (99.30 - 97.95) / 1.15 greater than 1.463
1.174 is less than 1.463, the value is not an outlier

c. For measurements less than the average:
If (average - measurement)/(standard deviation) is less than test criterion,
Then the measurement is not considered an outlier

for A-1  Check if (97.95 - 96.60) / 1.15 greater than 1.463
1.174 is less than 1.463, the value is not an outlier

NOTE: In this example, a measurement would be considered an outlier if the density was:
greater than (97.95+1.463x1.15) = 99.63 percent or,
less than (97.95-1.463x1.15) = 96.27 percent

<table>
<thead>
<tr>
<th>TABLE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE FOR ESTIMATING PERCENT OF LOT WITHIN LIMITS (PWL)</td>
</tr>
<tr>
<td>Percent Within Limits (PL and PU)</td>
</tr>
<tr>
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<tr>
<td>---</td>
</tr>
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<td>84</td>
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</table>
### TABLE 1
TABLE FOR ESTIMATING PERCENT OF LOT WITHIN LIMITS (PWL)

<table>
<thead>
<tr>
<th>Percent Within Limits ((P_{L} \text{ and } P_{U}))</th>
<th>(n=3)</th>
<th>(n=4)</th>
<th>(n=5)</th>
<th>(n=6)</th>
<th>(n=7)</th>
<th>(n=8)</th>
<th>(n=9)</th>
<th>(n=10)</th>
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<tbody>
<tr>
<td>83</td>
<td>0.9939</td>
<td>0.9900</td>
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<td>0.8417</td>
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**END OF SECTION 110**

### 21-2 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Work described in this section shall be considered incidental to other pay items and no separate payment will be made.

**END OF SECTION 21**
SECTION 23 – REMOVALS

23-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for removing, salvaging, abandoning, and/or disposing of existing asphalt and concrete pavements, asphalt-treated bases (ATB), cement-treated bases (CTB), econocrete bases, storm drain pipe, catch basins, manholes, and drains, sanitary sewer pipe, manholes and cleanouts, water pipe, valves, valve boxes, and hydrants, fencing and posts, miscellaneous structures, concrete slabs and footings, power/comm. ductbanks, vaults, handholes, and pull boxes, pavement markings and other miscellaneous items identified from within the limits designated on the plans, required by the Specifications, or as directed by the Engineer.

This section also covers protection, plugging and capping of existing underground utilities to remain in place. See LAWA GC-24, “Protection and Restoration of Existing Improvements” for additional requirements.

Removal of existing bridge sections related to the Sepulveda Boulevard Tunnel shall be in accordance with Section 75, Structural Bridge Modifications.

Adjusting existing utility structures to be raised to new grade shall be in accordance with Section 83, Manholes, Catch Basins, Inlets and Inspection Holes.

Removal of Airfield Lighting electrical systems, including light fixtures, wiring, conduit, and base cans shall be in accordance with Section 110, Airfield Electrical Work. Installation of Runway Status Light System shall be accordance with Section 144.

Removed concrete and asphalt pavement, including base course, and removed asphalt-treated or cement-treated base may be crushed for use as Processed Miscellaneous Base in accordance with Section 57, of these Specifications respectively.

For isolated sections of pavement surfacing removal prior to bituminous overlays, See Section 60, Surface Preparation.

Items identified to be “salvaged” and/or “relocated” shall be carefully salvaged and taken to a site as shown on the plans or as directed by the Engineer. Stockpiling will occur within the Contractor's Staging and Laydown Area. Removal of items for salvage shall include labeling all pieces, members, and joints to provide a sequence for reassembly. Unless reinstalled by the contractor, salvaged material shall be packaged and delivered to the LAWA maintenance yard for storage.

Unless otherwise specified, all items designated to be “removed” shall be removed and legally disposed of off the airport property, in accordance with all applicable local and federal laws and regulations. All trash, debris, pipe, conduit, catch basins, pull boxes, manholes, ducts, wiring, storm drain piping, and other items being removed shall be disposed. Proof of legal disposal is required. Whenever a pipeline, conduit, sewer, or other utility not shown on the Plans is encountered, the Contractor shall immediately inform the Engineer as required in LAWA PR-2 of the Specifications.

23-2 RELATED SECTIONS

Section 24 – Watering
Section 60 – Surface Preparation (FAA P-101)
Section 71 – Concrete Repair
Section 75 – Structural Bridge Modifications
Section 80 – Pipe for Storm Drain and Culverts (FAA D-701)
Section 83 – Manholes, Catch Basins, Inlets and Miscellaneous Utility System Structures (FAA D-751, -752, -754)
Section 91 – Marking (FAA P-620)
Section 110 – Airfield Electrical Work
Section 125 – Installation of Runway Status Light System
Other Sections, Tests, Specifications, and Standards referenced herein.

23-3 LIMITED ACCESS / NIGHT CONSTRUCTION. See Project Requirements - 1, Scope of Work, Project Requirements – Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

23-4 CONSTRUCTION METHODS

23-4.1 GENERAL. Should a pipeline, conduit, or other utility or structure not indicated on the plans be encountered that must be removed or relocated to permit the completion of the construction work, the Contractor shall remove or relocate the interfering object as directed by the Engineer, and as required by Section PR-7, Utilities, of the Specifications.

Excavation required for any removals under this section will not be measured for payment, except as noted in Project Requirements - 4.

No stockpiling of any material shall be allowed anywhere on the AOA except at the designated locations and the Staging and Laydown Area.

a. Prior to beginning any demolition operation the Contractor shall:
   1. Conform to Section 3303.9 of Uniform Building code for demolition of structures, safety of adjacent structures, dust control, runoff control and disposal.
   2. Obtain required permits from authorities.
   3. Notify affected utility companies before starting work, and with adequate lead time to comply with their schedule and requirements.
   4. Provide, erect, and maintain temporary barriers, hazard lights, and security devices as needed.
   5. Mark locations of all utilities
   6. Pothole all utilities and confirm depth at the horizontal limits of proposed pavement
b. At all times during demolition operations the Contractor shall:

1. Provide adequate and appropriate equipment to transport materials.
2. Maintain haul roads and stockpile sites in satisfactory condition.
3. Protect existing landscaping materials, appurtenances and structures which are not to be demolished.
4. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as needed.
5. Conduct demolition to minimize interference with adjacent structures.
6. Cease operations immediately if adjacent structures appear to be in danger. Notify Engineer. Do not resume operations until directed.
7. Conduct operations with minimum interference to public or private accesses. Maintain protected egress and access at all times.
8. Sprinkle Work with water to minimize dust. Provide hoses and water connections for this purpose.
9. Do not close or obstruct roadways or hydrants without permits.
10. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

23-4.2 BACKFILLING OF VOIDS. Unless otherwise indicated on the plans or directed by the Engineer, voids resulting from the abandonment or of removal structures, pipes, foundations and other items covered in this section shall be filled with Controlled Low Strength Material (CLSM) conforming to Section 43 of these Specifications, or with suitable material approved by the Engineer, compacted to 90 percent of maximum density as determined by ASTM D1557. Backfill will not be measured for payment but will be considered incidental to the associated removal pay item.

Where the plans indicate “Fill with Select Material to Grade” such material shall conform to the requirements for Select Material as discussed in Section 41, Earthwork, of the Specifications.

23-4.3 REMOVAL OF PAVEMENT MATERIALS

a. General. All Asphalt Concrete (AC), and Portland Cement Concrete (PCC) pavement, identified for removal on the plans shall be removed within the limits and to the depths shown on the Plans, unless otherwise specified. Pavement to be removed includes, but is not limited to runways, taxiways, roads, paved swales, paved infield areas, access roads and other features.

AC and PCC pavement, including any embedded metal, shall be removed along clean straight lines by sawcutting at all joints, phase lines, and/or match lines before removal. Saw-cuts shall be full depth, through existing dowels and keyways, if present. Where PCC pavement that is to be removed is adjacent to pavement to remain in service, the
PCC shall be removed as described for full slab removal in Section 71, Concrete Removal, Repair and Replacement, of these Specifications.

All match points shall be sawcut to a vertical edge. Sawcutting will not be measured for payment but will be considered incidental to pavement removal.

Existing pavement to remain in place that is damaged by the Contractor shall be repaired or replaced by the Contractor, at his expense, to the satisfaction of the Engineer. The repair or replacement method shall be approved by the Engineer prior to beginning the work.

Removed PCC, removed AC, demolished items and all excavated earth materials shall be removed and disposed of off Airport property at a properly licensed facility, in accordance with all applicable local and federal laws and regulations. Proof of legal disposal is required.

All unbound materials within a pavement section that are identified for removal, including aggregate bases, subbases and subgrade will be paid as Unclassified Excavation under Section 41, Earthwork, of these Specifications.

b. Changes in Pavement Thickness or Character. Pavement surface and base thickness information relative to the existing pavement sections shown in the Plans is according to information on file in the Engineer’s office and represents the best information available at the time. No guarantee of the thicknesses shown is expressed or implied, and variations from the thickness shall not be construed to change the amount to be paid for pavement removal unless the change is considered to be excessive. The Contractor shall consider the following conditions to be normally expected variables and shall include accommodation for these situations in his bid prices.

No additional compensation will be made for:

1. PCC thickness up to and including 50% above the thickness indicated on the plans.
2. Econocrete thickness up to and including 50% above the thickness indicated on the plans.
3. Cement-Treated Base Course thickness up to and including 50% above the thickness indicated on the plans.
4. AC thickness up to and including 100% higher than the thickness indicated on the plans.
5. Geogrid, filter fabric or other geotextiles as part of subsurface layers to be removed.
6. Reinforcing steel in PCC. PCC with reinforcement will be measured as a separate bid item.
The following changes will be considered significant changes and may be considered for additional compensation if the Contractor can demonstrate that they will have a significant impact on his operations:

1. PCC thickness more than 50% higher than the thickness indicated on the plans.

2. Cement-Treated Base Course more than 50% higher than the thickness indicated on the plans.

3. AC Surface course thickness more than 100% higher than shown on the plans.

4. Bound subsurface layers (Cement-treated or Asphalt-treated bases or subbases) where unbound material was shown on the plans. To be considered cement-treated, the material shall exhibit a strength of 500 psi unconfined compressive strength or higher.

c. Composite Pavements. Unless otherwise noted, removal of independent layers of bound pavement materials (PCC or AC) will be paid for the top layer of pavement only (PCC or AC removal), and no separate payment will be made for multiple layers of pavement.

Unbound aggregate materials will not be paid for as pavement demolition, but will be considered part of unclassified excavation.

d. Crushing Pavement for Recycling. All crushing and or pavement recycling shall be performed in the contractor’s laydown area or off airport property.

e. AC & PCC Cold Milling. Cold milling of asphalt and PCC to accommodate grade match or other pavement detailing is covered under Section 60, Surface Preparation, of these Specifications.

f. Protection of Adjacent Pavement. When pavement removal results in damage to adjacent pavement to remain in place, the Contractor will be required, at his expense, to repair the pavement.

For damaged asphalt concrete pavement, the damaged asphalt surface course shall be cut back at least 1 foot into sound surfacing. The Contractor shall provide repair and compaction of underlaying base course if it is determined to be necessary by the Engineer. Application of bituminous prime coat or tack coat in accordance with Sections 63 and 64, Bituminous Prime Coat and Bituminous Tack Coat, of these specifications will be applied to unbound and bound surfaces, respectively, prior to repaving. No payment will be made for this repair work.

Damaged Portland Cement Concrete pavement shall be repaired in accordance with Section 71, Concrete Removal, Repair and Replacement, of these specifications. Type of repair shall depend on degree of damage, which shall be determined by the Engineer as discussed in the specification.

g. Removal of Pavement in Fuel Company and Caltrans Rights-of-Ways. Contractor shall be precluded from using any impact method for pavement removal in fuel company and Caltrans rights-of-ways. All pavement removal in these areas shall be
done by sawcutting and lift-out methods. Sawcuts shall be full depth. Pavement removals in these areas will not be measured separately for payment, but will be included in the same pay item as removal of other pavements.

23-4.4 REMOVAL AND/OR ABANDONMENT OF UTILITY STRUCTURES

Utility Structures identified for removal, including storm drainage, sanitary sewer, water, electrical and communication structures, and ground monitoring wells, shall be completely removed and disposed of off airport property unless otherwise shown or directed. Work shall include any associated excavation, sawcutting, pavement removal, replacement or repairs, excavation, backfilling, compaction, disposal or other miscellaneous items of work necessary to bring the surface to its original condition. Pavement removal necessary to accommodate drainage structure removal shall be conducted in conformance with paragraph 23-4.3, above. When the structure is to be abandoned in place, it shall be capped or plugged as required by the plans, and backfilled in accordance with paragraph 23-4.2, above.

Excavation, sawcutting, removal, disposal of excavated material, replacement of pavement, capping, plugging and backfilling of voids associated with removing or abandoning drainage structures will not be measured for payment, but such work shall be considered incidental to the removal and/or abandonment of the items and no separate payment will be made.

Coordinate with the Engineer prior to demolition and removal of any existing ground monitoring well.

23-4.5 REMOVAL AND/OR ABANDONMENT OF UTILITY LINES

Utility Lines identified for removal or abandonment, including storm drainage lines and culverts, sanitary sewer, water lines, electrical and communication ductbanks, shall be completely removed, and disposed of off airport property, unless otherwise shown on the plans. Measurement will be per linear foot, regardless of the pipe size, type, or presence of concrete encasement. Contractor to assume that all storm drain pipe and utility lines are concrete encased. Pipe shall be sawcut at the limits of removal. Sawcutting shall be completed prior to beginning any other removal work on the line. Work will include any associated excavation, sawcutting, pavement removal, replacement or repairs, excavation, backfilling, compaction, disposal or other miscellaneous items of work necessary to bring the surface to its original condition. Pavement removal shall be conducted in conformance with paragraph 23-4.3, above. When a storm drain line is to be abandoned in place, it shall be capped or plugged as required by the plans, and backfilled in accordance with paragraph 23-4.2, above.

Excavation, sawcutting, removal, disposal of excavated material, replacement of pavement, capping, plugging and backfilling of voids associated with removing or abandoning drainage structures will not be measured for payment, but such work shall be considered incidental to the removal and/or abandonment of the items and no separate payment will be made.

23-4.6 FUEL PIPE AND PIT REMOVALS

Not Used

23-4.7 REMOVAL OF ELECTRICAL AND COMMUNICATION FACILITIES
Removal of electrical and communication structures and ductbanks shall be completed in accordance with paragraphs 23-4.4 and 23-4.5 above. In addition, the Contractor shall coordinate with the applicable utility (ie LADWP, FAA, and/or AT&T) for disconnection and removal of existing power and communication lines prior to removal. See PR-7, Utilities for utility contact information. Contractor shall coordinate with utility owners as needed for conformance to construction phasing requirements.

**23-4.8 AIRFIELD ELECTRICAL REMOVALS**

Removal of airfield electrical items shall be completed in accordance with Section 110, Airfield Electrical Work of these Specifications.

**23-4.9 BUILDING DEMOLITION**

Not in used

**23-4.10 FENCE, GUARD RAIL AND BARRIER REMOVAL**

a. **Chain Link Fence/Metal Guard Rail Removal.** Not used.

b. **Concrete K-Rail Removal.** Existing concrete k-rail to be removed shall be carefully removed by the Contractor by removing any connecting pins and anchors, and loaded, transported and reinstalled at new location(s) shown on the drawings or other airfield locations designated by the Engineer. Any remaining k-rail barrier not relocated to a new location shall be transported and delivered to LAWA maintenance and become property of LAWA.

**23-4.11 REMOVAL OF BLAST DEFLECTORS**

Existing blast deflectors identified for removal shall be completely removed and disposed of off airport property unless otherwise shown or directed. Work shall include removal and disposal of blast deflector frames and structures, deflector panels, fasteners, obstruction lights and cable, conduit, junction boxes, etc., and any associated sawcutting, backfilling, compaction, disposal, or other miscellaneous items of work necessary to bring the surface to its original condition. Pavement removal necessary to accommodate structure removal shall be conducted in conformance with paragraph 23-4.3, above.

The existing Environmental Monitoring Station shall be carefully removed and salvaged from the existing blast deflector prior to demolition, and reinstalled on the new blast deflector as shown on the drawings and in accordance with Section 89, Blast Deflectors, and Section 123, LADWP and FAA Power Services.

**23-4.12 REMOVAL OF PAVEMENT MARKINGS**

Pavement markings shall be removed from the indicated areas by methods acceptable to LAWA that cause negligible damage to existing pavements, surface texture, joint sealants or other airfield appurtenances. Waterblasting, Schibeci removals and other similar types of marking removal will be reviewed for approval by LAWA. Paint markings shall be removed from all areas indicated on the plans by at least 80%; however holding position markings, surface
painted signs, enhanced taxiway centerlines, and where marking is not to be re-installed shall be 95% -100% removed.

The Contractor shall repair at its expense any damage to the pavement, surface texture, joint sealants or appurtenances caused by the removal work by methods acceptable to LAWA. Any removal method that causes objectionable dust, contaminated water runoff, or other such hazard or nuisance shall be controlled by means that eliminate such causes of objection or its use will not be allowed. “Paintovers” – obliteration of existing markings by covering with paint or bituminous materials will not be allowed unless otherwise indicated on the plans.

In order to accommodate the various phasing requirements of the Plans, or for other reasons, the Contractor shall be required to remove pavement markings at various locations as the construction proceeds, as indicated on the Plans.

Contractor must maintain on site the minimum equipment listed in Table 1 or approved equal during marking and removal operations.

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>ITEM NAME</th>
<th>Minimum Specifications</th>
</tr>
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</table>
| 2      | Polyplaner 450 or approved equal with suitable skid steer for mounting | • Removes up to ½ inch thick concrete surfaces  
• Removes 18” wide in a single pass.  
• Cuts up to 3/8 inch deep per pass, working to within 1/32 inch tolerance |
| 1      | High Pressure Water blasting Trucks with Vacuuming Capabilities | • Capable of Pressures up to 20,000 psi*  
• Uses 15 to 25 gpm of water  
• Results in a hydraulic effect from the force of water  
• Recovers debris and water through a separate follow-behind vacuum system  
• Maneuvers around Fixtures to avoid damage to joints materials  
• Can remove existing markings up to 1000 SF per hour |

*Pressure application beyond 15,000 psi shall be reviewed and approved by the Engineer.

Upon completion of paint removal operations, any paint, pavement, or obliteration materials left on the pavement shall be removed by means of high pressure vacuum.

Areas where marking removals have occurred but where no subsequent overlay or surface treatment is planned shall have an emulsified asphalt fog seal placed on them after marking removal to bring the pavement color back to its original color. The fog seal shall be considered
incidental to the marking removals bid item and no separate payment will be made. Application rate shall be as approved by LAWA.

23-4.13 MISCELLANEOUS REMOVALS

Miscellaneous Removals shall consist of the removal of all other miscellaneous items which are necessary for the progress of the work which are identified on the plans for removal, but which are not covered in other removals bid items. This category includes, but is not limited to, steel plates; miscellaneous concrete foundations, footings, curbs and associated reinforcement; I-beam supports; lighting, sewer and water lines and appurtenances; misc. fencing, signs, bollards and all other items identified on the plans for removal but which are not expressly covered under other removals pay items. Work also includes miscellaneous electrical items including lights, signs, junction cans and boxes, electrical items, fixtures, duct, conduit, cable and appurtenances not paid under Section 110, Airfield Electrical Work, of these Specifications. Filling of resulting depressions, watering, compacting fill material, the disposal of all resulting materials shall be done as required herein.

23-4.14 PROTECTION OF EXISTING UTILITIES

The Contractor shall protect all existing utilities and improvements not designated for removal. Physical protection of utilities in proximity of pavement sections shall be provided by the Contractor where shown on the plans, or as directed by the Engineer.

Type 1 utility protection shall be as shown on the plans, including concrete encasement and reinforcement. Except where noted on the plans, encasement protection of utilities in proximity of pavement sections shall require prior approval of the Engineer.

The Contractor shall determine the exact locations and depth of all utilities indicated on the drawings in accordance with Project Requirements PR-2. In addition to those indicated, the Contractor shall make exploratory excavations of all utilities. All such exploratory excavations shall be performed as soon as practicable after award of the Contract, and in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor’s work. When such exploratory excavations show the utility locations as indicated on the drawings to be in error, the Contractor shall so notify the Engineer. The number of exploratory excavations required should be that number which is sufficient to determine the alignment of the utility. All costs for such work shall be absorbed by the Contractor.

23-4.15 PLUGGING AND CAPPING EXISTING UTILITIES TO REMAIN

Plugging and capping of existing utilities to remain shall be as shown on the plans, or as directed by the Engineer and in accordance with applicable utility specification.

The Contractor shall determine the locations existing utilities to remain, and use care to not damage existing pipe to remain during demolition and removal of adjacent pipe.

23-4.16 MAINTENANCE AND REPAIR OF HAUL ROAD

During removal and all other construction operations, and at the conclusion of the project, the Contractor shall sweep and maintain all haul roads used by the Contractor. Any damage to existing roadways caused by Contractor’s operations shall be immediately repaired to match the
original conditions that existed prior to the start of work, at no additional cost to the Owner. Contractor shall also make provisions to maintain vehicle roadway access as needed during any required repairs.

The Contractor shall construct temporary construction access roads to FAA, DWP and other facilities requiring access during construction, including temporary ramps as needed for construction vehicle access and FOD grates to prevent migration of debris onto airfield pavements. FOD mitigation measures shown on the plans are the minimum required and the Contractor shall provide additional provisions as may be needed to prevent construction debris, including rocks, mud, dirt, and dust, from being tracked onto airfield pavements.

Contractor shall also take precautions to protect existing or new pavements to remain. Any damage to new or existing pavements caused by Contractor’s operations shall be repaired by the Contractor at no additional cost to the Owner.

Adequate sweeper trucks and water-distribution trucks shall operate in accordance with the plans and PR-8, Environmental Mitigation Requirements, and as directed by the Engineer to eliminate dust and to Foreign Object Debris accumulation on all haul roads used by the Contractor. Contractor shall take photographs of site work areas and haul roads before the start of work, and at least monthly during the work, and shall provide copies to the Engineer to establish control conditions.

23-4.17 DUST CONTROL

The Contractor is advised that control of dust during demolition operations is his sole responsibility and is of utmost importance in the safe operation of the airport. Airborne dust and debris can cause hazards to operating jet aircraft in addition to creating visibility concerns. Adequate use of water trucks or other methods of dust control shall be utilized at all times during demolition operations. The Engineer will retain the authority to cease all construction operations, with no modification to the allowable contract schedule, when excess dust is observed. Dust control measures will not be measured for payment, but will be considered incidental to other bid items. See PR-18, Environmental Mitigation Requirements, of these Specifications for other required environmental control measures.

23-4.18 CONTAMINATED SOIL TESTING. Contaminated soils, if discovered, shall be handled in accordance with Section 41, Earthwork, and Project Requirements 18 – Environmental Mitigation Requirements and Special Construction.

23-4.19 TRANSITE PIPE. If the Contractor encounters Transite pipe during any work activities, the Contractor shall adhere to the following procedures:

a. Contractor shall stop work in the immediate vicinity and immediately notify LAWA Inspection who will document the finding.

b. The Contractor shall pothole to determine extent and limits of transite pipe.

c. If relatively intact pieces of Transite pipe are encountered, the Contractor shall direct an employee who is properly trained in asbestos procedures to spray each piece with latex paint on any fresh or broken surfaces to encapsulate the fibers. If the pipe is not encased in concrete, the sprayed piece of pipe shall be placed in an ACM plastic bag,
properly labeled, and disposed of as non-hazardous, asbestos-containing waste. If the pipe is encased, the pieces of encased pipe shall only be sprayed with latex paint on fresh or broken surfaces to encapsulate the fibers then the items must be properly labeled and disposed of as non-hazardous, asbestos-containing waste.

d. The Engineer shall determine which pieces are small or crushed as described in this step of the process. If small pieces of Transite pipe, or crushed pieces, are encountered or created, Contractor shall cordon off the area with barrier tape. The Engineer will employ a qualified asbestos consultant to assess the area for contaminated soil. Based on the consultant’s assessment, a Procedure 5 Work Plan, as defined by the South Coast Air Quality Management District (SCAQMD), may be required. If a Procedure 5 Work Plan is required, Contractor will retain a qualified asbestos abatement contractor to perform the abatement work.

1. In all cases, Contractor shall exercise extreme caution to prevent breaking or crushing Transite pipe, and shall minimize the area over which Transite pieces are distributed by Contractor’s activities.

2. The Contractor shall have a qualified trained representative on site at all times when excavation of any nature is being performed.

23-5 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The quantity of the following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. Remove 5-inch Concrete Slab with 6-inch Asphalt Overlay
2. Remove Variable Depth Asphalt Pavement (AC)
3. Remove Portland Cement Concrete (PCC) - Unreinforced
4. Remove Portland Cement Concrete (PCC) - Reinforced
5. Remove Storm Drain Line
6. Remove Jet Blast Deflector
7. Remove Painted Pavement Markings
8. Remove Glide Slope Concrete Foundations
9. Remove and Reinstall Existing Portable Lights
10. Type 1 Utility Protection

No measurement will be made for sawcutting, excavation, concrete encasement removal, backfill, Select Fill, disposal, dust control or other requirements stipulated herein which are considered to be incidental to other bid items and no separate payment will be made.

END OF SECTION 23
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SECTION 24 – WATERING

24-1 GENERAL

Watering shall consist of furnishing and applying water as required for compaction of embankments, subgrades, subbase and/or base courses, dust control and miscellaneous other construction needs.

24-2 FURNISHING WATER

The Contractor shall provide and maintain, at the Contractor's own expense, an adequate supply of water of a quality suitable for the required construction and for domestic use. The Contractor shall investigate the availability of suitable water, make all arrangements for the purchase of the water, and provide all facilities necessary to furnish water for his use during construction. The Contractor shall not draw any water from a fire hydrant for use on the work without first obtaining a written permit and meter from the City of Los Angeles Water Department.

In case water is to be furnished from mains owned and controlled by Los Angeles World Airports, this permission must be obtained from the Airport’s Engineer. An Eddy Valve approved by the Engineer shall be supplied by the Contractor, at Contractor’s own expense, for any connection to Los Angeles World Airports water mains. Recycled water for dust control will be available to the Contractor at no charge provided a containment water trailer (i.e. water buffalo) is stationed at the recycled water location. See plan sheets for locations and additional details.

24-3 SWEEPERS

The Contractor shall furnish and operate self-loading vacuum sweepers with spray nozzles as described in the plans, and in accordance with PR-18, Environmental Mitigation Requirements.

24-4 MEASUREMENT AND PAYMENT

Payment for furnishing and applying water shall be deemed to be included in the prices paid for various items of work involved. No separate payment will be made for furnishing and applying water. Self-loading vacuum motor sweepers and water trucks will be considered incidental to the construction and no separate payment will be made.

END OF SECTION 24
SECTION 25 – MOBILIZATION AND DEMOBILIZATION

25-1 GENERAL

This item shall consist of the following: all preparatory work and operations in mobilizing and demobilizing on the Project. Mobilization shall consist of those operations necessary for the movement of personnel, equipment, supplies and incidentals to the Project Site including obtaining all required insurance, bonds and permits, badging and training of all management and supervision staff, drivers, flaggers, escorts, gate guards and other employees as specified herein; preparation of a construction schedule; establishment of temporary offices including provision of utility services from utility providers and utility locate firms; establishing staging areas, employee parking lots, stockpile areas, stabilized construction access and haul roads, building facilities, safety equipment and first aid supplies, sanitary and other facilities as required, and all requirements indicated by the Contract Drawings, General Conditions and Special Conditions, Project Requirements, Technical Specifications, and State and local laws and regulations. The costs of other pre-construction expense necessary for the start of the work, excluding the cost of construction materials, shall also be included in this Section; and all other work which must be performed or cost incurred prior to beginning work on the various contract items at the project site.

a. Principal Items of Mobilization

Mobilization shall include the following principal items:

1. Insurance as required by LAWA GC-73.
2. Bonds as required by LAWA GC-7 of these specifications.
3. Permits for this project as required by these specifications, including but not limited to Building Permits, Electrical Permits, Caltrans permits, water use permits, FAA 7460-1 permit, Los Angeles Fire Department Division 5, SCAQMD Rule 1166 permit and mitigation plan.
4. The schedule of costs breakdown of the Bid as required in these Specifications.
5. The Contractor's approved Baseline Construction Schedule as required by SC-1 and GC-47.
6. Moving onto the Site all equipment required for the first sixty (60) days of construction, including procurement and installation of batch plant, crushing plant, and other temporary facilities as required, and in accordance with PR-6 Contractor's approved SWPPP, QC Plan, Safety Plan, Temporary Traffic Control Plan, and Hazardous Material Management Plan is also included.
7. Contractor’s Staging and Laydown Area, including:
   a. complete installation of all field offices and laboratories
   b. batch plant and crusher
c. site utilities

d. fiber installation

e. LADWP power service, and supply of temporary generator power as may be needed until LADWP power service is procured

f. fencing and gates, roadways and site improvements

g. installation of anti-tracking plates

h. supplies and other infrastructure requirements shown on the drawings and required by the specifications

8. Posting all required OSHA notices and establishing on-site safety programs.

9. Submitting and approval of all job mixes (P-152, P-401, P-501, P-610, etc.) and required plans (Quality Control, Safety Plan Compliance Document, etc.) shall be submitted within 30 days from Notice to Proceed following Mobilization.

10. Security badging and training of all flaggers, gate guards, vehicle inspectors, escorts and other employees and subconsultants, including any escort training, driver’s training and insurance for vehicles as required for the first sixty (60) days of construction.

11. Procurement and transport of long lead construction materials to the job site.

12. Procurement of barricades, flag lines, and construction fences as depicted in the construction drawings, or as required.

13. Survey, potholing, geotechnical and electrical investigations as required and not otherwise provided for.

14. Construction of stabilized construction entrances and haul routes identified in the construction plans.

15. Prior to commencement of construction activities the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster “Equal Employment Opportunity is the Law” in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL “Notice to All Employees” Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

b. Demobilization

Demobilization shall include

1. Removal of construction facilities, including all utilities

2. Removal of all equipment and remaining stockpiles off the site
3. Reconstruction of haul and service roads to pre-construction conditions
4. Final cleanup of the site after completion of the Project

25-2 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. Mobilization – Insurance, Bonds, Permits
2. Mobilization – Scheduling and Cost Breakdown Submittals
3. Mobilization – Plants, Batch and Crushing
4. Mobilization – Field Offices and Contractor Site Improvements
5. Mobilization – Job Mix Formulae, Laboratory Work and Submittals
6. Demobilization

END OF SECTION 25
SECTION 27 – CONSTRUCTION BARRICADES, FENCING, MARKERS AND SIGNS

27-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for providing and maintaining construction barricades, fencing, markers and signs and as needed to facilitate safety during construction. Work shall be as shown on the Plans, as specified hereafter, and as designated by the Engineer.

Because of its nature, Contractor shall anticipate providing and relocating items multiple times throughout the project as the work progresses. Unless otherwise stated, all items specified herein shall be provided, placed, maintained, relocated and replaced as necessary during the entire duration of the project. Normal wear and tear for the duration of the project shall be anticipated and will not be considered grounds for additional payment.

Where temporary pavement markings are required to temporarily reroute aircraft and vehicular traffic to accommodate construction it will be specified and measured for payment as “Taxiway Marking” under Section 91, Pavement Marking. Removal of temporary markings will be specified and paid in Section 23, Removals.

27-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

27-3 RELATED SECTIONS.

Section 23 – Removals

Section 91 – Marking (FAA P-620)

Section 110 – Airfield Electrical Work

Other Sections, Tests, Specifications, and Standards referenced herein.

27-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See Project Requirements PR-1 – Scope of Work, PR-2 - Work Sequencing Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

27-5 CONSTRUCTION BARRICADES, DELINEATORS AND SAFETY FENCING AND SIGNS. The Contractor shall provide and maintain barricades, delineators, safety fencing, signs and flashers, temporary covers of elevated airfield fixtures of the types shown on the plans. Location of barricades, delineators safety fencing, temporary covers of elevated airfield fixtures and signs shall be as shown on the plans or as approved by the Engineer and LAX Operations. Maintenance of all barricades, delineators, safety fencing, covers, signs and associated flashers will be the sole responsibility of the Contractor. No additional payment will be made for maintaining and moving barricades, delineators, safety fencing and, covers and signs to accommodate the phasing.

27-5.1 Temporary Construction Safety Fencing. The Contractor shall provide and maintain construction safety fencing to delineate work area limits for each construction phase. Type and
The location of safety fencing shall be as shown on the plans and as approved by the Engineer and LAX Operations. The fencing lines are intended as a safety device to aid the Contractor’s workers and subcontractors in easily delineating areas of the airport which are off limits from those areas approved for his work activities. Fencing shall be 18” high, orange temporary safety fence, Tensar Easy Gardener BX 205116, or approved equal. Posts, excavation, backfill, and all other incidentals necessary for complete fencing installation, as detailed on the Plans and as approved by the Engineer, shall be included in this item, including periodic relocation as may be needed to accommodate construction phasing.

27-5.2 Low Profile Airfield Barricades. Barricades shall be Low Profile Type 1, water-filled barricades. The Type 1 barricades shall be 10 inches in height, furnished in with orange and white reflective striping on two sides. They shall be constructed of resiliently deformable and frangible material, designed as modular, interlocking units, which will easily assemble, disassemble, and nest for compact storage. Barricade shape shall be low enough so as to not interfere with taxiing aircraft. The Type 1 barricade shall be furnished with orange and white reflective stripes. Each 96” length of barricade shall be equipped with at least two red omni-directional steady burning light. Barricades shall meet the minimum requirements of FAA AC 150/5370-2, Operational Safety on Airports During Construction, latest edition. Barricades will be Multi-Barrier Safety Barricade Model AR10-x96 or approved equal.

Standard weighted wooden barricades will not be allowed for airfield pavement construction area delineation.

27-5.3 Caltrans Portable Barricades. Where portable barricades are indicated on the plans they shall be Caltrans Type II lighted barricades conforming to Section 12-3.02 of the Caltrans Standard Specifications.

Barricades shall be constructed of lightweight commercial quality materials, as approved by the Engineer. Stay bracing for "A"-frame designs shall not be rigid.

Markings for barricade rails shall be alternate orange and white stripes. The entire area of orange and white stripes shall be Type-II, super engineering grade, retroreflective sheeting. The color of the orange retroreflective sheeting shall conform to PR No. 9, Highway Orange, of the Federal Highway Administration’s Color Tolerance Chart. Retroreflective sheeting shall be placed on rail surfaces in such a manner that no air bubbles or voids are present between the rail surface and retroreflective sheeting. The predominate color for barricade components other than rails shall be white, except that unpainted galvanized metal or aluminum may be used.

Owner identification shall not be imprinted on the reflectorized face of any rail, but may be imprinted elsewhere.

Ballasting shall be by means of sand filled bags placed on the lower parts of the frame or stays, but shall not be placed on top of the barricade nor over any reflectorized barricade rail face facing traffic.

If the barricades are displaced or are not in an upright position, from any cause, the barricades shall immediately be replaced or restored to their original location, in an upright position, by the Contractor. Contractor is responsible to ensure that flashers are operational, and at their full brightness, for the duration of the project.
27-5.4 Taxiway Closure Barricades. Taxiway Closure Barricades shall consist of alternating 28-inch high weighted cones and solar-powered red lights, as spacing shown on the plans. Weighted 28-inch cones shall be orange with horizontal reflective strips and shall be Traffic Devices model CG28-30-RC-64 or approved equal. Weighted bases shall be at least 30 pounds to prevent blow-over by wind and jet blast. Red lights shall be solar powered and securely mounted on weighted supporting devices as shown on the plans, no higher than 14-inches in overall height. Solar powered red lights shall be A-601 type, as manufactured by Airport Lighting Company, or approved equal. Mounting device shall be as shown on the plans, and shall be as manufactured by Airport Lighting Company, or approved equal.

At the completion of construction, taxiway closure barricades, consisting of weighted cones and solar-powered lights and mounting devices shall be cleaned and hauled to a location on the airfield as directed by the Engineer, and shall become property of LAWA.

27-5.5 Concrete K-Rail Barricades. Concrete K-Rail barriers shall be as shown on the plans and conform to the provisions in Section 12-3.08, “Temporary Railing (Type K)”, of the Caltrans Standard Specifications. Concrete k-rail barricades salvaged from removal operations may be used for temporary installations. Concrete k-rail barricades salvaged from removal operations shall be delivered to LAWA maintenance upon completion or work.

27-5.6 Construction Signs. Where required on the plans, the Contractor shall provide 16 gauge aluminum signs, with reflectorized faces and legends, for “Stop” signs, “Stop for Aircraft” signs, Taxiway Designation signs and other signs as shown on the Plans or as needed for Contractor to suitably direct construction traffic. Sizes, materials, and mounting methods shall be as indicated on the Plans. Posts, excavation, backfill, and all other incidentals necessary for complete signs as detailed on the Plans and as approved by the Engineer shall be included in this item, including periodic relocation as may be needed to accommodate construction phasing.

Messages and dimensions shall be as shown on the plans. Roadway signage shall conform to the requirements of the Manual of Uniform Traffic Control Devices, latest edition.

27-6 TEMPORARY AIRFIELD LIGHTING. Temporary airfield lighting, circuiting and visual aids, including temporary edge and threshold lights and obstruction lights shall be installed in accordance with the locations and details shown on the plans or as directed by the Engineer, and in accordance with Section 110, Airfield Electrical Work. The Contractor shall coordinate with the Engineer prior to connection of existing airfield lighting circuitry to confirm circuit capacity. Contractor shall remove and/or relocate temporary lighting as needed to accommodate the construction phasing schedule.

27-7 TEMPORARY CHAINLINK SECURITY FENCE. Not in Used

27-8 TEMPORARY JET BLAST DEFLECTOR. Not in used

27-9 PORTABLE JET BLAST DEFLECTOR. The Contractor shall supply and construct portable jet blast deflectors and footings in accordance with Section 89 and as shown on the drawings. The placement of portable jet blast deflectors shall be as shown on the plans or as directed by the Engineer.
The Contractor shall install portable blast deflectors at the locations shown and within the allowable time periods. Contractor shall properly align existing frames and panels to minimize re-drilling of holes, and to maintain segmented white/orange facing appearance.

Also, the Contractor shall move Owner furnished portable jet blast deflectors to locations as indicated on the plans or as directed by the Engineer. Owner furnished jet blast deflectors are located on airport property.

All hauling and coordination with airport personnel shall be incidental to the placement of the Blast fence.

27-10 CONTRACTOR FURNISHED LIGHTED “X” RUNWAY CLOSURE MARKERS. Under this section the Contractor shall supply new lighted runway closure markers to indicate to inbound aircraft that the marked runway is closed. Contractor shall provide and maintain the equipment during the project construction period, and they shall become the property of the Contractor upon completion of the work. Each marker shall be provided with a generator power unit, but during the progress of the project they will be fueled by the Contractor as needed.

The Contractor shall transport and operate each runway closure marker to the location as shown on the drawings, take-down and remove to the contractor staging area at the completion of each phase or as directed. The Contractor shall protect, clean and maintain lighted “X” throughout the duration of the project, and shall supply fuel (diesel or gasoline as required). When not in use the markers shall be towed and stored in a safe location within the Contractor’s laydown area.

The units shall be manufactured by Hali-Brite, RXM or approved equal and shall consist of an all-weather sign panel and illuminated “X” with indicators capable of being visible from a distance of up to five miles. The units shall contain their own power-generating systems sufficient for total operation in a stationary stable position.

Lighted Xs shall meet the following requirements:

a. The portable runway closure marker shall be designed to form a lighted X which contains twenty-one (21) 90-watt par 38, 10-degree weather proof outdoor standard base clear Halogen spot bulbs with one (1) bulb located in the center and five (5) bulbs located in each of the four (4) legs. All X panel bulbs, light sockets, wiring and connections shall be enclosed in a weather resistant housing.

b. The lighted X formed when opened and operating shall be 20 feet 6 inches each continuous leg and 14 feet 6 inches on the peripheral.

c. The marker shall collapse for transport and storage so that all parts are inside the trailer frame dimensions to prevent damage.

d. Illumination of the marker shall be workable in a continuous or flashing mode. This shall be controlled by a solid state flasher. Mechanical flashers are not acceptable.

e. A photo cell shall be used to reduce the voltage to 75 volts for nighttime operations.

f. Flash interval time shall be:
(1) Bright Mode: Approximately 2.5 seconds on and 2.5 seconds off.
(2) Dim Mode: Approximately 2.5 seconds on and 2.5 seconds off.

g. A radio interference filter shall be installed with a operation frequency of 50 Hz.

h. The marker shall have at least two (2) lights (mounted at the backside of the upper portion of the top of the legs of the X) on the backside of the X to indicate power is being supplied to the marker and to indicate that more than one (1) bulb has become inoperative.

i. The marker shall be designed so it can be used while still attached to the tow vehicle or have the means to stand alone.

j. The marker shall be able to withstand winds of 40 MPH (64.37 KPH) while in operational mode. This must be documented.

k. The runway closure marker shall be visible from a distance of 3 to 5 miles VFR daytime and a minimum of 6 miles VFR nighttime. These distances shall be determined from an aircraft using a Loran receiver. Documents substantiating these field tests by an independent third party shall accompany specifications.

l. Set up time for the marker shall be capable of being accomplished by one person in two (2) minutes or less. This means the marker can be raised and operating within this time frame.

m. The marker shall have the fuel capacity to run at FULL LOAD for a minimum of 120 hours without refueling. Contractor shall be responsible for refueling.

n. The marker shall have the capability of being hard wired for the convenience of operating without the use of a generator for prime power.

o. The marker angle mechanism shall be constructed of 2” (5.08 cm) square tubing, minimum.

p. All electrical components shall be UL listed.

q. The angle mechanism shall be capable of tilting 3 degrees from vertical and have trailer adjustments to accommodate this angle no matter what the degree of the runway.

r. The angle mechanism shall be operated by an electric actuator which will both raise and lower the mechanism with power from the generator.

s. The marker lighted legs shall be constructed from a lightweight aluminum type material.

t. A locking system shall be installed to secure the legs from expanding when the marker is in the transport mode.

u. The trailer frame shall be constructed from approximately 2” (5.08 cm) square tubing.

v. Trailer dimensions: 7 feet 6 inches wide, 10 feet long.
w. The trailer floor shall be expanded steel to serve as a work platform for servicing personnel and to minimize the possibility of ice and snow accumulation.

x. The tires shall be minimum 4.80 X 12" (203.20 X 30.48 cm) tubeless 4-ply tires, 12" (30.48 cm) wheels and be covered with metal type fenders. Shall come with three (3) tires mounted on three wheels (one is for a spare).

y. A 1,500-pound axle with built-in independent Henschen type suspension or equal. Axle springs, shackles, or shock absorbers are not acceptable.

z. 2-Inch FAS-LOC coupling rated at 3,500 pounds GVW., with safety chains.

aa. Shall have 3" pintle ring hitch mounted at the rear of the trailer to facilitate towing of a second runway closure marker.

bb. Provisions to accommodate safety chains shall be mounted at the rear of the trailer.

c. D.O.T. approved brake, tail, and turn signal lights and reflectors shall be provided.

d. Five (5) 2,000-pound jack stands located at each corner and tongue.

e. The entire marker unit shall be powder coated gloss to a 1.8 mil minimum dry film thickness. Powder to be outdoor rated, UV resistant, polyester TGIC with the following characteristics:
   2. 160 IN-Lb Gardner direct & reverse impact ASTM-D2794 modified.
   3. Flex over 1/4 dia. needed without fracture.

ff. Diesel Powered Generator:
   1. Rated Watts: Minimum 4,000.
   2. Voltage: 120/240.
   5. Run Time: 120 hours.
      a) CF-1.
      b) CF-2.
      c) JET-A.
   7. Starting System: 12V DC Electric & Recoil Rope.
   8. Electrical Outlets:
      a) 2-120V (15A) w/ GFI.
      b) 1-120V (30A) w/ twistlock.
      c) 1-240V (20A).
9. Other Features:
   a) Low Oil Pressure Safety Protection System.
   b) Running Time Meter.
   c) USDA Forestry Approved Muffler.
   d) Circuit Breaker Protection.
   e) Anti-Vibration Rubber Mounts.
   f) Dry Air Cleaner.
   g) 12V Battery Charging System.

gg. Protective Cover
   1. Total Weight: 18 OZ P.S.Y.
   2. Width: 61 inches.
   5. Denier: 1000D by 1000D.
   7. Tongue Tear (FS 5134): 77 by 77.
   9. Abrasion (FS 5306): 1,000 cycles.
   10. Low Temperature: -40 degrees.
   15. Putup: 75 yards.

hh. The marker shall have a protective “Sunbrella” or approved equal type storage cover.

ii. Manuals – One (1) operators manual, and one (1) parts manual for each unit shall accompany equipment at time of delivery. Microfiche, computer diskette or CD is acceptable if printed manuals are not available. Manuals to be in English.

jj. Warranty
   1. State terms and conditions of factory warranty. Minimums of one (1) year, to include parts and labor.
   2. Equipment and all components thereof must comply with all Federal, State, and local regulations that may apply at time of delivery.
   3. Vendor shall be responsible to provide the Department of Airports, Construction and Maintenance, all applicable service bulletins. These shall be mailed to the same location as the delivery address.
kk. Training/Startup

1. Vendor shall have training of operation and maintenance provided. Time and location to be determined by LAWA personnel.
2. Equipment shall be ready for immediate use.

27-11 OWNER FURNISHED LIGHTED “X” RUNWAY CLOSURE MARKERS.  Under this section the Owner shall provide lighted runway closure markers to indicate to inbound aircraft that the marked runway is closed, for use on the project. Contractor shall provide a power generation unit for each marker, fuel and maintain the equipment during the project construction period. Each marker shall be cleaned and receive a tune up prior to returning to the Owner upon completion of the work. Refer to Section 27-10 regarding details on the power generation unit.

27-12 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Safety Fencing
b. Low Profile Airfield Barricades
c. Caltrans Portable Barricades
d. Construction Signs
e. Lighted X’s

27-13 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications. Unless specifically identified in the items below, all provisions of this specification shall be included in the item “Construction Barricades, Delineators, Safety Fencing and Signs.”

1. Construction Barricades, Delineators, Safety Fencing and Signs
2. Temporary Airfield Lighting
3. Lighted “X” Runway Closure Marker (Contractor Furnished)

END OF SECTION 27
SECTION 28 – LOCATION OF UNDERGROUND UTILITIES

28-1 GENERAL. Under this section, the Contractor will provide potholing for establishing and confirming utility location and depth of utilities that are not shown on the plans, or for other purposes requested by the Engineer.

Potholing of utilities that are shown on the plans, including potholing of fuel and oil company pipelines, shall be considered incidental to the associated work items and no separate payment will be made. Potholing of utilities not shown on the plans, and approved by the Engineer prior to proceeding with the work, will be paid under this section.

Potholing for utilities will be of two types, in earth and in paved areas.

28-2 RELATED SECTIONS.

a. Section PR-7 - Utilities

b. Other Sections, Tests, Specifications, and Standards referenced herein.

28-3 LIMITED ACCESS / NIGHT CONSTRUCTION. See construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

28-4 EQUIPMENT. Potholing in earth may be accomplished by shovel, backhoe, excavators, vacuum trucks, or other equipment suitable for the conditions. Potholing in paved areas shall be accomplished by core-drilling through existing PCC or asphalt surfacing, and vacuum excavation until the utility is located. Care shall be taken to not damage utility under investigation, or any other utilities or structures.

28-5 METHODS

28-5.1 WHEN REQUIRED. Prior to the beginning of demolition or earthwork operations, or any work which may impact nearby underground utilities, the Contractor shall provide 12-inch diameter potholes for locating fuel lines, storm drains, electrical conduit and all other utility lines crossing, or within five feet of the construction areas, as directed by the Engineer. Prior to digging potholes, the Contractor shall indicate to the Engineer the specific potholes he plans to excavate. Equipment and tools shall be approved by the Engineer.

In pavement demolition areas, potholes may be completed after demolition and removal of PCC or asphalt pavements, but prior to any excavation or grading operations.

28-5.2 PRIOR APPROVAL REQUIRED FOR POTHOLING. Prior to beginning the work for any pothole, the prior approval of the Engineer for the number, location, method of digging and equipment to be used, shall be obtained. All necessary permits from Underground Services Alert ("USA"), FAA, oil companies, or other affected agencies, shall also be in effect. Permits are the responsibility of the Contractor.
In addition, a work plan clearly showing intended locations of digging, and whether potholes are paid or incidental shall be approved in advance by the Engineer for each day’s potholing activities.

The Contractor shall provide utility owner access onto work site for potholing operations and/or inspection as needed.

28-5.3 WORK PRODUCTS. From the elevation information obtained from potholes completed under this section, the Contractor shall provide survey to establish the elevations of the top of the exposed utility lines for the Engineer, and for the purpose of establishing methods of protecting the structures during construction activities. The Contractor shall expose and verify, by survey, the depth and alignment of all underground utilities in the construction site for each phase. The Contractor shall pothole and survey all utilities where they enter the horizontal limits of any new pavement construction, and anywhere they cross a new storm drain or electrical duct installation. The Contractor shall notify the Engineer immediately, in writing, of any conflicts between the project work and any existing utility. Pothole elevations shall be included in the “as-built” construction plans. The Engineer may request additional potholes at anytime.

28-5.4 AIRPORT GIS SYSTEM. All survey information acquired as a result of potholing activities shall be submitted in an approved format for entry into the LAWA Geographic Information Systems Database. Data shall conform to the LAWA GIS and Survey standards which can be obtained at:


28-5.5 FINISHING. After completion of potholes, disturbed surfaces shall be replaced with like materials and recompacted to original lines, grades and densities. Materials and methods of repair shall be approved in advance by the Engineer.

28-6 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Permits

b. Agency Approvals

c. Proposed Equipment

d. Daily Work Plan

  1. Location

  2. Type of Pothole (Manual or Equipment)

  3. Identify Paid vs. Incidental potholes

e. Materials and Methods of Repair.
28-7 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

“Potholes - Paved Areas” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 28
SECTION 29 – NUCLEAR GAUGES (FAA 120)

29-1 GENERAL

This section covers the use of nuclear gauges for material testing. The use of nuclear gauges shall be in accordance with FAA Specification Section 120 as included and modified hereafter. The use of nuclear gauges shall be approved in advance by the Engineer.

FAA SECTION 120
NUCLEAR GAGES

120-1 TESTING. When the specifications provide for nuclear gauge acceptance testing of material for Items P-152, P-154, P-209, and PMB (Section 41, Earthwork; Section 50, Subbase Course; Section 52, Crushed Aggregate Base Course, respectively), and other applicable materials, the testing shall be performed in accordance with this section. At each sampling location, the field density shall be determined in accordance with ASTM D 6938 using the Direct Transmission Method. The nuclear gauge shall be calibrated in accordance with ASTM D 6938. Calibration and operation of the gauge shall be in accordance with the requirements of the manufacturer. The operator of the nuclear gauge must show evidence of training and experience in the use of the instrument. The gauge shall be standardized daily in accordance with ASTM standards.

When using the nuclear method, ASTM D 6938 shall be used to determine the moisture content of the material. The calibration curve furnished with the nuclear gauges shall be checked in accordance with ASTM standards. The calibration checks shall be made at the beginning of a job and at regular daily intervals. The moisture content for any material containing lime or cement shall be determined by using the oven method.

The material shall be accepted on a lot basis. Each Lot shall be divided into eight (8) sublots when ASTM D 6938 is used.

120-2 PWL

Section deleted.

120-3 VERIFICATION TESTING. (For FAA Items P-152, P-154, P-209 and PMB only.) The Engineer will verify the maximum laboratory density of material placed in the field for each lot. A minimum of one test will be made for each lot of material at the site. The verification process will consist of: (1) compacting the material and determining the dry density and moisture-density in accordance with ASTM D 1557, and (2) comparing the result with the laboratory moisture-density curves for the material being placed. This verification process is commonly referred to as a "one-point Proctor". If the material does not conform to the existing moisture-density curves, the Engineer will establish the laboratory maximum density and optimum moisture content for the material in accordance with ASTM D 1557.
Additional verification tests will be made, if necessary, to properly classify all materials placed in the lot.

The percent compaction of each sampling location will be determined by dividing the field density of each sublot by the laboratory maximum density for the lot.

END OF SECTION 120

29-2 METHOD OF MEASUREMENT

Use of nuclear gauges will not be measured for payment

29-3 BASIS OF PAYMENT

Use of nuclear gauges, if approved by the Engineer, will be considered incidental to the bid items for which they are utilized and no separate payment will be made. The Contractor shall bear the full expense of the operation, calibration, and maintenance of nuclear gauges.

END OF SECTION 29
SECTION 30 – TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL (FAA P-156)

30-1 GENERAL

The Contractor shall perform all work required by the plans and specifications for the temporary control of erosion, siltation, and pollution on the Airport in accordance with the Standard Specifications, except as specified otherwise in FAA Specification Item P-156, as included and modified hereafter, and as shown on the Plans.

See Project Requirements, PR-18, Environmental Mitigation and Special Construction Requirements of these Specifications for additional requirements relative to the Storm Water Pollution Prevention Plan and other requirements.

ITEM P-156 TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL

156-1 DESCRIPTION This item shall consist of temporary control measures as shown on the plans or as ordered by the Engineer during the life of a contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, hydraulic mulches, mulches, grasses, slope drains, and other erosion control devices or methods.

The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

156-2 MATERIALS

156-2.1 GRASS. Grass that will not compete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover.

156-2.2 MULCHES. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.

156-2.3 TEMPORARY HYDRAULIC MULCHES shall meet the requirements of Caltrans Specification Section 13-5, Temporary Soil Stabilization.

156-2.4 FERTILIZER. Fertilizer shall be a standard commercial grade and shall conform to all Federal and state regulations and to the standards of the Association of Official Agricultural Chemists.
156-2.5 SLOPE DRAINS. Slope drains may be constructed of pipe, fiber mats, rubble, Portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.

156-2.6 OTHER. All other materials shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

156-3 CONSTRUCTION REQUIREMENTS

156-3.1 GENERAL. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The Contractor shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved. The Engineer will monitor and inspect for compliance with the applicable regulations.

156-3.2 SCHEDULE. Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Engineer.

156-3.3 AUTHORITY OF ENGINEER. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

156-3.4 CONSTRUCTION DETAILS. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
Where erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

The Engineer will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Engineer, such work shall be performed by the Contractor at his/her own expense.

The Engineer may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.

The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures should be provided.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

156-4  **METHOD OF MEASUREMENT.** See Section 30-2.

156-5  **BASIS OF PAYMENT.** See Section 30-2.

**END OF ITEM P-156**

**30-2  METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Temporary Air and Water Pollution, Soil Erosion, and Siltation Control shall be measured and paid for as described in Project Requirements – 4 of these specifications.

**END OF SECTION 30**
SECTION 31 – OIL COMPANY RIGHT-OF-WAY / EASEMENT REQUIREMENTS

31-1 GENERAL. This section outlines Contractor obligations and work restrictions to be in effect for all improvement work done within Oil or Fuel Company Rights-of-Way. These Rights-of-Way are shown on the plans. These requirements are in addition to all requirements within the technical specifications for each type of work.

31-2 RELATED SECTIONS

Section 23 – Removals, for restrictions on pavement and other removals in oil company rights-of-way

Section 27 – Construction Barricades, Fencing, Markers and Signs

Section 28 – Location of Underground Utilities, for requirements relative to potholing in oil company rights-of-way

Other Sections, Tests, Specifications, and Standards referenced herein.

31-3 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequencing Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited access or night-time construction.

31-4 GENERAL

Work required for this project will encroach, cross, or impact existing and active pipelines and facilities belonging to several oil companies. These companies include Chevron, ExxonMobil, Conoco Philips, Shell and others. Reference to “oil company”, “fuel company”, or their plurals in this specification, or elsewhere in the Contract Documents, shall refer to any and/or all of the companies and company facilities listed. Pipelines are active, carrying both jet fuel and/or crude oil.

The following minimum design and facilities specifications and load capacity guidelines have been provided by the oil companies and will be binding on the Contractor at all times during work within the easement or right-of-way for the oil pipelines. The terms easement and right-of-way are used interchangeably in this specification. The right-of-way limits are shown on the plans.

In accordance with State and Federal Government Code regulating hazardous liquids, and guidelines for protection of high-risk pipelines, oil company operations and maintenance procedures require Contractors to “Design to Miss” and “Protect-in-Place”. Specific requirements to satisfy these procedures include the following, which are described below:

a. Identify Positive Location.

b. Oil Company Review and Approval.

c. Contractor-Written Job Site Safety Plan (JSSP).
d. Minimum Considerations for Protection of High Risk Pipelines.

e. Minimum Facilities Inspection Requirements.

f. Applicable Federal, State and Local requirements.

g. Contractor shall provide escorts for fuel company representatives as required to complete the work within the fuel company’s right-of-way.

The Contractor is advised to allow ample time to coordinate site visits, reviews, approvals, and other actions required on the part of the oil companies. No contract extensions will be allowed for failure on the part of the Contractor to coordinate with the fuel companies in a timely manner.

### 31-5 IDENTIFY POSITIVE LOCATION

Prior to working within the pipeline right-of-way, the Contractor shall determine pipeline elevations a minimum of every 100 feet. This data shall be used to render accurate profile views of the pipelines so that clearance and maximum allowable load capacities (surcharge and/or overburden) over the pipelines can be determined. The Contractor shall plot detail section and/or profile views within the right-of-way (easement) boundaries showing elevation of underground facilities in relation to proposed improvements and existing and proposed grade elevations. Profiles and/or section views shall be rendered on the proposed Job Site Safety Plan (JSSP) Drawing(s), indicating general pipeline profile TOP and TOG throughout the limits of work within the oil company right-of-way. Easement boundaries and pipeline locations should be surveyed and delineated on site before any work in proximity to oil company facilities begins.

### 31-6 POTHOLING

Potholing of undocumented fuel lines will be measured and paid as described in Section 28, Location of Underground Utilities, of these Specifications. As described in that section, no payment will be made for potholing of utilities which are shown on the plans. Therefore potholing of known fuel lines shall be considered incidental to other pay items, and no separate payment will be made.

Surveyed information shall be delivered to LAWA for inclusion in the airport GIS system as described in Section 28, Location of Underground Utilities.

The Contractor to supply air testers for all potholing near fuel pipelines.

### 31-7 REQUIREMENTS AND APPROVALS

**31-7.1 PROTECT IN PLACE OR CONSTRUCT TO MISS.** Before beginning construction activity near or over oil company facilities, the Contractor shall develop a plan for “protection in place” or “construct to miss” relative to oil company facilities. This plan must be reviewed and approved by the affected oil company facilities representative and oil company engineering or technical services personnel prior to the start of construction. This review is required to ensure that minimum safe construction offsets for placement of major structures are established outside of oil company easement boundaries, and that consideration of excessive loads have been calculated and compensated for. All responsible parties must agree upon an appropriately
engineered solution for construction activities and improvements proposed in proximity to oil company facilities.

No structural encroachments or improvements impacting safe pipeline operations will be permitted within, or immediately adjacent to, oil company easements. Encroachments include, but are not limited to, foundations, footings, trees, parallel fencing and/or utilities. Approvals for proposed improvements within the right-of-way will require engineering and technical calculations to determine:

a. Safe construction and equipment offset distances;

b. Appropriate angles of repose;

c. Surcharge or overburden factors.

These requirements are necessary to insure prevention against undermining the proposed improvements in the event of future oil company pipeline maintenance or emergency excavations to access pipeline facilities.

31-7.2 DEPTH OF COVER. If it is determined by oil company engineering or technical services that adequate cover, clearance or protection from load bearing forces cannot be obtained within the scope of the proposed project improvements, it will be necessary to modify, relocate, lower in place, or place additional fill above the oil company pipelines. It is expected that when improvements requiring pipeline system design changes are required, the affected oil company will be reimbursed for actual costs and shall receive payment of estimated costs in advance before scheduling work for such changes. Such changes may include depth of cover modifications, lowering, relocation, or removal of pipelines. The Contractor shall notify the Engineer immediately when any potential conflicts arise which may require changes in oil pipeline alignment.

The Contractor shall determine minimum depth of cover requirements to protect pipelines in place from anticipated construction loads during and upon completion of construction to ensure compliance with the appropriate oil company polices, pipeline safety laws, government codes and other related regulatory requirements. Where less than five-and-a-half feet of compacted soil cover exists, the Contractor’s construction plan and design must provide equivalent protection, and assure that construction loads will not exceed allowable loading.

31-7.3 OFFSETS AND EQUIPMENT RESTRICTIONS. Minimum safe working offset distances for heavy equipment must be determined to ensure that heavy equipment operations are conducted safely away from the pipelines to prevent equipment mechanical or excess load (rupture) damage to the pipelines.

Specification of appropriate equipment placement and safe working offset distances, including outrigger placement, and utilization and excavation methods for grade cuts or fill over pipelines are to be determined before the beginning of any grading operations. Final import fill and grade cuts over oil company facilities must be approved by the respective oil companies before beginning grading activity.

See restrictions on methods and equipment for pavement removal in Section 23, Removals.
31-7.4 APPROVALS AND AGREEMENTS. Final approval will be granted by oil company engineers after they have conferred, confirmed and mutually agreed with the Contractor that oil company facilities are adequately protected from excessive load or potential mechanical damage from proposed construction activities and improvements within the right-of-way.

Oil companies will not permit any excavation activity or improvements over or near oil pipelines or facilities without prior compliance review and final permit approval of the project plans and review and approval of a written Contractor Job Site Safety Plan (JSSP). Final permit approval will be granted by each affected oil company.

LAWA and the Contractor shall sign and abide by the terms of an “Acknowledgement of Line Crossing Procedures” and/or “Hazardous Liquid Substructure Notification”, prior to work within the oil company right-of-way.

31-8 CONTRACTOR-WRITTEN JOB SITE SAFETY PLAN (JSSP)

Prior to undertaking any work in the oil company right-of-way, the Contractor shall develop an appropriate written “Contractor Job Site Safety Plan (JSSP). The JSSP will be a collaborative effort between the Contractor and oil company personnel. It shall be reviewed and approved by all affected oil companies prior to construction within the oil right-of-way.

The purpose of the JSSP is to indicate how the Contractor intends to protect oil company pipelines and facilities during, and upon completion of, construction activities. Primary construction conditions of concern requiring consideration are heavy equipment, and materials placement at critical locations, including heavy equipment crossings and/or grading activity over oil company facilities.

No work will be undertaken in the right-of-way until the JSSP has received written approval from all affected oil companies.

The JSSP will summarize project plans for “Design to Miss” and/or “Protect-in-Place” procedures relative to oil company facilities. It will include pipeline protective measures, proper excavation techniques, and an emergency response protocol that will include evacuation, isolation, deny entry, notification, and emergency shutdown procedures.

The JSSP will set forth safe construction plans, proper excavation techniques and equipment placement procedures to protect and support existing pipelines from any excessive anticipated static or dynamic loads. Such loads may cause facilities to move or rupture. Heavy vibratory equipment loading must be considered and alternative compaction methods used to avoid direct stress applied to the pipelines.

Utilization of heavy equipment for extensive equipment runs over, or in immediate proximity to, oil company pipelines require potholing for survey of pipeline elevations as described in paragraph 31-5 “Identify Positive Location”. Existing grades and depth of soil cover above the pipelines and proposed heavy equipment weight ratings are required to determine accurate maximum allowable load capacities of the pipelines.

Minimum consideration for the JSSP includes, but is not limited to, the following:
a. Plans showing results of the “Identify Positive Location” requirements of Paragraph 31-5. A minimum of three (3) section views shall be provided - one on each end and one at the middle of the excavation limits or zone of impact. This information will be presented on a site plan drawing from the project plan set.

b. Determination of “Maximum Allowable Loads” over oil pipelines, and provision for “Design to Miss” or “Protect-in-Place” to prevent rupture due to excessive load stress or mechanical damage.

c. A Vehicle/Equipment list, such as the sample form included at the end of this specification, listing vehicles and equipment which the Contractor proposes to use inside the oil company easement. The list shall include the make, model, and equipment weight ratings, of all vehicles and equipment proposed, with a column for indication of rubber tired (and number of tires) or track mounted equipment type. This data, submitted with the JSSP, will allow oil company engineers to calculate or confirm the maximum allowable loads permitted over oil company facilities.

d. A site plan drawing designating the approved roadway crossings and haul routes for heavy equipment and materials crossing over oil company facilities. These locations shall be only at the locations pre-approved by the oil companies for proposed "maximum allowable loads". All areas not approved for crossing will be barricaded off and delineated to deny entry. Project plans shall be “redlined” to show “approved for heavy equipment” locations.

31-9 MINIMUM CONSIDERATIONS FOR PROTECTION OF HIGH RISK PIPELINES

a. Excavators must verify exact elevations/depth of cover of oil company facilities within the project area by excavating with hand tools. Oil company facilities are to be exposed by hand digging only, before using power-operated equipment, over or within pipeline easements operated or maintained by oil companies. Depth of cover data obtained during pothole surveys shall be, and shall remain, the proprietary and confidential property of the respective oil company. Contractors may use data obtained for the sole purpose of assisting with design of the project, to determine proper excavation techniques and construction requirements, to protect pipelines in place during project activity over or near oil company facilities, and for preventing unauthorized or illegal encroachment of such facilities.

b. Oil company facilities must be protected from hazards causing pipelines to move or sustain abnormal loads, or excess localized stress and potential pipeline rupture. Anticipated external loads over or near oil company facilities must be provided for, both during construction and upon completion of approved improvements. Depth of cover data must be obtained for calculation of safe load bearing factors which shall be determined before deployment of heavy equipment or placement of load-bearing structures over oil company pipelines is allowed.

c. Final depth of cover over oil company facilities must meet requirements for the expected maximum load application, as approved by oil company engineering and/or technical services departments. Adequate ground cover is critical for maintaining safe
pipeline operations. Existing cover over oil company lines is to be field verified by the Contractor under observation of the assigned oil company facilities inspector.

d. Specific details of proposed utilities crossing oil company pipelines shall be planned in advance with the owning oil company. Installation of utility crossings must be placed below oil company facilities and shall provide 24 inches clearance, if feasible. In no case shall clearance be less than 12 inches. Only lateral service crossings are permitted within oil company easements. Parallel utilities are not allowed.

e. Oil company facilities are cathodically protected. In the event that proposed improvements in the oil company right-of-way requires the use of metallic pipes or structures, it is absolutely necessary that arrangements be made for the protection of oil company facilities in order to prevent problems of electrical interference upon the pipelines.

f. Proposed backfill material must provide pipe support and protection for any pipe coatings. Only rock free native soil, clean sand, or zero sack slurry may be used as backfill material. No cement slurry will be allowed within 24 inches of oil company pipelines.

g. Grade design must provide adequate protective soil cover allowing pipelines to withstand dynamic forces exerted by anticipated traffic loads, during and upon completion of construction activity.

h. Equipment lists specifying fully loaded gross vehicle weights must be provided to confirm that maximum allowable loads will not apply excessive loads or abnormal bearing forces that may cause pipelines to move, rupture or sustain mechanical damage.

i. Proposed grade changes must be approved by oil company facilities representatives and engineering or technical services. Excessive fill will not be permitted over oil company facilities. Changes to existing pipeline cover within 50 feet of any oil company pipeline will require adjustment to insure a minimum of 48 inches cover above the pipelines.

j. To prevent undermining of proposed structures, and to allow for safe construction offset for future routine or emergency pipeline maintenance excavation access, structural improvements in the oil company right-of-way must provide for minimum safe construction offsets of:

1. A minimum of five (5) feet outside of right-of-way boundaries, or

2. A one and a half to one (1½ : 1) excavation angle of repose from the pipeline nearest to proposed structures, or

3. A dimension required by government code, whichever of items 1 through 3 is greater.

4. Field conditions preventing minimum safe offsets require minimum footing depths of 24 inches to 30 inches or more below the bottom of the deepest pipeline within the easement. In order to prevent stress in excess of maximum allowable loads to the pipelines, footings must ensure that the angle load influence miss underground
pipelines. In no case will the face of footings be permitted with less than 36 inches horizontal clearance from the pipeline nearest the proposed structural footings.

k. The right-of-way must be securely maintained with clear, unobstructed, routine maintenance excavation access and emergency ingress and egress at all times, during, and upon completion of, construction improvements.

l. The Contractor shall utilize high visibility barricades or K-Rail barriers, as described in Section 27, Construction Barricades, Fencing, Markers and Signs, of the types as shown on the plans, to field delineate oil facilities. Markers shall include delineation of the right-of-way boundaries and pipeline alignment as shown on project design plans.

m. A preliminary pre-job safety orientation meeting with oil company facilities inspectors, project superintendents and excavation contractor crews shall be held prior to the start of construction. To ensure that Contractor employees and subcontractors are aware of proper actions to follow in the event pipelines are damaged or ruptured and fuel or oil is potentially released, protective measures and emergency response procedures which are presented in the JSSP will be reviewed with all affected project employees at all project safety meetings.

n. Representatives from the Owner, the Contractor, and the oil companies will conduct "tail gate" safety meetings before each new work period and after any new equipment operator turnover.

31-10 MINIMUM FACILITIES INSPECTION REQUIREMENTS

a. An oil company representative for the affected pipeline must be present whenever Contractors are potholing or working over or near oil company facilities.

b. The Contractor shall notify all affected oil company inspectors at the numbers listed below, and Underground Service Alert at (800) 227-2600 a minimum of 2 to 14 working days prior to any on-site work. Oil company contacts are:

**Chevron:**
Gerald McClellan
16301 Trojan Way
Bldg. R01/B561
La Mirada, CA 90638
Ph: 714-228-1530
Cell: 714-228-1503

Mike Roberts
16301 Trojan Way
La Mirada, CA 90638
Ph: 714-228-1530

**ExxonMobil:**
Dave Kingston
12851 E. 166th St. Room 123
Cerritos, CA 90703
Office: 310-212-1768
Cell: 310-968-1180
31-11 APPLICABLE FEDERAL, STATE AND LOCAL REQUIREMENTS

Failure to comply with requirements of Pipeline Safety Laws, or other applicable Federal, State or Local laws or regulations, will subject the Contractor to liability for any damage incurred to oil company facilities during excavation or construction operations. Civil and/or criminal penalties may result from failure to comply.

31-12 LOAD BEARING CAPACITY GUIDELINES FOR PIPELINES

The Contractor shall use the information contained in Table 1 and Figure 1 as guidelines for planning his proposed equipment, operations, and improvements within the oil company right-of-way. Final approval of the adequacy of protection remains with the individual oil companies.

31-13 SAMPLE EQUIPMENT FORM

Table 2, on page 31-12 presents a sample of an acceptable Vehicle / Equipment form for inclusion in the JSSP.

31-14 SUBMITTALS . Submittals required for this item include, but are not limited to:

a. JSSP Job Site Safety Plan
b. Proposed Equipment List
c. Fuel line profiles

31-15 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Requirements outlined in this Section will not be measured for payment, but will be considered incidental to the respective work items. Potholing to determine exact location of oil lines will be paid for separately.
No separate payment will be made for constructing the item under construction sequencing restrictions, including limited access or nighttime work areas.
### Table 1. LOAD BEARING CAPACITY GUIDELINES FOR PIPELINES

<table>
<thead>
<tr>
<th>Coverage Over the Top of the Pipe</th>
<th>4-inch pipe</th>
<th>6-inch pipe</th>
<th>8-inch pipe</th>
<th>10-inch pipe</th>
<th>12-inch pipe</th>
<th>18-inch pipe</th>
<th>20-inch pipe</th>
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<td>inches</td>
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<td>15,000</td>
<td>11,000</td>
<td>9,000</td>
<td>7,000</td>
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<td>42,000</td>
<td>29,000</td>
<td>23,000</td>
<td>20,000</td>
<td>11,000</td>
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<tr>
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<td>106,000</td>
<td>60,000</td>
<td>42,000</td>
<td>32,000</td>
<td>27,000</td>
<td>14,000</td>
<td>10,500</td>
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<td>82,000</td>
<td>56,000</td>
<td>43,000</td>
<td>35,000</td>
<td>17,000</td>
<td>12,000</td>
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<td>106,000</td>
<td>72,000</td>
<td>54,000</td>
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<td>136,000</td>
<td>90,000</td>
<td>67,000</td>
<td>53,000</td>
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<td>109,000</td>
<td>80,000</td>
<td>62,000</td>
<td>22,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Assumptions:

1. Grade-B pipe strength
2. Lap Weld Joints
3. Schedule 10 pipe wall thickness
4. Vehicle has 4 wheels
5. Weight includes vehicle-driver-cargo-fuel
6. Weight does not include dynamic forces of a moving vehicle over rough terrain
7. Analysis performed with the typical 1.25 factor of safety
8. Internal pipe pressure = 0-psi
Figure 1

Load Capacity on Pipelines

Coverage Over the Pipe (inches)

Maximum Allowable Vehicle Weight (#)

4-inch pipe
6-inch pipe
8-inch pipe
10-inch pipe
12-inch pipe
18-inch pipe
20-inch pipe

Oil Company Right-of-Way / Easement Requirements
### TABLE 2. PROPOSED EQUIPMENT LIST CROSSING OIL COMPANY PIPELINES

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Make/Model</th>
<th>Gross Wt (lbs)</th>
<th>Downward Pressure (psi)</th>
<th>Bucket Size (cu yds)</th>
<th>Rubber Tires (# of tires)</th>
<th>Track Mount (Width &amp; Length)</th>
<th>Submitted by:</th>
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END OF SECTION 31
SECTION 39 – PRECONSTRUCTION VIDEO

39-1 GENERAL

39-1.1 PRE-CONSTRUCTION RECORDABLE DISCS

   a. Before starting construction, record video of the construction site, Contractor's Staging and Laydown Area, haul routes and access gates, and all surrounding properties from various viewpoints selected by the Engineer. Record pre-existing conditions at each location and abutting properties obtained from several perspectives. Provide audio narrative describing the vantage point and area being recorded.

      1. Take videos in sufficient number to show existing conditions adjacent to the property before starting work.

      2. Take videos of existing improvement adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.

      3. Contractor to show conditions of existing PCC to remain, existing AC, haul routes, and any other features that may be relevant during construction.

      4. Provide lighting suitable to the Engineer for any required nighttime recording.

39-2 SUBMITTALS

   a. Submit two Recordable Discs (CD-R, DVD ± R) of the recordings prior to the commencement of any work. Video format shall be compatible with the latest release of Windows operating system; resolution shall be high definition; 1080P or approved equal. The discs shall be approved by the Engineer prior to the commencement of construction activity.

39-3 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

No separate payment will be made for preconstruction video. The cost of performing this item shall be considered incidental to other items of work and no additional payment will be made.

END OF SECTION 39
INTENTIONALLY LEFT BLANK
SECTION 41 – EARTHWORK (FAA P-152)

41-1 GENERAL. This item covers excavation, grading, disposal, placement, subgrade preparation, application of soil sterilant, and compaction of all earthwork materials within the limits shown on the plans and constructed in accordance with FAA Specification, Item P-152, as included and modified hereafter.

For subgrade preparation areas identified on the plans, subgrade preparation shall be performed as required below. Subgrade preparation shall consist of grading, forming, scarifying, watering or aerating, and compacting, as specified below, or as indicated on the Plans.

This section also covers the procedures required in the event that earthwork operations encounter contaminated or suspected contaminated soils.

Quantities of Asphalt or Portland Cement Concrete pavement, or Asphalt or Cement-treated base course to be removed prior to earthwork operations shall be measured and paid under applicable portions of Specification Section 23 of these Specifications, Removals. All underlying unbound base, subbase, filter fabric and subgrade materials under pavements requiring removal shall be measured and paid as Unclassified Excavation under this Section.

The Contractor should refer to the project geotechnical reports, Subsurface Data, and should review the soil boring logs shown on the plans.

The Contractor is required to perform all Grade and Smoothness Testing under this Section, witness by the Engineer. LAWA will perform all Density Testing under this Section.

41-2 DEFECTIVE WORK Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

41-3 RELATED SECTIONS

a. Section 23 – Removals

b. Section 29 – Nuclear Gauges (FAA 120)

c. Section 30 – Temporary Air and Water Pollution, Soil Erosion and Siltation Control (FAA P-156)

d. Section 57 – Processed Miscellaneous Base (PMB)

e. Other Sections, Tests, Specifications, and Standards referenced herein.

41-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.
ITEM P-152 EXCAVATION AND EMBANKMENT

152-1 DESCRIPTION

152-1.1 GENERAL. This item covers excavation, disposal, stockpile construction, placement, and compaction of all subsurface materials within the limits of the work required to construct safety areas, runways, taxiways, aprons and intermediate areas. It also covers areas for drainage, building construction, parking, or other purposes shown on the plans. Work shall be completed in accordance with these specifications and in conformity to the dimensions and typical section(s) shown on the plans.

152-1.2 CLASSIFICATION. Unless otherwise specified, all material excavated shall be considered to be Unclassified Excavation, as defined below:

a. Unclassified Excavation. Unclassified excavation shall consist of the excavation and disposal of all subsurface material, regardless of its nature, which is not otherwise classified and paid for under the following items. Contractor shall anticipate filter fabric or other geotextiles within the excavation limits and this will not constitute a basis for extra payment. Unclassified Excavation shall be further classified as follows:

(1) Unclassified Excavation for Embankment shall consist of excavation and re-use on-site as subgrade, embankment construction, and/or backfill material.

(2) Unclassified Excavation for Disposal shall consist of excavation and disposal off airport property.

(3) Unclassified Excavation for Existing Stockpiled Material shall consist of excavation and disposal off airport property of existing stockpiled materials identified on the plans.

b. Debris Excavation. Debris excavation shall consist of material excavated from areas shown on the drawings or identified by the Engineer. In the designated areas, the existing ground contains a significant quantity of large sized concrete and asphalt rubble from near the surface to unknown depths. The Contractor shall determine the method and equipment needed to achieve the excavation and grading in these areas.

c. Unsuitable Excavation. Any soft or yielding material at or below subgrade elevation identified by the Engineer and considered unsuitable for use in the subgrade.

All unsuitable excavation will become the property of the Contractor and shall be hauled off the Airport site, at the expense of the Contractor, to a suitably licensed facility. The Contractor shall conform to all Federal, State and Local laws and regulations regarding the removal, handling, and transport of unsuitable materials. The stipulation of Section 41-9
and 41-10 - shall apply regarding any materials the Contractor believes to be contaminated soil or hazardous materials. The Contractor shall provide documentary evidence of legal disposal of all unsuitable materials.

d. **Select / Suitable Material.** When “select material”, or “certified material”, is specified on the plans, the more suitable material as designated by the Engineer shall be used in constructing the embankment, in structure backfilling, or in capping the pavement subgrade. These selective materials shall be of the following quality, unless otherwise approved by the Engineer:

  (1) Maximum Size: 3 inch
  (2) Maximum Percent Passing #200 Sieve: 25%
  (3) Maximum Liquid Limit (LL): 35
  (4) Maximum Plasticity Index (PI): 12

e. **Subgrade Preparation**

  (1) **Subgrade Preparation Type A.** Subgrade Preparation Type A shall consist of compaction of subgrade soils to the depth of 12” below the top of subgrade and compacted to 100% density measured per ASTM D 1557. Subgrade Preparation Type A will be measured and paid as a separate pay item.

  (2) **Subgrade Preparation Type B.** Subgrade Preparation Type B shall be in accordance with 41-7 and consists of minimizing disturbance of existing native subgrade soils after cutting to grade, and rolling to provide a smooth, uniform grade to the satisfaction of the Engineer. Subgrade Preparation Type B will be measured and paid as a separate pay item.

152-2 **CONSTRUCTION METHODS**

152-2.1 **GENERAL.** Before beginning excavation, grading, and embankment operations, existing unimproved areas shall be completely cleared, grubbed and stripped in accordance with Section 40, Item P-151, Clearing and Grubbing. The exposed surface shall then be surveyed in accordance with the requirements of PR-16.

The suitability of material to be placed in embankments shall be subject to approval by the Engineer. All unsuitable material, and any excess suitable material, shall be disposed of by the Contractor off airport property at a legal disposal site.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. At
the direction of the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Those areas outside of the pavement areas in which the top layer of soil material has become compacted by hauling or other activities of the Contractor shall be scarified and disked to a depth of 4 inches in order to loosen and pulverize the soil. This work shall be considered incidental, and no separate payment shall be made for this work.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for their protection and shall take all necessary precautions to preserve them or provide temporary services. The Contractor shall ensure that the requirements of Section 30, Temporary Air and Water Pollution, Soil Erosion and Siltation Control are met relative to surface drainage. When such facilities are encountered, the Contractor shall notify the Engineer, who shall arrange for their removal if necessary. The Contractor shall, at his own expense, satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

152-2.2 EXCAVATION. No excavation shall be started until the work has been staked out by the Contractor and until existing ground surface elevation information has been provided to, and approved by, the Engineer. All areas to be excavated shall be stripped of vegetation and topsoil in accordance with Section 40, prior to survey of the existing ground surface.

When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be disposed of by the Contractor off airport property.

During excavation, the grade shall be maintained so that the surface is well drained at all times. When necessary, temporary drains and drainage ditches shall be installed to intercept or divert surface water that may affect the work. The Contractor shall provide temporary pumps, piping and other equipment necessary for proper drainage. All costs associated with the surface drainage is considered to be incidental.

Prior to any embankment placement, the excavated surface shall be surveyed by the Contractor in accordance with the requirements PR-16 for determination of excavation quantities.

When the volume of excavation is not sufficient for constructing the fill to the grades indicated, the deficiency shall be obtained by the Contractor from areas outside the airport. This borrow material shall be paid for at the contract unit price per cubic yard for Unclassified Excavation for Embankment.

a. Selective Grading. When project earthwork results in an excess of excavated materials, selective grading shall be employed. The more
suitable material, as designated by the Engineer, shall be used in constructing the embankment, pipe or structure backfill, or in capping the pavement subgrade. If at the time of excavation it is not possible to place this material in its final location, it shall be stockpiled in approved areas. Stockpile areas shall be at the Contractor’s Staging Area, unless otherwise approved, in writing, by the Engineer. Material to be stockpiled will be measured for payment once, at the point of excavation.

b. **Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsuitable for safety areas, subgrades, roads, shoulders, or any areas intended for turfing shall be excavated to a minimum depth of 12 inches, or to the depth specified by the Engineer, below the subgrade. Muck, peat, matted roots, or other yielding material, unsuitable for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be legally disposed of off the Airport site. This excavated material shall be paid for at the contract unit price per cubic yard for Unsuitable Excavation. The excavated area shall be refilled with suitable material obtained from the grading operations and compacted to specified densities. The necessary refilling will constitute a part of the embankment and shall be paid for at the contract unit price per cubic yard for Unclassified Excavation for Embankment.

c. **Overbreak.** Overbreak, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the Engineer. The Engineer shall determine if the displacement of such material was unavoidable and his/her decision shall be final. All overbreak shall be graded or removed by the Contractor and disposed of as directed; however, payment will not be made for the removal and disposal of overbreak that the Engineer determines was avoidable. Unavoidable overbreak will be measured and paid as Unclassified Excavation.

d. **Removal of Utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor, e.g., the utility unless otherwise shown on the plans. All existing foundations shall be excavated for at least 2 feet below the top of subgrade or as indicated on the plans, and the material disposed of as directed. All foundations thus excavated shall be backfilled and with suitable material, as defined herein. See other requirements relative to utilities in Project Requirements - 7, Utilities.

e. **Compaction Requirements.** The subgrade under all areas to be excavated shall be compacted to 100% of the relative densities, at depth of 6” below the pavement section, unless otherwise noted or directed. For embankment areas, see 152-2.6. Maximum density shall be as determined by ASTM 1557. The material to be compacted shall
be within +/- 2 percent of optimum moisture content before rolling to obtain the prescribed compaction (except for expansive soils).

If nuclear density machines are to be used for density determination, the machines shall be calibrated in accordance with ASTM D 6938. The nuclear equipment shall be calibrated using blocks of materials with densities that extend through a range representative of the density of the proposed embankment material. See Section S29, Nuclear Gauges, for additional guidance with nuclear density testing.

Tests for conformance with moisture and density requirements shall be made before and after compaction for every 1,000 cubic yards of compacted subgrade layer. Maximum compacted layer thickness shall be as defined in 152-2.6.

The in-place field density shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. Stones or rock fragments larger than 3 inches in their greatest dimension will not be permitted in the top 6 inches of the subgrade. The finished grading operations, conforming to the typical cross section, shall be completed and maintained at least 1,000 feet ahead of the paving operations or as directed by the Engineer.

All loose or protruding rocks on the back slopes shall be pried loose or otherwise removed to the slope finished grade line. All cut-and-fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the plans or as directed by the Engineer.

f. **Blasting.** Blasting will not be permitted.

g. **Proof Rolling.** After compaction is completed, the subgrade shall be proof-rolled in the presence of the Engineer. Proof rolling, except for areas identified as “Subgrade Preparation Type B” shall be performed with a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 30,000 pounds (13.6 metric tons) and inflated to a minimum of 125 psi (0.861 MPa). Apply a minimum of three coverages, or as specified by the Engineer, to all areas to be paved. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch (25 mm) or show permanent deformation greater than 1 inch (25 mm) shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications.

152-2.3 **BORROW EXCAVATION.** Not Used

152-2.4 **DEBRIS EXCAVATION.** Excavation areas containing a significant quantity of large sized concrete and asphalt rubble, and identified by
the Engineer, shall be designated as Debris Excavation. The Contractor is responsible for using whatever means required to excavate the area to the depth and grades shown on the drawings. The volume of material excavated and designated as Debris Excavation, including asphalt and concrete debris, and non-debris material shall become the property of the Contractor and shall be hauled and disposed of off airport property.

a. Debris Excavation shall be limited to the extent necessary to complete removals of debris encountered, or as directed by the Engineer.

b. Where Debris Excavation is required, the excavation shall be limited to the extent possible the volume required to remove the debris and avoid excavation of underlying natural soils or intervening soil layers within the debris areas that are visually free of waste.

c. At the direction of Engineer, the debris exposed on the perimeter of the excavation may be left in place.

d. The Contractor will be compensated for debris disposal off airport property in accordance with Contract Unit Price Item 46 – Debris Excavation for Disposal. Measurement shall be based upon tonnage of unsuitable material hauled off site and documentation of legal disposal.

e. All debris excavation shall be performed in presence of Engineer in order to be eligible for payment under this item.

f. Where debris removal is required, the excavation shall not be extended beyond 1-foot below the bottom of debris, or as directed by LAWA.

g. Excavated debris that is visually free of draining water may be directly loaded into haul units for transportation to the legal disposal facility. Visually saturated debris that contains freely draining water shall be allowed to dry prior to hauling.

h. Contractor shall maintain excavations in a manner that will allow safe and easy access for the Engineer to collect confirmation samples and surveyor to survey the bottom of the completed excavation areas.

i. Engineer shall determine the type and size of construction debris which may remain in place.

j. Concrete and asphalt construction debris may be segregated and recycled, at the Contractor’s option.

152-2.5 PREPARATION OF SUBGRADE AND EMBANKMENT (FILL) AREAS. In all areas to be paved, unless otherwise noted or directed, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed in accordance with Section 40, Clearing, Grubbing and Stripping, and the cleared surface shall be completely broken up by plowing or scarifying to the depth shown on the plans, or to a minimum depth of 12 inches. This area

Earthwork
shall then be graded, shaped, watered, and re-compacted as indicated in paragraph 152-2.6.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches (300 mm) and compacted as specified for the adjacent fill. Where embankments are to be placed on natural slopes steeper than 3 to 1, horizontal benches shall be constructed as directed by the Engineer.

The necessary removals, and the quantity of excavation removed will be paid for under the respective items of work.

152-2.6 FORMATION OF EMBANKMENTS. Embankments shall be formed in successive horizontal layers of not more than 8 inches in loose depth for the full width of the cross section, unless otherwise approved by the Engineer.

The grading operations shall be conducted, and the various soil strata shall be placed, to produce a soil structure as shown on the typical cross section or as directed. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage.

The material in the layer shall be within +/-2 percent of optimum moisture content before rolling to obtain the prescribed compaction. To achieve a uniform moisture content throughout the layer, the material shall be moistened or aerated as necessary. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken for each 1,000 cubic yards of material placed per layer. Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

If nuclear density machines are to be used for density determination, the machines shall be calibrated in accordance with ASTM D 6938.

Rolling operations shall be continued until the embankment is compacted to not less than 95% of maximum density for noncohesive soils, and 90% of maximum density for cohesive soils as determined by ASTM D 1557. Under all areas to be paved, the embankments shall be compacted to the densities, at depth, shown in Table 1.
TABLE 1 – SUBGRADE COMPACATION FOR EMBANKMENT

<table>
<thead>
<tr>
<th>Depth/% Compaction Subgrade Soils</th>
<th>Percent Compaction per ASTM D 1557</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Cohesive Soils (PI &gt; 3)</td>
</tr>
<tr>
<td></td>
<td>Cohesive Soils (PI ≤ 3)</td>
</tr>
<tr>
<td>100% 95% 90% 85%</td>
<td>95% 90% 85% 80%</td>
</tr>
<tr>
<td>25” 25”-44” 44”-64” 64”-81”</td>
<td>10” 10”-20” 20”-29” 29”-38”</td>
</tr>
</tbody>
</table>

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches.

The in-place field density shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM 6938 using Procedure A, the direct transmission method. Contractor shall perform quality control testing to ensure proper installation. Once passing quality control, the Contractor shall coordinate with inspection and the Engineer. Final approval of the material will be based on quality assurance testing completed by the Engineer.

Compaction areas shall be kept separate, and no layer shall be covered by another layer until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each layer is placed. Layer placement shall begin in the deepest portion of the fill; as placement progresses, layers shall be constructed approximately parallel to the finished pavement grade line.

When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portion of the embankment and the other material shall be incorporated under the future paved areas. Stones or fragmentary rock larger than 3 inches in their greatest dimensions will not be allowed in the top 6 inches of the subgrade. Rockfill shall be brought up in layers as specified or as directed and every effort shall be exerted to fill the voids with the finer material forming a dense, compact mass. Rock or boulders shall not be disposed of outside the excavation or embankment areas, except at places and in the manner designated by the Engineer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in layers not exceeding 2 feet in thickness. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of rock. These type lifts shall not be constructed above an elevation 4 feet below the finished subgrade. Density requirements as outlined herein will not apply to portions of embankments constructed of materials which cannot be tested in accordance
with specified methods. However compaction efforts shall be sufficient to minimize large voids and shall be subject to the approval of the Engineer.

When the excavated material consists predominantly of sand, the Contractor may, at its expense, add a blend of finely-graded material to the excavated sand material for placement and compaction on fill areas.

There will be no separate measurement of payment for compacted embankment, and all costs related to placing excavated materials in layers, compacting, diskng, watering, mixing, sloping, proof-rolling, maintaining drainage and other necessary operations for construction of embankments will be included in the contract price for Unclassified Excavation.

There will be no separate measurement for payment for stockpile formation or for disposal of excavated material off airport property. All costs for stockpile placement, shaping, formation, compaction, drainage maintenance, and legal disposal shall be considered incidental to the contract price for Unclassified Excavation.

152-2.7 FINISHING AND PROTECTION OF SUBGRADE. After the subgrade has been substantially completed the full width shall be conditioned by removing any soft or other unstable material that will not compact properly. The resulting areas and all other low areas, holes or depressions shall be brought to grade with suitable select material. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans. Compaction shall be in accordance with 152-2.6, Table 1, unless otherwise indicated or directed.

Grading of the subgrade shall be performed so that it will drain readily. The Contractor shall take all precautions necessary to protect the subgrade from damage. He/she shall limit hauling over the finished subgrade to that which is essential for construction purposes.

All ruts or rough places that develop in a completed subgrade shall be smoothed and recompacted.

No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been approved by the Engineer, and the finished surface has been surveyed by the Contractor in accordance with the requirements of PR-16.

152-2.8 HAUL. All hauling will be considered a necessary and incidental part of the work. Its cost shall be considered by the Contractor and included in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

152-2.9 TOLERANCES. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 16-foot straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 1/2-inch, or shall not be more than 0.05-foot from true grade as established by grade hubs or pins. Any
deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recomping by sprinkling and rolling. The Contractor shall perform the smoothness and grade test in the Engineer’s presence and provide the test results upon completion to the Engineer for acceptance.

On safety areas, intermediate and other designated areas, the surface shall be of such smoothness that it will not vary more than 0.10 foot from true grade as established by grade hubs. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

152-2.10 TOPSOIL. Not Used.

152-3 METHOD OF MEASUREMENT. See 41-11.

152-4 BASIS OF PAYMENT. See 41-11.

152-5 TESTING REQUIREMENTS

<table>
<thead>
<tr>
<th>ASTM D 1556</th>
<th>Test for Density of Soil In Place by the Sand-Cone Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D 1557</td>
<td>Test for Laboratory Compaction Characteristics of Soil Using Modified Effort</td>
</tr>
<tr>
<td>ASTM D 2167</td>
<td>Test for Density and Unit Weight of Soil In Place by the Rubber Balloon Method.</td>
</tr>
<tr>
<td>ASTM D 6938</td>
<td>Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods</td>
</tr>
</tbody>
</table>

END OF ITEM P-152

41-5 SOIL STERILANT. Under all areas of asphalt pavement construction, the Contractor shall apply an approved commercial pre-emergent soil sterilant: Round-Up ProMax or approved equal. Sterilant shall be applied after grading and compaction operations on the subgrade are completed, and prior to proceeding with pavement construction. Soil sterilant shall be applied at the rates and in the manner recommended by the manufacturer, but no less than 4 ounces of sterilant per gallon of fluid. Soil sterilant and placement will not be measured separately for payment but will be considered incidental to the pavement construction and no separate payment will be made.

41-6 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Quality Testing for
   1. Select/Suitable Material
b. Proof of legal disposal
c. Soil Sterilant

41-7 SUBGRADE PREPARATION TYPE B

In specific areas identified on the plans or designated as Subgrade Preparation Type B, the subgrade shall be cut to grade with a minimum of disturbance, and the subgrade shall be compacted and proof-rolled to demonstrate, as witnessed by and to the satisfaction of the Engineer, that the grade is of uniform consistency and that there are no soft or yielding areas. The compaction requirements of paragraph 152-2-2.e will not be enforced within areas identified as Subgrade Preparation Type B.

Proof-rolling shall be performed by the Contractor with a large, smooth steel wheel non-vibratory roller with a gross weight of at least 10 tons. Operate roller at walking speed, or between 2 ½ and 5 miles per hour as directed by the Engineer. Adjust speed to minimize deflections, ruts and surface irregularities. Subgrade shall be proof-rolled with at least two passes. After the first pass, the second pass shall be offset from the first by ½ the width of roller drum width to completely cover the subgrade area. Operate the roller in a pattern to readily allow recording the number of passes. After proof-rolling, re-check the subgrade for conformance to the plans, and correct any surface irregularities to the satisfaction of the Engineer.

41-8 REMOVE AND REPLACE SUBGRADE/SUBGRADE IMPROVEMENTS

Although the project is designed for the predominant soils, the Contractor shall be prepared to remove and replace isolated pockets of unacceptable subgrade materials should they be found on the project. Based on the historical geotechnical investigations, areas where isolated pockets of sensitive clays, poorly graded sands and sand with a very low angle of internal friction, have been found west of Sepulveda Blvd.

After completion of subgrade preparation improvements, The Contractor shall advise the Engineer in the event soft, spongy, or unstable materials are found. Within the limits identified and approved by the Engineer, these materials shall be removed and replaced as shown on the drawings, or as directed by the Engineer. After unsuitable excavation is completed, one layer of subgrade stabilization fabric, conforming to the requirements of Section 84, Geotextiles, shall be placed and the excavation shall be filled with material conforming to Section 57, Processed Miscellaneous Base (PMB). Material shall be placed and compacted in layers not to exceed 6 inches in thickness. Material shall be compacted to relative density at depth as outlined in 152-2.6, Table 1 of this section.

All excavation, fabric placement, and PMB backfill associated with subgrade improvements will be paid as either “Subgrade Improvement – Small”, or “Subgrade Improvement – Large” as described in PR-4 of these Specifications. All work shall be pre-approved by the Engineer in order to be eligible for payment under this item.

41-9 PROCEDURE FOR THE MANAGEMENT OF CONTAMINATED MATERIALS ENCOUNTERED DURING CONSTRUCTION

Trained personnel shall be present on site to initiate spill response and to contact the proper regulatory agencies in the event of encountering contaminated soils. The citation and
qualifications of such personnel must be included in the Contractors site’s Health and Safety Plan.

In the case of any spill or discovery of unknown contamination, especially when odors or fumes are detected from such onsite material, the Contractor shall contact the LAX Fire Department at (310) 646-5000. For active fuel release, stopping the spill at the source shall be a priority.

No Contractor may introduce chemicals to an LAWA airport site without prior approval from the Engineer. In case of such approval, Contractor shall provide complete Material Safety Data Sheets (MSDS) to the Engineer.

The Contractor shall plan their activities so that parallel activities can be scheduled while any contamination is investigated and/or remediated so that the overall project’s schedule is not affected.

41-10 CONTAMINATED SOIL TESTING, REMOVAL, AND DISPOSAL

41-10.1 Summary. This section covers the procedures required in the event that earthwork operations encounter potentially impacted soils and impacted soils that may result in regulated waste, hazardous waste or VOC Contaminated Soils; in particular, soil that has been impacted by petroleum products (i.e., fuels). This section also includes minimum requirements for removal and disposal of such soils.

41-10.2 References. California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA)

41-10.3 Scope of Work. The scope of work includes the identification, testing, screening, excavation, segregation, waste minimization, handling, stockpiling, transportation, characterization, and disposal of impacted soils that may result in regulated waste, hazardous waste or VOC Contaminated Soils, as may be encountered at the Los Angeles International Airport during site earthwork or any other construction activities. In the event soils or other materials are encountered and are known or suspected to be contaminated or hazardous for reasons other than being impacted by petroleum hydrocarbons (i.e., asbestos containing materials, solvents, chemically treated wood, etc.), a separate scope of work specific to the particular soils/materials encountered will be defined separately.

41-10.4 Procedure for the Management of Petroleum-Impacted Soil Encountered During Construction. Details regarding the identification, testing, screening, excavation, segregation, waste minimization, handling, stockpiling, transportation, characterization, and disposal of impacted soils that may result in regulated waste, hazardous waste or VOC Contaminated and other impacted soil will be identified in the Contractor submittal; Hazardous Materials Management Plan (HMMP), based on the guidance provided below. Procedures for managing impacted soil will comply with all regulatory requirements and other requirements for work performed at LAWA. HMMP shall be submitted and approved before construction begins.

When required by permit and regulation; excavation of soils impacted or potentially impacted by Volatile Organic Compounds (VOCs) shall be performed in accordance with requirements of the South Coast Air Quality Management District Rule 1166, such as in the case when excavation or grading is undertaken in areas where the use, storage, or transfer (piping) of volatile organic
compound (VOC) materials, including fuels, has occurred, where previous investigation indicates the presence of VOCs, or where visual or olfactory observation of soils impacted or potentially impacted by VOCs occurs during excavation or grading.

Contractor will provide personnel qualified to identify potentially impacted soil and shall also have trained personnel present on site to initiate spill response and to make notifications required by LAWA and regulatory agencies in the event of encountering contaminated soils. The citation and qualifications of such personnel must be included in the Contractor's Site Specific Health and Safety Plan, and HMMP to be provided as a Submittal.

In the case of any fuel spill or discovery of uncontained free product (raw fuel in liquid state) within the excavation, especially when strong odors or fumes are detected from such material, Contractor shall contact the Engineer and shall also contact the Los Angeles Fire Department (LAFD). The LAFD representative at LAX is Inspector Braxton Clark. Inspector Clark can be contacted in his office 424/646-6497 or via his cell phone 213/359-8053. For active fuel release, safely stopping the spill at the source shall be a priority.

Contractor shall stop excavation in the location and immediately notify the Engineer of any observance or occurrences of soil contamination. Note: If only evidence of soil contamination is observed, but there is no standing/pooled free product, only the Engineer needs to be notified; if there is soil contamination and/or standing/pooled free product present, both the Engineer and the LAFD Inspector need to be contacted.

Contractor shall not introduce chemicals to an LAWA airport site without prior approval from the Engineer. In case of such approval, Contractor shall provide complete Material Safety Data Sheets (MSDS) to the Engineer.

Contractor shall plan their activities so that parallel activities can continue in other areas of the project site while any contamination is investigated and/or remediated so that the overall project’s schedule is minimized.

Removal of VOC Contaminated Soil shall be in conformance with applicable federal, state, and local regulations, including, but not limited to, South Coast Air Quality Management District (SCAQMD).

Contractor shall quantify all potentially contaminated soil by the cubic yard (CY) for testing, documentation, excavation, stockpiling, re-use and removal from airport property, as identified in the Contract Documents, and per regulatory requirements.

As will be specified in the Contractor’s HMMP, the Contractor shall provide, at the end of the construction project, a “Contaminated Soil and Hazardous Material Management Report” that details the characterization and disposition of all contaminated soils and hazardous material removed from the project site. Report shall include at minimum the following sections:

1. Identification of Contractors, subcontractors, test labs, disposal sites and associated contract responsibilities;
2. Soil management approach;
3. Soil sampling and analyses;
4. Soil disposition for the several “phase” areas of earthwork;

5. Other tasks.

41-10.5 Petroleum Impacted Soil Testing.

a. General. Oil company pipelines, above and below ground fuel tanks, and pipelines for the various fuel delivery systems are known to exist on the airport. The locations of these pipelines have been identified on the plans, to the best of LAWA’s knowledge, in order to avoid accidental damage. Locations of soils known or suspected to be impacted by petroleum hydrocarbons are shown on the plans, to the extent known by Engineer. The Contractor shall contract with an environmental consultant (i.e., a professional consultant/firm qualified and experienced in the assessment, management, and handling of non-designated/non-hazardous contaminated soils/materials as well as hazardous soils/materials) capable of soils testing to further assess the nature and geographic extent of such soils occurring within the project area, if and as necessary to formulate a grading approach and schedule that will avoid unnecessary interruptions or delays due to special handling requirements of impacted soils, as further described below. The Contractor’s environmental consultant shall also be available to assess soils known or suspected as being impacted by VOCs or contaminants that are unexpectedly encountered during site grading and excavation.

Additionally, the Contractor, or Subcontractor(s) to the Contractor, shall have experience in complying with all aspects of SCAQMD Rule 1166 including, but not limited to, the ability to expeditiously obtain approval from SCAQMD for a Rule 1166 Various Locations Mitigation Plan or Rule 1166 Site Specific Mitigation Plan. It is the Contractor’s responsibility for complying with all requirements of SCAQMD Rule 1166 without interruption or delay in the project schedule.

The Contractor shall exercise care in the event that soils known or suspected as being impacted by VOCs or contaminants are encountered during excavation of soil in in all areas of the project.

All work associated with impacted soil treatment/remediation shall be pre-approved by the Engineer in order to be eligible for payment under this item, and shall also be in accordance with Project Requirements PR-18 Environmental Mitigation Requirements and Special Construction.

b. Identification and Screening. The monitoring for, and identification and screening of, soils for the presence of VOC materials will be based on whether such materials are known or suspected to be present within the specific area of excavation/grading, based on previous soil investigations, or is in an area subject to the requirements of SCAQMD Rule 1166 (i.e., when excavation or grading is undertaken in areas where the use, storage, or transfer (piping) of VOC materials, including fuels, has occurred), investigation has determined there is a potential for VOCs at or above the SCAQMD lower limit, or where visual or olfactory observation of soils impacted or potentially impacted by petroleum products or other VOC materials occurs during excavation or grading. Unless there is specific knowledge or observation of, or good reason to believe the presence of, soils/materials impacted by petroleum products or other VOC
material, the monitoring, identification, and screening requirements described below do not apply.

Petroleum impacted soils may be identified by characteristic odor (i.e., a moderate to strong hydrocarbon odor, or other strong or unusual odors) and/or dark gray to black or greenish staining of the soil. The measurement of VOC levels near excavated soils using a photoionization detector (PID), measured within three inches of the excavated soils, within three minutes after being excavated) can also determine the presence of impacted soils. If petroleum impacted soils are found or suspected to be present, the measured VOC levels provide the basis for screening and preliminary characterization of the excavated soils, as follows:

**PID Reading of > 50 parts per million (ppm):** This excavated material is considered under SCAQMD Rule 1166 to be “Contaminated” and must be treated/disposed of within 30 days of excavation. Contaminated soil is subject to special handling requirements set forth in Sections 42-3.2.3 and 42-3.2.4 below.

**PID Reading of between 1 ppm and 50 ppm:** This excavated material is not contaminated pursuant to SCAQMD Rule 1166, but is considered by LAWA to be “Non-Contaminated but Impacted” and is subject to special handling requirements set forth in Section 42-3.2.3 below.

**PID Reading of less than 1 ppm (and no visual or olfactory sign of being VOC-impacted):** This excavated material is considered to be neither contaminated nor impacted, and is not subject to any special requirements for handling, reuse, or disposal (i.e., Unrestricted).

c. Handling of Contaminated and Non-Contaminated/Impacted Soil

The following table summarizes the special handling requirements associated with Contaminated and Non-Contaminated/Impacted Soils.

<table>
<thead>
<tr>
<th>Soil Category</th>
<th>PID Reading</th>
<th>Handling Requirements</th>
</tr>
</thead>
</table>
| Contaminated        | >50 ppm     | • Manage soil in accordance with the Contractor’s HMMP, SCAQMD Rule 1166 Mitigation Plan, and Project Storm Water Pollution Prevention Plan (SWPPP).  
|                     |             | • Spray with water or approved vapor suppressant prior to transport.                  |
|                     |             | • Segregate and transport to contaminated stockpile area designated by Engineer       |
|                     |             | • Conduct characterization as related to the soil disposition-See Section 42-3.2.4 below. |
|                     |             | • Immediately transport to approved treatment, storage, and disposal facility (TSDF) – see Section 42-3.2.4 below. |
|                     |             | • Contaminated soil must be removed from the Site within 30 days of excavation.      |
| Contaminated        | >1,000 ppm  | • Manage soil in accordance with Contractor’s HMMP, SCAQMD Rule 1166 Mitigation Plan, and SWPPP.  
|                     |             | • Immediately spray soil and work area with water or approved                          |
Earthwork  Page 41-17

<table>
<thead>
<tr>
<th>Soil Category</th>
<th>PID Reading</th>
<th>Handling Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>vapor suppressant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Place soil in SCAQMD-approved containers with vapor-tight lids, OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Load directly into trucks, spray with vapor suppressant, conduct characterization as related to soil disposition, and transport immediately off-site to approved TSDF - see Section 42-3.2.4 below.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Notify SCAQMD within one hour of detection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Contaminated soil must be removed from the Site</td>
</tr>
<tr>
<td>Non-Contaminated</td>
<td>&gt;1 ppm - &lt;50ppm</td>
<td>• Manage soil in accordance with requirements of SWPPP.</td>
</tr>
<tr>
<td>Impacted</td>
<td></td>
<td>• Coordinate with LAWA for characterization and reuse or disposal – see Section 42-3.2.8 below.</td>
</tr>
<tr>
<td>Unrestricted</td>
<td>&lt;1 ppm and no visual or olfactory sign of potential VOCs</td>
<td>• Manage soil in accordance with requirements of SWPPP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If Contractor takes soil samples on his/her own accord, provide copy of laboratory analysis results to LAWA.</td>
</tr>
</tbody>
</table>

d. Disposition of Contaminated Soil.

The Contractor shall conform to all local, state, and federal laws and regulations regarding the removal, handling, and transport of contaminated materials. The Contractor shall provide LAWA documentary evidence (manifests) of legal disposal of all unsuitable-for-reuse materials. All costs associated with contaminated soil testing, excavation, transportation, remediation/recycling, and disposal shall be included in the payment under the Bid Item, and shall be in accordance with Project Requirements PR-4.

The Contractor will propose a disposal/recycle method and facility/location for disposal of soils. Acceptance of Contractor’s proposed disposal/recycle method and facility is subject to review and approval of Engineer.

e. Soil Disposal and Reuse. Soil will be disposed of, recycled, or reused in accordance with the Contractor HMMP, regulatory requirements and as directed by LAWA. Contaminated Soil, as defined in the table above, will be sampled in accordance with the proposed TSDF or other intended recipient. For example, Soil Safe’s typical sampling requirements as of November 2013 are: “Unless otherwise noted, composite samples should be collected with the following frequency: 1 sample for 100 cubic yards (cy) or less; 3 samples for 500 cy; 5 samples for 1000 cy and 1 additional sample for each additional 500 cy greater than 1000 cy.”. Such sampling and soil characterization shall occur prior to transport for disposal, recycle or reuse. Disposal facilities, including recycling facilities, establish their own criteria for acceptance of these materials and typically provide them to the Contractor on request. The Contractor is responsible to
determine facility-specific acceptance criteria and the laboratory testing methods necessary to meet those criteria. Procedures include but are not limited to;

1. sample and analyze samples at a qualified laboratory;

2. prior to submitting results of analysis to the disposal/recycling facility; the Contractor will request a temporary EPA Identification Number from the LAWA Environmental Monitor;
   - LAWA can typically provide an EPA ID number in one business day.
   - Temporary EPA ID numbers are valid for 90 days from date of issue to LAWA.

3. submit analytical results to the disposal/recycle facility to obtain a waste profile;

4. obtain required profiles (from the disposal facility);

5. obtain manifests/bill of ladings (from the disposal facility);

6. provide other documents required for transportation and disposal, recycle or reuse of soil for all VOC Contaminated and Non-Contaminated soils.

The Contractor will submit waste profiles to the LAWA Environmental Monitor for review. The Environmental Monitor will forward profiles to the LAWA Environmental and Land Use Planning department for signature and approval. Once approved, the Environmental Monitor will deliver the signed profiles to the Contractor. This internal LAWA process typically takes 5 working days, providing the waste profile form is properly completed.

f. VOC Contaminated Soil – Non-hazardous. VOC Contaminated Soil (as determined by AQMD Rule 1166 screening procedures) that has been characterized as Non-hazardous Waste (as determined by review of sample analysis for characterization for disposal) will be disposed of by recycling (i.e., thermal desorption) or as directed by LAWA. Such recycling facilities include:

   Thermal Remediation Solutions, Waste Management
   1211 W. Gladstone Street
   Azusa, CA 91702

   Soil Safe
   12328 Hibiscus Road
   Adelanto, CA 92301

The Contractor will obtain a certificate of recycle for all project soils treated at the facility and provide the certificate(s) to LAWA as a submittal. Payment under this bid item cannot occur until LAWA receives these certificates.

g. VOC Contaminated Soil - Hazardous. VOC Contaminated Soil (as determined by AQMD Rule 1166 screening procedures) that has been characterized as hazardous -
RCRA or Non-RCRA Waste (as determined by review of sample analysis for characterization for disposal) will be disposed of at a facility designated by LAWA. Disposal facilities for RCRA and Non-RCRA Waste include:

US Ecology  
PO Box 578  
Hwy 95, 12 Miles South of Beatty  
Beatty, NV 89003

h. Non-Contaminated Impacted Soil. The Contractor will propose a location and identify the facility or entity who will disposal of or reuse Non-Contaminated Impacted Soil pending LAWA approval. Non-Contaminated Impacted Soil (i.e., soil with PID reading of between 1 and 50 ppm) will be sampled and analyzed by the Contractor if/as required by the disposal facility or the entity receiving the soil for reuse. Pending analytical results; Non-Contaminated Impacted Soil will be disposed of or reused as approved by LAWA.

i. Transporting Soil. Soils will be transported in accordance with the approved Contractor HMP. VOC Contaminated Soil will be loaded and handled in accordance with AQMD Rule 1166, Department of Transportation (DOT), and other requirements for the transport of VOC Contaminated Soil. Soil characterized as Non-RCRA and RCRA hazardous waste will be transported in accordance with DOT and other regulatory requirements. Manifests and bill of ladings requiring generator signature will be signed by the LAWA Inspector.

Non-Contaminated soil that has been characterized based on sampling and review of analysis as unregulated waste and unrestricted soil may be transported as unregulated soil. Bill of ladings requiring generator signature will be signed by the LAWA Inspector.

41-10.6 TESTING REQUIREMENTS

a. Testing Requirements defined separately under this article.

41-11 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. Unclassified Excavation for Disposal  
2. Subgrade Preparation Type A - Scarify & Recompact  
3. Subgrade Preparation Type B – Proof Roll  
4. Subgrade Improvement

END OF SECTION 41
SECTION 43 – CONTROLLED LOW-STRENGTH MATERIAL (CLSM) (FAA P-153)

43-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of controlled low-strength material for backfill as shown on the plans, as directed by the Engineer, or as needed for Contractor's operations. Work shall be in accordance with FAA Specification Item P-153 as included and modified.

Backfill of utility trenches may require inspection and/or coordination with other agencies. It is the Contractor's responsibility to ensure that coordination is completed in a timely manner. No schedule extensions will be approved due to the failure of the Contractor to coordinate with utility companies in a timely manner.

CLSM used for backfilling of utility trenches will not be measured for payment but will be considered incidental to the utility construction.

Contractor is responsible for all testing requirements included within this Section.

43-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor's expense.

43-3 RELATED SECTIONS

Other Sections, Tests, Specifications, and Standards referenced herein.

43-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-153 CONTROLLED LOW-STRENGTH MATERIAL (CLSM)

153-1 DESCRIPTION. This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches, abandoned pipes, manholes or other underground structures, or at other locations shown on the plans, as directed by the Engineer, or as required for Contractor's operations.

153-2 MATERIALS

153-2.1 MATERIALS

a. Portland Cement. Portland cement shall conform to the requirements of ASTM C 150, Type II or IV. If for any reason, cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

b. Fly Ash. Fly Ash shall conform to ASTM C 618, Class F.
c. **Fine Aggregate (Sand).** Fine aggregate shall conform to the requirements of ASTM C 33 except for aggregate gradation. Any aggregate gradation which produces performance characteristics of the CLSM specified herein will be accepted, except as follows.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 12</td>
</tr>
</tbody>
</table>

**TABLE 1. FINE AGGREGATE EXCLUDED GRADATION**

d. **Water.** Water used in mixing shall be free of oil, salt, acid, alkali, sugar, vegetable matter, or other substances injurious to the finished product.

153-3 **MIX DESIGN**

153-3.1 **PROPORTIONS.** The Contractor shall submit, to the Engineer, a mix design including the proportions and source of aggregate, fly ash, cement, water, and approved admixtures. No CLSM mixture shall be produced for payment until the Engineer has given written approval of the mix design. The mix design shall be prepared by an approved laboratory, and shall remain in effect for the duration of the project. Laboratory costs shall be considered incidental to this item. The proportions shall establish a single percentage or weight for aggregate, fly ash, cement, water, and any admixtures proposed.

a. **Compressive Strength.** CLSM shall be designed to achieve a 28-day compressive strength of 100 to 200 psi when tested in accordance with ASTM D4832. Where used as substitute for base or subbase course under paved surfaces, CLSM shall achieve a 28-day compressive strength of 200 to 300 psi.

There should be no significant strength gain after 28 days and this property must be demonstrated by mix design test results before use of a particular mix will be approved. Test specimens shall be made in accordance with ASTM D4832 except that the samples will not be rodded or vibrated and shall be air cured in their molds for the duration of the cure period.

b. **Consistency.** CLSM should be designed to achieve a consistency that will produce an approximate 8-inch (200 mm) diameter circular-type spread without segregation when tested by: (1) filling a 3-inch inside diameter by 6-inch length flow cylinder (non-absorbent pipe) (2) strike off of the flow cylinder and start of lift within five seconds of filling and (3) by steady upward pull, lift the cylinder in a time period of between two and four seconds. Adjustments of the material proportions should be made to achieve proper solid suspension and flowable characteristics,
however the theoretical yield shall be maintained at one cubic yard (cubic meter) for the given batch weights.

153-4 CONSTRUCTION METHODS

153-4.1 PLACEMENT

a. Placement. CLSM may be placed by any reasonable means from a mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed in such a manner that structures or pipes are not displaced from their desired final position and intrusion of CLSM into undesirable areas is avoided. The material shall be brought up uniformly to the fill line shown on the plans or as directed to the Engineer. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one layer, the base layer shall be free of surface water and loose of foreign material prior to placement of the next layer.

b. Limitations of Placement. CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35 degrees F and rising. At the time of placement, CLSM shall have a temperature of at least 40 degrees F. Mixing and placement shall stop when the air temperature is 40 degrees F and falling or when the anticipated air or ground temperature will be 35 degrees F or less in the 24 hour period following proposed placement.

153-4.2 CURING AND PROTECTION

a. Curing. The air in contact with the CLSM should be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32 degrees F, the material may be rejected by the Engineer if damage to the material is observed.

b. Protection. The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 psi is obtained. The Contractor shall be responsible for providing evidence to the Engineer that the material has reached the desired strength. Acceptable evidence shall be based upon compressive tests made in accordance with paragraph 153-3.1a.

153-5 MATERIAL ACCEPTANCE. Acceptance of CLSM delivered and placed as shown on the plans or as directed by the Engineer shall be based upon mix design approval and batch tickets provided by the Contractor to confirm that the delivered material conforms to the mix design. The Contractor shall verify by additional testing each 100 cubic yards of material used. Verification shall include confirmation of material proportions and tests of compressive strength to confirm that the material meets the original mix design and the
requirements of CLSM as defined in this specification. Adjustments shall be made as necessary to the proportions and materials prior to further production.

153-6 METHOD OF MEASUREMENT. See Section 43-6.

153-7 BASIS OF PAYMENT. See Section 43-6.

153-8 TESTING REQUIREMENTS

ASTM C 31 Making and Curing Concrete Test Specimens in the Field
ASTM C 39 Compressive Strength of Cylindrical Concrete

153-9 MATERIAL REQUIREMENTS

ASTM C 33 Specification for Concrete Aggregates
ASTM C 150 Specification for Portland Cement
ASTM C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 595 Specification for Blended Hydraulic Cements

END OF ITEM P-153

43-5 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Job Mix Formula
b. Cement
c. Aggregate
d. Flyash
e. Admixtures

43-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

For all uses, including backfilling of trenches and excavations for new utilities, whether wrapped in geomembrane fabric or not, CLSM shall be considered incidental to the installation of the utility or other feature for which CLSM backfill is used. No separate measurement or payment of CLSM for these purposes will be made.

END OF SECTION 43
SECTION 50 – SUBBASE COURSE (FAA P-154)

50-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of aggregate subbase courses for airfield or road pavement subbase, for haul road surfacing, or for other uses as shown on the Plans. Work shall be done in accordance with FAA Specification Item P-154 as included and modified hereafter.

When approved by the Engineer, Processed Miscellaneous Base conforming to Section 57, Processed Miscellaneous Base, of these specifications may be used in lieu of P-154 for subbase courses as approved by the Engineer. When so substituted, Section 57, Processed Miscellaneous Base (PMB), will replace this Section 50, Subbase, only regarding Materials, Section 154-2. All other requirements of this section will remain binding, including Construction Methods, Measurement and Payment.

LAWA will be responsible to perform all Density Testing under this Section. The Contractor shall be responsible for all other testing, including Daily Gradation, Surface Tolerance, Thickness, and Grade, under this Section. All Contractor performed tests shall be witnessed by the Engineer.

50-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

50-3 RELATED SECTIONS

Section 29 – Nuclear Gauges (FAA 120)

Section 57 – Processed Miscellaneous Base (PMB)

Other Sections, Tests, Specifications, and Standards referenced herein.

50-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-154 SUBBASE COURSE

154-1 DESCRIPTION. This item shall consist of a subbase course composed of granular materials constructed on a prepared subgrade or underlying course in accordance with these specifications, and in conformity with the dimensions and typical cross section shown on the plans.

154-2 MATERIALS

154-2.1 MATERIALS. Subbase material shall consist of hard durable particles or fragments of granular aggregates. This material will be mixed or blended with fine sand, clay, stone dust, or other similar binding or filler materials.
produced from approved sources. This mixture must be uniform and shall comply with the requirements of these specifications as to gradation, soil constants, and shall be capable of being compacted into a dense and stable subbase. The material shall be free from vegetable matter, lumps or excessive amounts of clay, and other objectionable or foreign substances. Pit-run material may be used, provided the material meets the requirements specified.

Sieve designations shall be in accordance with as per ASTM C136 and ASTM D422.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentage Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>85-100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>50-85</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>-</td>
</tr>
<tr>
<td>No. 4</td>
<td>25-45</td>
</tr>
<tr>
<td>No. 30</td>
<td>10-25</td>
</tr>
<tr>
<td>No. 200</td>
<td>2-9</td>
</tr>
</tbody>
</table>

The portion of the material passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 when tested in accordance with ASTM D 4318.

The material finer than 0.02 mm shall be limited to a maximum of 3% and the maximum allowable material passing the No. 200 sieve shall be reduced from 0-8% to 0-5%. Testing per ASTM D422 will be required for the percentage passing the 0.02 mm particle size once per lot.

Samples of aggregates to check gradation shall be taken by the Engineer at the start of production and at least twice per lot. The lot will be consistent with acceptable sampling for density. The samples shall be taken from the in-place, compacted material once daily. Sampling shall be in accordance with ASTM D 75, and testing shall be in accordance with ASTM C 136 and ASTM C 117.

154-2.2 SAMPLING AND TESTING. Material used on the project shall be sampled per ASTM D75 and tested per ASTM C136 and ASTM C117. Results shall be furnished to the Engineer by the Contractor prior to the start of construction and once per day during construction.

154-3 CONSTRUCTION METHODS

154-3.1 GENERAL. The subbase course shall be placed where designated on the plans or as directed by the Engineer. The material shall be shaped and thoroughly compacted within the tolerances specified.
Granular subbases which, due to grain sizes or shapes, are not sufficiently stable to support the construction equipment without movement shall be mechanically stabilized to the depth necessary to provide such stability as required by the Engineer. The mechanical stabilization shall principally include the addition of a fine-grained medium to bind the particles of the subbase material sufficiently to furnish a bearing strength, so that the course will not deform under the traffic of the construction equipment. The addition of the binding medium to the subbase material shall not increase the soil constants of that material above the limits specified.

154-3.2 OPERATION IN PITS. The subbase material shall be obtained from pits or sources that have been approved by the Engineer. The material in the pits shall be excavated and handled to produce a uniform and satisfactory product. All work involved in clearing and stripping pits and handling unsuitable material encountered shall be performed by the Contractor. The cost of this work is incidental to this item.

154-3.3 PREPARING UNDERLYING COURSE. Prior to constructing the subbase course, clean the underlying course or subgrade of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances specified in Section 41, Earthwork. Correct ruts, or soft yielding spots, in the underlying courses and subgrade areas having inadequate compaction and deviations of the surface from the specified requirements by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the overlying course is placed. The course shall be checked and accepted by the Engineer before placing and spreading operations are started.

To protect the subgrade and to ensure proper drainage, the spreading of the subbase shall begin along the centerline of the pavement on a crowned section or on the high side of pavements with a one-way slope.

154-3.4 MATERIALS ACCEPTANCE IN EXISTING CONDITION. When the entire subbase material is secured in a uniform and satisfactory condition and contains approximately the required moisture, such approved material may be moved directly to the spreading equipment for placing. The material may be obtained from gravel pits, stockpiles, or may be produced from a crushing and screening plant with the proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. It is the intent of this section of the specifications to secure materials that will not require further mixing. The moisture content of the material shall be approximately that required to obtain maximum density. Any minor deficiency or excess of moisture may be corrected by surface sprinkling or by aeration. In such instances, some mixing or manipulation may be required, immediately preceding the rolling, to obtain the required moisture content. The final operation shall be blading or dragging, if necessary, to obtain a smooth uniform surface true to line and grade.
154-3.5 PLANT MIXING. When materials from several sources are to be blended and mixed, the subbase material shall be processed in a central or travel mixing plant. The subbase material, together with any blended material, shall be thoroughly mixed with the required amount of water. After the mixing is complete, the material shall be transported to and spread on the underlying course without undue loss of the moisture content.

154-3.6 GENERAL METHODS FOR PLACING. The subbase course shall be constructed in layers. Any layer shall be not less than 3 inches nor more than 8 inches of compacted thickness. The subbase material shall be deposited and spread evenly to a uniform thickness and width. The material, as spread, shall be of uniform gradation with no pockets of fine or coarse materials. The subbase, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards in advance of the rolling. Any necessary sprinkling shall be kept within this limit. No material shall be placed in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

During the placing and spreading, sufficient caution shall be exercised to prevent the incorporation of subgrade, shoulder, or foreign material in the subbase course mixture.

154-3.7 FINISHING AND COMPACTING. After spreading or mixing, the subbase material shall be thoroughly compacted by rolling and sprinkling, when necessary. Sufficient rollers shall be furnished to adequately handle the rate of placing and spreading of the subbase course.

The field density of the compacted material shall be at least 100 percent of the maximum density of laboratory specimens prepared from samples of the subbase material delivered to the jobsite for airfield pavement subbase, and at least 95% for haul road surfacing. The laboratory specimens shall be compacted and tested in accordance with ASTM D 1557. The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 6938 using Procedure A, the direct transmission method, and ASTM D 6938 shall be used to determine the moisture content of the material. The moisture content of the material at the start of compaction shall be +/-2% of the optimum moisture content.

All testing shall be done by the Contractor's laboratory in the presence of the Engineer, and density test results shall be furnished upon completion to the Engineer for acceptance determination.

Material meeting the requirements of Item P-154 may be free-draining which may prevent the material from retaining sufficient moisture to meet the compaction moisture requirements of this paragraph. If this situation occurs during field operations, minimum moisture content should be established for placement of the material.
The course shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the subbase. When the rolling develops irregularities that exceed 3/8 inch when tested with a Contractor-provided 12-foot straightedge, the irregular surface shall be loosened and then refilled with the same kind of material as that used in constructing the course and again rolled as required above.

Along places inaccessible to rollers, the subbase material shall be tamped thoroughly with mechanical or hand tampers.

Sprinkling during rolling, if necessary, shall be in the amount and by equipment approved by the Engineer. Water shall not be added in such a manner or quantity that free water will reach the underlying layer and cause it to become soft.

154-3.8 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. Aggregate subbase course shall be accepted for density on a lot basis. A lot will consist of one day's production where it is not expected to exceed 2400 square yards. A lot will consist of one-half day's production where a day's production is expected to consist of between 2400 and 4800 square yards.

Each lot shall be divided into two equal sublots. One test shall be made for each sublot. Sampling locations will be determined by the Engineer on a random basis in accordance with statistical procedures contained in ASTM D 3665.

Each lot will be accepted for density when the field density is as specified in 154-3.7. The specimens shall be compacted and as specified in 154-3.7. The in-place field density shall be determined as specified in 154-3.7. If the specified density is not attained, the entire lot shall be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached.

154-3.9 SURFACE TOLERANCE. The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12-foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

154-3.10 THICKNESS. The completed thickness of the course(s) shall be in accordance with the thickness and grade indicated on the drawings. The completed course shall not be more than 1/2 inch deficient in thickness nor more than 1/2 inch above or below the established grade. Where any of these tolerances are exceeded, correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 1/2 inch or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness shown. The thickness of the
completed subbase course shall be determined by depth tests or sample holes taken at intervals so each test shall represent no more than 500 square yards, or by survey.

154-3.11 PROTECTION. Work on subbase course shall not be conducted during freezing temperature nor when the subgrade is wet. When the subbase material contains frozen material or when the underlying course is, in the opinion of the Engineer, excessively wet, the construction shall be stopped. The Contractor shall protect and maintain the subgrade from yielding until the subbase is accepted.

154-3.12 MAINTENANCE. The Contractor shall maintain the completed course in a satisfactory condition until accepted by the Engineer.

154-4 METHOD OF MEASUREMENT. See Section 50-6.

154-5 BASIS OF PAYMENT. See Section 50-6.

154-6 TESTING REQUIREMENTS

| ASTM C 136 | Sieve Analysis of Fine and Coarse Aggregates |
| ASTM D 422 | Particle Size Analysis of Soils |
| ASTM D 1556 | Density of Soil in Place by the Sand-Cone Method |
| ASTM D 1557 | Test for Laboratory Compaction Characteristics of Soil Using Modified Effort |
| ASTM D 4318 | Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D 6938 | Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| AASHTO T180 | Moisture-Density Relations of Soils Using a 10-lb. Rammer and a 18-in. Drop |

END OF ITEM P-154

50-5 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Aggregate subbase

50-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

“Aggregate Subbase Course (P-154)” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 50
SECTION 52 – CRUSHED AGGREGATE BASE COURSE (FAA P-209 & CALTRANS)

52-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of crushed aggregate base courses.

Crushed Aggregate Base Course (P-209) for base courses under runways, taxiways, aprons and other uses as shown on the Plans shall conform to the requirements of FAA Specification Item P-209 as included and modified hereafter.

Crushed Aggregate Base Course (Caltrans) for base courses under roadways and other uses shown on the Plans shall conform to the requirements of Paragraph 52-5.

LAWA will be responsible to perform all Density Testing under this Section. The Contractor shall be responsible for all other testing, including Gradation, Smoothness, Thickness, and Grade, under this Section. All Contractor performed tests shall be witnessed by the Engineer.

52-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

52-3 RELATED SECTIONS

Section 29 – Nuclear Gauges (FAA 120)
Section 41 – Earthwork (FAA P-152)
Section 57 – Processed Miscellaneous Base (PMB)

Other Sections, Tests, Specifications, and Standards referenced herein.

52-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

FAA ITEM P-209 CRUSHED AGGREGATE BASE COURSE

209-1 DESCRIPTION. This item consists of a base course composed of crushed aggregates constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross sections shown on the plans.

209-2 MATERIALS

209-2.1 AGGREGATE. Aggregates shall consist of clean, sound, durable particles of crushed stone, crushed gravel, or crushed slag and shall be free from coatings of clay, silt, vegetable matter, and other objectionable materials and shall contain no clay balls. Fine aggregate passing the No. 4 sieve shall consist of fines from the operation of crushing the coarse aggregate. If necessary, fine
aggregate may be added to produce the correct gradation. The fine aggregate shall be produced by crushing stone, gravel.

The coarse aggregate portion, defined as the material retained on the No. 4 sieve, shall not have a loss of greater than 45% when tested per ASTM C 131. The sodium sulfate soundness loss shall not exceed 12%, or the magnesium sulfate soundness loss shall not exceed 18%, after five cycles, when tested in accordance with ASTM C88. The aggregate shall contain no more than 15%, by weight, of flat, elongated, or flat and elongated particles per ASTM D 4791. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than three (3). The aggregate shall have at least 90% by weight of particles with at least two fractured faces and 100% with at least one fractured face per ASTM D 5821. The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

a. **Sampling and Testing.** Sampling and testing for initial aggregate base requirements. Samples shall be taken by the Contractor in the presence of the Engineer. Material shall meet the requirements in paragraph 209-2.1 and 209-2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

b. **Gradation Requirements.** The gradation of the aggregate base material shall meet the requirements of the gradation given in the following Table 1, when tested per ASTM C 136. The gradation shall be well graded from coarse to fine as defined by ASTM D 2487 and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Design Range Percentage by Weight Passing Sieves</th>
<th>Contractor's Final Gradation</th>
<th>Job Control Grading Band Tolerances for Contractor's Final Gradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2- in max (FAA)</td>
<td>100</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2 in</td>
<td>95-100</td>
<td>±5</td>
<td></td>
</tr>
<tr>
<td>1-1/2 in</td>
<td>70-95</td>
<td>±8</td>
<td></td>
</tr>
<tr>
<td>1 in</td>
<td>55-85</td>
<td>±8</td>
<td></td>
</tr>
<tr>
<td>3/4 in</td>
<td>30-60</td>
<td>±8</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
<td>12-30</td>
<td>±5</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td>0-5</td>
<td>±3</td>
<td></td>
</tr>
</tbody>
</table>
The “Job Control Grading Band Tolerances for Contractor’s Final Gradation” in Table 1 shall be applied to the “Contractor’s Final Gradation” to establish a job control grading band. The full tolerance still applies if application of the tolerances results in a job control grading band outside the design range.

The fraction of the final mixture that passes the No. 200 sieve shall not exceed one-half of the fraction passing the No. 40 sieve.

c. **Sampling and testing for gradation.** Gradation tests shall be performed by the Contractor per ASTM C 136 and sieve analysis on material passing the No. 200 sieve per ASTM C 112. The Contractor shall take at least two aggregate base samples per lot to check the final gradation. Sampling shall be per ASTM D 75. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material in the presence of the Engineer. Sampling points and intervals will be designated by the Engineer.

d. **Other Requirements.** Aggregate shall meet the following additional requirements.

(1) R-value: 80, Minimum, per California Test Method 301

(2) Sand Equivalent: 35 Minimum, per California Test Method 217

**209-3 CONSTRUCTION METHODS**

**209-3.1 PREPARING UNDERLYING SUBGRADE AND/OR SUBBASE.** The underlying subgrade and/or subbase course shall be checked and accepted by the Engineer before base course placing and spreading operations begin. Re-proof-rolling of the subgrade or proof-rolling in accordance with P-152, at the Contractor's expense, may be required by the Engineer if the Contractor fails to ensure proper drainage or protect the subgrade and/or subbase. Any ruts or soft yielding places due to improper drainage conditions, hauling, or any other cause shall be corrected at the Contractor's expense before the base course is placed thereon. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

**209-3.2 PRODUCTION.** The aggregate shall be uniformly blended and, when at a satisfactory moisture content per paragraph 209-3.4, the approved material may be transported directly to the spreading equipment.

**209-3.3 PLACING.** The aggregate base material shall be placed on the prepared underlying subgrade and/or subbase and compacted in layers to the thickness shown on the plans. Work shall progress without interruption. The material shall be deposited and spread in lanes in a uniform layer without segregation to such loose depth that, when compacted, the layer shall have the specified thickness. The aggregate base course shall be constructed in layers of uniform thickness of not less than 3 inches nor more than 6 inches of compacted
thickness. The aggregate as spread shall be of uniform grading with no pockets of fine or coarse materials. The aggregate, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards in advance of the rolling. Any necessary sprinkling shall be kept within these limits. Care shall be taken to prevent cutting into the underlying layer during spreading. No material shall be placed in snow or on a soft, muddy, or frozen course. The aggregate base material shall be spread by spreader boxes or other approved devices. This equipment shall have positive thickness controls that spread the aggregate in the required amount to avoid or minimize the need for hand manipulation. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

209-3.4 COMPACTION. Immediately after completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The moisture content of the material during placing operations shall be within ± 2 percentage points of the optimum moisture content as determined by ASTM D 6398.

209-3.5 ACCEPTANCE SAMPLING AND TESTING FOR DENSITY. Aggregate base course shall be accepted for density on a lot basis. A lot will consist of one day's production if it does not exceed 2,400 square yards. A lot will consist of one-half day's production if a day's production consists of between 2,400 and 4,800 square yards. The Engineer shall perform all density tests.

Each lot shall be divided into two equal sublots. One test shall be made for each sublot and shall consist of the average of two random locations for density determination. Sampling locations will be determined by the Engineer on a random basis per ASTM D 3665.

Each lot will be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens. The specimens shall be compacted and tested in accordance with ASTM D 1557. The in-place field density shall be determined in accordance with ASTM D 1556 or D 2167. If the specified density is not attained, the entire lot shall be reworked and/or recompacted and two additional random tests made at the Contractor's expense. This procedure shall be followed until the specified density is reached.

209-3.6 SURFACE TOLERANCES. After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and recompacted to grade, until the required smoothness and accuracy are obtained and approved by the Engineer. Any deviation in surface tolerances shall be
corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

a. **Smoothness.** The finished surface shall not vary more than 3/8 inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

b. **Accuracy.** The grade and crown shall be measured on a 50-foot grid and shall be within +0 and -1/2 inch of the specified grade.

**209-3.7 THICKNESS CONTROL.** The thickness of the base course shall be within +0 and -1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Engineer. Tests shall be taken at intervals representing no more than 300 square yards per test. Sampling locations will be determined by the Engineer per ASTM D 3665. Where the thickness is deficient by more than 1/2 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. Additional test holes may be required to identify the limits of deficient areas. The Contractor shall replace, at his expense, base material where depth tests have been taken.

Thickness determination may be completed by survey. Survey shall be completed before and after placement of the base material.

**209-3.8 PROTECTION.** Perform construction when the atmospheric temperature is above 35°F. When the temperature falls below 35°F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements. When the aggregates contain frozen materials or when the underlying course is frozen or wet, the construction shall be stopped. Hauling equipment may be routed over completed portions of the base course, provided no damage results. Equipment shall be routed over the full width of the base course to avoid rutting or uneven compaction. The Engineer will stop all hauling over completed or partially completed base course when, in the Engineer’s opinion, such hauling is causing damage. Any damage to the base course shall be repaired by the Contractor at the Contractor’s expense.

**209-3.9 MAINTENANCE.** The Contractor shall maintain the base course in a satisfactory condition until the full pavement section is completed and accepted by the Engineer. The surface shall be kept clean and free from foreign material and properly drained at all times. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.
Equipment used in the construction of an adjoining section may be routed over completed portions of the base course, provided no damage results and provided that the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

The Contractor shall remove all survey and grade hubs from the base courses prior to placing any bituminous surface course.

209-4 **METHOD OF MEASUREMENT.** See Section 52-7.

209-5 **BASIS OF PAYMENT.** See Section 52-7.

209-6 **TESTING REQUIREMENTS**

<table>
<thead>
<tr>
<th>ASTM Standard</th>
<th>Test Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C 29</td>
<td>Unit Weight of Aggregate</td>
</tr>
<tr>
<td>ASTM C 88</td>
<td>Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate</td>
</tr>
<tr>
<td>ASTM C 117</td>
<td>Materials Finer than 75µm (No. 200) Sieve in Mineral Aggregates by Washing</td>
</tr>
<tr>
<td>ASTM C 131</td>
<td>Resistance to Degradation of Small-Size Coarse Aggregate by abrasion and impact in the Los Angeles Machine</td>
</tr>
<tr>
<td>ASTM C 136</td>
<td>Sieve Analysis of Fine and Coarse Aggregates</td>
</tr>
<tr>
<td>ASTM D 75</td>
<td>Sampling Aggregate</td>
</tr>
<tr>
<td>ASTM D 422</td>
<td>Particle Size Analysis of Soils</td>
</tr>
<tr>
<td>ASTM D 698</td>
<td>Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in (305mm) Drop</td>
</tr>
<tr>
<td>ASTM D 1556</td>
<td>Density of Soil in Place by the Sand-Cone Method</td>
</tr>
<tr>
<td>ASTM D 1557</td>
<td>Test for Laboratory Compaction Characteristics of Soil Using Modified Effort</td>
</tr>
<tr>
<td>ASTM D 2167</td>
<td>Density and Unit Weight of Soil in Place by the Rubber Balloon Method</td>
</tr>
<tr>
<td>ASTM D 2419</td>
<td>Sand Equivalent Value of Soils and Fine Aggregate</td>
</tr>
<tr>
<td>ASTM D 3665</td>
<td>Random Sampling of Construction Materials</td>
</tr>
<tr>
<td>ASTM D 4718</td>
<td>Correction of Unit Weight and Water Content for Soils Containing Oversize Particles</td>
</tr>
<tr>
<td>ASTM D 4791</td>
<td>Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate</td>
</tr>
</tbody>
</table>
52-5  CRUSHED AGGREGATE BASE COURSE (CALTRANS).

52-5.1 GENERAL

Crushed Aggregate Base Course (Caltrans) shall be in accordance with the requirements of Section 26, Aggregate Bases of the Caltrans Standard Specifications, for Class 2 Aggregate Base. Placement shall be in accordance with Section 26-1.03 of the Caltrans Standard Specifications.

52-5.2 MATERIALS

The Contractor shall use Class 2 ¾ - inch maximum gradation aggregate base.

Aggregate must be clean and free from organic matter and other deleterious substances.

Aggregate must consist of any combination of up to 100 percent of any combination of processed:

1. Asphalt concrete
2. Portland cement concrete
3. Lean concrete base
4. Cement treated base

a. Class 2 Aggregate Base

1. Coarse Aggregate. Clay lumps and friable particles shall not exceed 0.3 percent by weight when tested in accordance with ASTM C-142. Clay ironstone, claystone, mudstone, and siltstone shall not exceed 0.2 percent when tested per (ASTM C 295). Clay ironstone is defined as an impure variety of iron carbonate, iron oxide, hydrous iron oxide, or combinations thereof, commonly mixed with clay, silt, or sand.

2. Fine Aggregate. Clay lumps and friable particles shall not exceed 0.3 percent by weight when tested in accordance with ASTM C-142.

When tested under California Test 202, aggregate must comply with the grading requirements for the sieve sizes shown in the following table:
Aggregate Grading

<table>
<thead>
<tr>
<th>Sieve sizes</th>
<th>Percentage passing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operating range</td>
</tr>
<tr>
<td></td>
<td>Contract compliance</td>
</tr>
<tr>
<td>2&quot;</td>
<td>--</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>--</td>
</tr>
<tr>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>90–100</td>
</tr>
<tr>
<td>No. 4</td>
<td>35–60</td>
</tr>
<tr>
<td>No. 30</td>
<td>10–30</td>
</tr>
<tr>
<td>No. 200</td>
<td>2–9</td>
</tr>
</tbody>
</table>

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

Aggregate Quality

<table>
<thead>
<tr>
<th>Property</th>
<th>California Test</th>
<th>Operating range</th>
<th>Contract compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance (R-value) (min)</td>
<td>301</td>
<td>--</td>
<td>78</td>
</tr>
<tr>
<td>Sand equivalent (min)</td>
<td>217</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>Durability index (min)</td>
<td>229</td>
<td>--</td>
<td>35</td>
</tr>
</tbody>
</table>

Aggregate samples must not be treated with lime, cement, or chemicals before testing for durability index. Aggregate from untreated reclaimed processed asphalt concrete, PCC, LCB, or CTB is not considered treated.

52-5.3 CONSTRUCTION

a. General. Water shall be potable water.

b. Subgrade. Immediately before spreading AB, the subgrade must comply with the specified compaction and elevation tolerance for the material involved and be free from loose or extraneous material.

Fill areas of finished Subgrade that are lower than the grade established by the Engineer with Aggregate Base.

c. Spreading. Deliver uniform mixtures of Aggregate Base to the roadbed. Deposit Aggregate Base in layers or windrows. Spread and shape the Aggregate Base to such thickness that after watering and compacting, the completed AB is within the tolerances specified in section 26-1.03D. When Aggregate Base is spread and compacted the moisture content must be uniform and sufficient to obtain the required compaction. Avoid material segregation. AB must be free from pockets of coarse or fine material.

Where the subgrade is cohesionless sand you may dump Aggregate Base in piles and spread it ahead in sufficient quantities to stabilize the subgrade, if authorized.
Where the shown AB thickness is 0.50 foot or less you may spread and compact the Aggregate Base in one layer. Where the shown thickness is more than 0.50 foot, spread and compact in 2 or more layers approximately equal in thickness. The compacted thickness of any one layer must not exceed 0.50 foot. At locations inaccessible to spreading equipment, spread and compact AB by any means that will obtain the specified results.

d. Compaction, Thickness and Grade Requirements

All areas indicating Aggregate Base are shown on the plans.

Compact to 100% relative compaction per California Test 231 (CALTRANS Std Spec. 2010 Section 26-1.03D). The completed thickness of the aggregate base shall be within 0.5 in of the design thickness. Contractor shall perform grading and thickness tests per 500 square yards or the day’s production whichever is less in the presence of the Engineer and submit test results to the Engineer for approval. The Engineer shall perform compaction acceptance tests per 500 square yards or the day’s production corresponding to the Contractor’s grade and thickness testing.

The finished AB surface must not vary more than 0.05 foot from the grade established by the Engineer.

52-6 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Crushed Aggregate Base - P-209

b. Crushed Aggregate Base - Caltrans

52-7 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Crushed Aggregate Base Course (P-209) shall be measured and paid for as described in Project Requirements – 4 of these specifications.

Crushed Aggregate Base Course (Caltrans) shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 52
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SECTION 57 – PROCESSED MISCELLANEOUS BASE (PMB)

57-1 GENERAL. This item covers the construction of Processed Miscellaneous Base (PMB) for asphalt or concrete pavement base or subbase courses, for haul road and laydown area surfacing, for isolated subgrade removal and replacement, and for other uses shown in the plans. PMB may also be substituted for the aggregate in base and subbase courses as noted below. All work shall be done at the locations and to the lines and grades shown on the plans or as directed by the Engineer.

PMB may be considered to be an acceptable substitute for the following materials when specifically approved in advance by the Engineer:

   a. Section 50 – Subbase Course (P-154) - Aggregate

For the above uses, the requirements of this section shall control for material quality and gradation. All other requirements, including construction, measurement and payment, shall be as stipulated under the respective sections for which they are used.

LAWA will be responsible to perform all Density Testing under this Section. The Contractor shall be responsible for all other testing, including Smoothness, Thickness, and Grade, under this Section. All Contractor performed tests shall be witnessed by the Engineer.

57-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

57-3 RELATED SECTIONS

   Section 23 – Removals
   Section 24 – Watering
   Section 29 – Nuclear Gauges (FAA 120)
   Section 41 – Earthwork (FAA P-152)
   Section 50 – Subbase (FAA P-154)
   Other Sections, Tests, Specifications, and Standards referenced herein.

57-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.
57-5 MATERIAL

57-5.1 MATERIAL SOURCES

PMB may be obtained from two sources, at the Contractor’s discretion:

a. Produced by the Contractor from recycled materials produced under Section 23 of these Specifications, Removals, from the crushing of removed concrete and asphalt pavements. Actual production of PMB shall be considered incidental to the applicable removal item under Section 23.

b. PMB obtained by the Contractor from other sources.

If PMB is Contractor-provided from sources outside of the project limits, the bid price shall include the cost of acquiring the material. The bid price for PMB regardless of its source shall include all costs for transporting, handling, placing, shaping, watering and compacting the material.

When PMB is accepted as a substitute for another material, it will be measured and paid under the original specification. In those instances, the Contractor shall consider the source of the material and associated costs in establishing bid prices for PMB provided under those specification sections.

57-5.2 MATERIAL QUALITY. Processed Miscellaneous Base shall conform to Section 200-2.5 of the Standard Specifications for Public Works Construction (SSPWC) “Greenbook”, latest edition, and as amended below.

a. General. Processed miscellaneous base shall consist of broken or crushed asphalt concrete, Portland cement concrete, railroad ballast, glass, crushed porcelain material, crushed rock, rock dust, or natural material. The material that is retained on a No. 4 sieve shall contain at least 25 percent particles with two or more fractured faces. The material shall be free of any detrimental quantity of soft, friable, thin, elongated or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance. The material may contain no more than 3 percent brick by weight as determined by California Test 202 as modified. Brick material retained on a No. 4 sieve shall be identified visually and separated manually. Brick quantification shall be based on total weight of dry sample.

Prior to crushing and processing salvaged asphalt and concrete materials as PMB, all materials not suitable for subbase materials shall be segregated, removed, and disposed of by the Contractor off airport property, including but not limited to joint sealant material, reinforcing steel, dowel bars, conduit, wire and cable, and any other material deemed unsuitable by the Engineer.

b. Grading. The material shall be uniformly graded and shall conform to one of the gradations in Table 1. (ASTM C 131 Test Grading A, B):
TABLE 1. PROCESSED MISCELLANEOUS BASE GRADATION

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentage Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
</tr>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>85-100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>50-85</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>-</td>
</tr>
<tr>
<td>No. 4</td>
<td>25-45</td>
</tr>
<tr>
<td>No. 30</td>
<td>10-25</td>
</tr>
<tr>
<td>No. 200</td>
<td>2-9</td>
</tr>
</tbody>
</table>

When PMB is used for one of the materials listed in Section 57-1, the gradation shall fall within the overlap of one of the PMB grading bands in Table 1 and the grading band of the originally specified material. When this is not possible, the grading band of the originally specified material shall control.

c. Quality Requirements. This material shall conform to the following requirements in Table 2. The Engineer may waive the percentage wear requirements, provided the material has a minimum durability of 35 in accordance with California Test 229.

TABLE 2. Quality Requirements

<table>
<thead>
<tr>
<th>Tests</th>
<th>Test Method No.</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-Value</td>
<td>California 301</td>
<td>78 Minimum</td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>California 217</td>
<td>35 Minimum</td>
</tr>
<tr>
<td>Percentage Wear:</td>
<td>ASTM C131</td>
<td></td>
</tr>
<tr>
<td>100 Revolutions</td>
<td></td>
<td>15 Maximum</td>
</tr>
<tr>
<td>500 Revolutions</td>
<td></td>
<td>52 Maximum</td>
</tr>
</tbody>
</table>

The portion of the material passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 when tested in accordance with ASTM D 4318.

d. Testing. All PMB supplied and placed by the Contractor, whether Contractor-produced or Contractor-furnished, shall be tested and approved by the Engineer prior to acceptance.

e. Moisture-Density Requirements. Moisture content is critical to obtaining adequate compaction of PMB. To ensure proper moisture content PMB shall be tested at the source of production (or plant), at stockpile or storage locations, and at the point of placement.
Maximum density and optimum moisture content shall be established in accordance with ASTM D 1557. In-place field density shall be determined in accordance with ASTM D 1556. The moisture content of the material at the start of compaction shall be not more than 1 1/2 percentage points above, or below, the optimum moisture content.

f. **Contractor-Produced PMB.** The material shall be produced from a crushing and screening plant with the proper source materials as described in Section 23 of these Specifications, Removals. The materials from these sources shall meet the requirements noted herein for gradation, quality, and consistency. It is the intent of this section to secure materials that will not require further mixing.

The moisture content of the material shall be approximately that required to obtain maximum density. When the entire PMB material is secured in a uniform and satisfactory condition and contains approximately the required moisture, such approved material may be moved directly to the spreading equipment for placing.

Any minor deficiency or excess of moisture may be corrected by surface sprinkling or by aeration. In such instances, some mixing or manipulation may be required, immediately preceding the rolling, to obtain the required moisture content. The final operation shall be blading or dragging, if necessary, to obtain a smooth uniform surface true to line and grade.

g. **Plant Mixing of PMB.** When materials from several sources are to be blended and mixed, the PMB material shall be processed in a central or travel mixing plant. The PMB material, together with any blended material, shall be thoroughly mixed with the required amount of water. After the mixing is complete, the material shall be transported to and spread on the underlying course without undue loss of the moisture content.

The Engineer may require additional and on-going monitoring of moisture content to ensure conformance with requirements.

h. **Mix-in-Place PMB.** Mix-in-Place PMB shall not be allowed.

57-6 CONSTRUCTION METHODS

57-6.1 **CONSTRUCTION OF PMB FOR AGGREGATE BASE COURSE (P-208) USING PMB.** Not used.

57-6.2 **CONSTRUCTION OF PMB FOR CRUSHED BASE COURSE (P-209) USING PMB.** Not used.

57-6.3 **CONSTRUCTION OF PMB FOR RECYCLED CONCRETE BASE COURSE (P-219) USING PMB.** Not used.

57-6.4 **CONSTRUCTION OF PMB FOR SUBBASE COURSE (P-154) USING PMB.** When used as Aggregate Subbase, construction shall comply with Paragraph 154-3, of Section 50, Aggregate Subbase Course. Engineer may require additional monitoring of moisture content to ensure PMB moisture content requirements are met.
57-6.5 REMOVE SUBGRADE AND REPLACE WITH PMB. When used as a replacement material for unacceptable subgrade, construction shall comply with Section 41-7, of Section 41, Earthwork. Engineer may require additional monitoring of moisture content to ensure PMB moisture content requirements are met.

57-6.6 CONSTRUCTION OF ROAD SURFACING USING PMB

a. General. The location for haul roads, construction access, laydown area and temporary backfill, as shown on the plans, is approximate. Prior to beginning work on haul roads, construction access and temporary backfill locations, the Contractor shall carefully examine the field conditions and shall propose and stake an alignment which eliminates conflicts with lights, signs, drainage structures and other airfield structures and utilities. The Engineer shall approve the alignment prior to any subgrade preparation or the placement of any PMB.

Initial construction of haul roads, or realignment requested by LAWA, will be measured and paid for on a unit price basis as described herein. Maintenance of haul roads throughout the construction period, or realignment at the request of the Contractor, shall be the responsibility of the Contractor. Material to be placed on haul roads and within the laydown area as needed to maintain them throughout the construction period shall meet the requirements of this specification for PMB although there will be no compensation to the Contractor for such additional materials.

b. Preparing Underlying Course. Before any PMB material is placed, the underlying course shall be prepared and conditioned as subgrade preparation as specified in Section 41 of these Specifications, Earthwork, including scarification, grading, compacting and application of soil sterilant. The course shall be checked and accepted by the Engineer before placing and spreading operations are started. Subgrade Preparation will be paid under Section 41.

c. General Methods for Placing. The PMB course shall be constructed in layers. No layer shall be less than 3 inches, nor more than 6 inches, in compacted thickness. The material, as spread, shall be of uniform gradation with no pockets of fine or coarse materials. The PMB, unless otherwise permitted by the Engineer, shall not be spread more than 1,000 square yards in advance of the rolling. Any necessary sprinkling shall be kept within this limit. No material shall be placed on a soft or muddy course.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer. To protect the subgrade and to ensure proper drainage, the spreading of the PMB shall begin along the centerline of the pavement on a crowned section or on the high side of pavements with a one-way slope.

During the placing and spreading, sufficient caution shall be exercised to prevent the incorporation of subgrade, shoulder, or foreign material into the subbase course mixture.

d. Finishing and Compacting. After spreading and/or mixing and shaping, the PMB material shall be thoroughly compacted by rolling and sprinkling, when necessary. Sprinkling during rolling, if necessary, shall be in the amount, and by
equipment, approved by the Engineer. Water shall not be added in such a manner or quantity that free water will reach the underlying layer and cause it to become soft.

Sufficient rollers shall be furnished to adequately handle the rate of placing and spreading of the material. The course shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the subbase. Along places inaccessible to rollers, the PMB material shall be tamped thoroughly with mechanical or hand tampers.

PMB for Haul Road surface courses shall be compacted to a density of 95% as determined by ASTM D 1557. In-place field density shall be determined in accordance with ASTM D 1556. The moisture content of the material at the start of compaction shall not more than 1 1/2 percentage points above, or below, the optimum moisture content.

The Contractor shall conduct his operations in a manner so as to minimize the production of dust, including the use of water as described in Section 24 of these specifications, Watering.

e. Surface Test. After the course is completely compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion found to lack the required smoothness, or to fail in accuracy of grade or crown, shall be scarified, reshaped, recompacted, and otherwise manipulated as the Engineer may direct until the required smoothness and accuracy be obtained. The finished surface shall not vary more than 1/2 inch when tested with a Contractor-provided 16-foot straightedge applied parallel with, and at right angles to, the centerline.

When the rolling develops irregularities that exceed 1/2 inch when tested with a 16 foot straightedge, the irregular surface shall be loosened and then refilled with the same kind of material as that used in constructing the course and again rolled as required above.

f. Thickness. The thickness of the completed PMB course shall be determined by depth tests or cores taken at intervals so each test shall represent no more than 500 square yards. When the deficiency in thickness is more than 1/2 inch, the Contractor shall correct such areas by scarifying, adding satisfactory mixture, rolling, sprinkling, reshaping, and finishing in accordance with these specifications. The Contractor shall replace at his expense the PMB material where borings are taken for test purposes.

g. Protection. Work on the PMB course shall not be conducted during freezing temperatures nor when the subgrade is wet. When the subbase material contains frozen material or when the underlying course is excessively wet, the construction shall be stopped.

h. Maintenance. Following the final shaping of the material, the PMB shall be maintained by the Contractor, along its entire length, for the duration of the project, by the use of standard motor graders and rollers. Condition shall be maintained to the satisfaction of the Engineer as conforming to the plans and specifications.

ASTM C 136 Sieve or Screen Analysis of Fine and Coarse Aggregate

ASTM D 1556 Density of Soil in Place by the Sand-Cone Method

ASTM D 1557 Moisture-Density Relations of Soils and SoilAggregate Mixtures Using 10-lb (4.5 kg) Rammer and 18-in (457 mm) Drop

ASTM D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

California 202 Method of Tests or Sieve Analysis of Fine And Coarse Aggregates

California 207 Method of Test for Specific Gravity and Absorption of Fine Aggregate

California 229 Method of Test for Durability Index

California 301 Method for Determining the Resistance “R” Value of Treated and Untreated Bases, Subbases, and Basement Soils by the Stabilometer

57-8 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. PMB Aggregate

57-9 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

No separate payment will be made for PMB, the cost is considered incidental to associated bid items. PMB will be paid for under “Section 50 – Subbase Course (P-154) - Aggregate.”

END OF SECTION 57
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SECTION 60 – SURFACE PREPARATION (FAA P-101)

60-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for surface preparation of asphalt pavements prior to bituminous overlays, emulsified asphalt slurry sealing, or other surface repair work as stated. All work shall be done as shown on the Plans or as directed by the Engineer. All work shall be in accordance with FAA Specification Item P-101 as included and modified hereafter.

Work covered under this Section includes:

1. Cold milling of AC pavements
2. Cold milling of PCC pavements
3. Crack cleaning and filling of AC pavement

For joint repair, crack filling and spall repair of PCC pavement, see Section 71, Concrete Repair. For removal PCC pavement, or removal of AC pavement as part of demolition operations, see Section 23, Removals. For removal of pavement markings, see Section 23, Removals.

60-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

60-3 RELATED SECTIONS

Section 23 – Removals
Section 62 – Hot Mix Asphalt (HMA) – Surface and Base Course (FAA P-401 & Greenbook)
Section 71 – Concrete Repair
Other Sections, Tests, Specifications, and Standards referenced herein.

60-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-101 SURFACE PREPARATION

101-1 DESCRIPTION. This item shall consist of the preparation of existing asphalt pavement surfaces for asphaltic overlay, and other miscellaneous items of work. The work shall be accomplished in accordance with these specifications and the applicable drawings.
101-2  **EQUIPMENT.** All equipment shall be specified here and in the following paragraphs or approved by the Engineer. The equipment shall not cause damage to the pavement to remain in place.

101-3  **CONSTRUCTION**

101-3.1  **REMOVAL OF EXISTING PAVEMENT**

a. **Removal of Portland Cement Concrete:** Portland cement concrete pavement shall be removed and paid under Section 23, Removals.

b. **Removal of Asphaltic Concrete.** Asphaltic concrete pavement to be removed shall be removed and paid under Section 23, Removals.

101-3.2  **PREPARATION OF JOINTS AND CRACKS.** All joints and cracks in bituminous pavements to be sealed with an emulsified asphalt slurry seal shall be cleaned of any existing joint and crack sealer, debris, and vegetation. Any excess joint or crack sealer on the surface of the pavement shall also be removed from the pavement surface. A soil sterilant shall be applied to the crack after cleaning and preparation has been completed.

a. **Crack Size Guidelines.** Crack preparation procedures depend on size. The following information shall be used when preparing cracks for sealing.

   (1) **Hairline cracks.** Hairline cracks (less than 1/4 inch). Hairline cracks require no preparation.

   (2) **Small cracks (1/4 to 2 inches).** Cracks that are 3/4 to 2 inches shall be prepared by cleaning the crack using a sandblaster, HCA heat lance, or wire brushes, followed by cleaning with compressed air. The crack must be clean and dry prior to filling.

   (3) **Large cracks (greater than 2 inches).** Cracks wider than 2 inches shall be prepared in the same manner as failed AC sections. A saw shall be used to cut away damaged pavement to provide vertical faces and a section suitable for patching. The area shall then be cleaned and filled in accordance with asphalt as directed by the Engineer.

b. **Preparation of Cracks in AC Pavements.**

   (1) **Cleaning.** All cracks shall be cleaned of any debris or laitance by use of a hot air lance, picks, stiff wire brushes and compressed air free of oil and water. The crack shall be dry prior to sealing.

   (2) **Sealing.** Immediately before sealing, the cracks shall be blown out with compressed air free of oil and water. Only air compressors with operable oil and water traps shall be used to prepare the cracks for sealing. The crack faces shall be surface dry when the seal is
applied. Sealing shall only be performed when the air temperature is higher than the dew point.

101-3.3  **FILLING CRACKS IN AC OR PCC PAVEMENT PRIOR TO OVERLAY.** Section not used.

101-3.4  **FILLING CRACKS IN AC PAVEMENT GENERAL REPAIR.**
Repair of cracks in AC pavement identified for crack filling shall be cleaned and prepared as described in 101-3.2.c. Crack filler shall be a hot-applied material conforming to ASTM D 6690, Type I, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements. Cracks shall be filled within 0 to 1/8 inch of the surface, or in conformance with the manufacturer’s recommendations.

Cracks will be inspected for proper width, depth, alignment, and preparation, and will be approved by the Engineer before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

- **Hot Poured Sealants.** The crack sealant shall be applied uniformly solid from bottom to top and shall be filled without formation of entrapped air or voids. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation will be provided. The sealant shall not be heated to more than 20°F (-11°C) below the safe heating temperature. The safe heating temperature can be obtained from the manufacturer’s shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint will be provided. Any sealant spilled on the surface of the pavement, structures and/or lighting fixtures shall be removed immediately.

Any material spilled outside the width of the joint shall be removed from the surface prior to constructing the overlay.

101-3.5  **REMOVAL OF PAINT AND RUBBER PRIOR TO OVERLAY.** All paint and rubber shall be removed from the surface of the existing pavement prior to overlay. Chemicals, high-pressure water, heater scarifier (asphaltic concrete only), cold milling, or sandblasting may be used. Any methods used shall not cause major damage to the pavement, and shall be in accordance with Section 23, Removals. Major damage is defined as changing the properties of the pavement or removing pavement over 1/8 inch deep. If chemicals are used, they shall comply with the state’s environmental protection regulations. All wastes shall be removed by vacuuming and shall be legally disposed of, off the airport, at the Contractor’s expense.

101-3.6  **COLD MILLING OF AC PAVEMENT.** AC pavement shall be cold milled in accordance with Sections 302-1.1 through 302-1.3.2 in the Standard Specifications (Greenbook, latest edition). All match points shall be saw cut to a vertical edge. All cold milled surfaces shall be remove and disposed of off Airport property at a properly licensed facility, in accordance with all applicable local and federal laws and regulation.
Only a minimal amount of water needed to facilitate the pavement milling operation shall be permitted. If the Engineer determines that excess water is being used, the contractor shall immediately reduce the water volume and remove all standing water completely from the surface to achieve a dry condition.

The milled surface shall be dry and free from dirt and slurry prior to placement of tack coat.

101-3.7 COLD MILLING OF PCC PAVEMENT. PCC pavement shall be cold milled in accordance with Sections 302-1.1 through 302-1.3.2 in the Standard Specifications (Greenbook, latest edition). All match points shall be saw cut to a vertical edge. All cold milled surfaces shall be remove and disposed of off Airport property at a properly licensed facility, in accordance with all applicable local and federal laws and regulation.

101-4 TESTING REQUIREMENTS

ASTM D 36 Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)


101-5 MATERIAL REQUIREMENTS

ASTM D 6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

101-6 METHOD OF MEASUREMENT. See Section 60-6.

101-7 BASIS OF PAYMENT. See Section 60-6.

END OF ITEM P-101

60-5 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Equipment

b. Crack Sealant materials and application procedure

60-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Unless specifically identified in other bid items of this section, all requirements of this section, and surface preparation as described herein and as required to complete the work, will not be measured for payment but shall be considered incidental to other bid items of work.
“Cold Milling of Pavement, 6 to 9-Inch Depth” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 60
SECTION 62 – HOT MIX ASPHALT (HMA) PAVEMENTS - SURFACE AND BASE COURSE  
(FAA P-401 & GREENBOOK)

62-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of Asphalt Concrete surface and base courses for pavement areas as shown on the Plans and in accordance with FAA Specification Item P-401 as included and modified herein.

In addition, this section includes Asphalt Concrete of the Standard Specifications for Public Works Construction, Public Works Standards, Inc., 2012 (Greenbook) and modified latest edition of City of Los Angeles Additions and Amendments to the 2009 Edition of the Standard Specifications for Public Works Construction (Brown Book), which shall be placed as shown on the Plans and in accordance with Paragraph 62-5 of this specification.

62-1.1 Asphalt Base Course (P-401). Unless otherwise indicated on the plans, asphalt base course (P-401) as specified in this section shall be used for:
   a. Base course and surface course for runway, taxiway, shoulders and apron pavements
   b. LAWA will be responsible to perform all Material Tests under this Section, including Stability, Flow, Bulk Specific Gravity, and Air Voids. In addition, LAWA will perform the following In-Field Tests under this Section: Mat Density, Joint Density, and Thickness. The Contractor is required to perform the following In-Field Tests, witnesses by the Engineer: Thickness Cores, Smoothness, and Grade.

62-1.2 Greenbook/Brownbook Asphalt Pavement. Unless otherwise indicated on the plans, Greenbook/Brownbook asphalt pavement as specified in this section shall be used for:
   a. Erosion control pavements, airfield roadways, Contractor's laydown area, and temporary asphalt paving.
   b. LAWA will be responsible to perform all Material Tests under this Section, including Gradation, Stability, Flow, Bulk Specific Gravity, and Air Voids. In addition, LAWA will perform the following In-Field Tests under this Section: Mat Density, Joint Density, and Thickness. The Contractor is required to perform the following In-Field Tests, witnesses by the Engineer: Thickness Cores, Smoothness, and Grade.

62-2 DEFECTIVE WORK Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

62-3 RELATED SECTIONS
   a. PR-14 – Quality Control Program
   b. Section 29 – Nuclear Gauges (FAA 120)
   c. Section 60 – Surface Preparation (FAA P-101)
   d. Section 63 – Bituminous Prime Coat (FAA P-602) and Dust Palliative
e. Section 64 – Bituminous Tack Coat (FAA P-603)

f. Other Sections, Tests, Specifications, and Standards referenced herein.

62-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-401 HOT MIX ASPHALT (HMA) PAVEMENTS
(BASEOR SURFACE COURSE)

401-1 DESCRIPTION

401-1.1 This item shall consist of a base and/or surface course (for shoulders and service roads) composed of mineral aggregate and asphalt cement binder mixed in a central mixing plant and placed on a prepared course in accordance with these specifications. Courses shall conform to the lines, grades, thicknesses, and typical cross sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

401-2 MATERIALS

401-2.1 AGGREGATE. Aggregates shall consist of crushed stone, crushed gravel, natural sand and mineral filler, as required. The aggregates should be free of ferrous sulfides, such as pyrite, that would cause “rust” staining that can bleed through pavement markings. The portion retained on the No. 4 sieve is coarse aggregate. The portion passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate, and the portion passing the No. 200 sieve is mineral filler.

a. Coarse Aggregate. Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the bituminous material and free from organic matter and other deleterious substances. The percentage of wear shall not be greater than 40 percent when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium sulfate soundness loss shall not exceed 18 percent, after five cycles, when tested in accordance with ASTM C 88. Clay Lumps and friable particles shall not exceed 1.0% when tested in accordance with ASTM C142.

Aggregate shall contain at least 75 percent by weight of individual pieces having two or more fractured faces and 85 percent by weight having at least one fractured face. The area of each face shall be equal to at least 75 percent of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the
angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be obtained by crushing.

The aggregate shall not contain more than a total of 8 percent, by weight, of flat particles, elongated particles, and flat and elongated particles, when tested in accordance with ASTM D 4791 with a value of 5:1.

b. **Fine Aggregate.** Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter.

The fine aggregate, including any blended material for the fine aggregate, shall have a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318.

The soundness loss shall not exceed 10% when sodium sulfate is used or 15% when magnesium sulfate is used, after five cycles, when tested per ASTM C88.

Clay lumps and friable particles shall not exceed 1.0 percent, by weight, when tested in accordance with ASTM C142.

Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The fine aggregate shall not contain more than 15 percent natural sand by weight of total aggregates. If used, the natural sand shall meet the requirements of ASTM D 1073 and shall have a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318.

The aggregate shall have sand equivalent values of 45 or greater when tested in accordance with ASTM D 2419.

c. **Sampling.** ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler.

401-2.2 **MINERAL FILLER.** If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D 242.

401-2.3 **ASPHALT CEMENT BINDER.** Asphalt cement binder shall conform to the following requirements:

a. **For Surface Courses:** Performance Grade (PG) 70-10, ASTM D 3381, Table 1, 2, or 3.

b. **For Base Courses:** Performance Grade (PG) 64-10, ASTM D 3381, Table 1, 2, or 3. (PG) 70-10 is permitted to be used at contractor's option.
A certificate of compliance from the manufacturer shall be included with the mix design submittal.

The supplier’s certified test report with test data indicating grade certification for the asphalt binder shall be provided to the Engineer for each load at the time of delivery to the mix plant. A certified test report with test data indicating grade certification for the asphalt binder shall also be provided to the Engineer for any modification of the asphalt binder after delivery to the mix plant and before use in the HMA.

401-2.4 PRELIMINARY MATERIAL ACCEPTANCE. Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

a. Coarse Aggregate
   (1) Percent of wear
   (2) Soundness
   (3) Clay lumps and friable particles
   (4) Percent fractured faces
   (5) Flat and elongated particles

b. Fine Aggregate
   (1) Liquid limit
   (2) Plasticity index
   (3) Soundness
   (4) Clay lumps and friable particles
   (5) Percent natural sand
   (6) Sand equivalent

c. Mineral Filler

d. Asphalt Binder. Test results for asphalt binder shall include temperature/viscosity charts for mixing and compaction temperatures.

The certification(s) shall show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the specification requirement.

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.
401-2.5 **ANTI-STRIPPING AGENT.** Any anti-stripping agent or additive if required shall be heat stable, shall not change the asphalt cement viscosity beyond specifications, shall contain no harmful ingredients, shall be added in recommended proportion by approved method, and shall be a material approved by Caltrans.

401-3 **COMPOSITION**

401-3.1 **COMPOSITION OF MIXTURE.** The HMA plant mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent if required, and asphalt binder. The several aggregate fractions shall be sized, handled in separate size groups, and shall be combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

401-3.2 **JOB MIX FORMULA.** No hot-mixed asphalt (HMS) for payment shall be produced until a JMF has been approved in writing by the Engineer. The asphalt mix design and JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 401-3.4. The HMA shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. ASTM D6926 shall be used for preparation of specimens using the manually held and operated hammer for the mix design procedure. ASTM D 6927 shall be used for testing for Marshall stability and flow.

If material variability exceeds the standard deviations indicated, the JMF and subsequent production targets shall be based on a stability greater than shown in Table 1 and the flow shall be targeted close to the mid-range of the criteria in order to meet the acceptance requirements.

The Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867, shall not be less than 75 when tested at a saturation of 70-80%, or an anti-stripping agent shall be added to the HMA, as necessary, to produce a TSR of not less than 75 when tested at a saturation of 70-80%. If an anti-strip agent is required, it will be provided by the Contractor at no additional cost to the Owner.

The JMF shall be submitted in writing by the Contractor to the Engineer at least 30 days prior to the start of paving operations. The JMF shall be developed within the same construction season (no more than 90 days) using aggregates currently being produced.

The submitted JMF shall be stamped or sealed by the responsible professional Engineer of the laboratory, and shall include as a minimum:

- Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the JMF
- Percent of asphalt cement
- Asphalt performance, grade, and type of modifier if used
d. Number of blows per side of molded specimen

e. Laboratory mixing temperature

f. Laboratory compaction temperature

g. Temperature-viscosity relationship of the PG asphalt cement binder showing acceptable range of mixing and compaction temperatures and for modified binders including supplier recommended mixing and compaction temperatures.

h. Plot of the combined gradation on the 45 power gradation curve

i. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content

j. Specific gravity and absorption of each aggregate

k. Percent natural sand

l. Percent fractured faces

m. Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria)

n. Tensile Strength Ratio (TSR)

o. Anti-strip agent (if required)

p. Date the job mix formula was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.

q. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph “Reclaimed Hot-Mix Asphalt,” if RAP is used.

The Contractor shall submit to the Engineer the results of verification testing of three (3) asphalt samples prepared at the optimum asphalt content. The average of the results of this testing shall indicate conformance with the job mix formula requirements specified in Tables 1, 2 and 3.

When the project requires asphalt mixtures of differing aggregate gradations, a separate job mix formula and the results of job mix formula verification testing must be submitted for each mix.

The job mix formula for each mixture shall be in effect until a modification is approved in writing by the Engineer. Should a change in sources of materials be made, a new job mix formula must be submitted within 15 days and approved by the Engineer in writing before the new material is used. After the initial production job mix formula(s) has/have been approved by the Engineer and a new or modified job mix formula is required for whatever reason, the subsequent cost of the Engineer’s approval of the new or modified job mix formula will be borne by the Contractor. There will be no time extension given or considerations for extra costs associated with the stoppage of production paving or restart of production paving.
due to the time needed for the Engineer to approve the initial, new or modified job mix formula.

### TABLE 1. MARSHALL DESIGN CRITERIA

<table>
<thead>
<tr>
<th>Test Property</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of blows</td>
<td>75</td>
</tr>
<tr>
<td>Stability, pounds minimum</td>
<td>2,150</td>
</tr>
<tr>
<td>Flow, 0.01 in.</td>
<td>10-16</td>
</tr>
<tr>
<td>Air voids (percent)</td>
<td>3.5</td>
</tr>
<tr>
<td>Percent voids in mineral aggregate, minimum</td>
<td>See Table 2</td>
</tr>
</tbody>
</table>

### TABLE 2
**MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE**

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Minimum Voids in Mineral Aggregate</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation 3</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Gradation 2</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 3 when tested in accordance with ASTM C 136 and C 117. Unless otherwise specified, the Contractor shall select one gradation from those in Table 3, appropriate to the lift thickness as stated herein.

The gradations in Table 3 represent the limits that shall determine the suitability of aggregate for use from the sources of supply. The aggregate, as selected (and used in the JMF), shall have a gradation within the limits designated in Table 3 and shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

### TABLE 3
**AGGREGATE – BITUMINOUS PAVEMENTS – P-401**

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Gradation 2 (¼ inch Max)</th>
<th>Gradation 3 (¼ inch Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in.</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>¾ in.</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>½ in.</td>
<td>79-99</td>
<td>100</td>
</tr>
<tr>
<td>3/8 in.</td>
<td>68-88</td>
<td>79-99</td>
</tr>
<tr>
<td>No. 4</td>
<td>48-68</td>
<td>58-78</td>
</tr>
<tr>
<td>No. 8</td>
<td>33-53</td>
<td>39-59</td>
</tr>
</tbody>
</table>
### TABLE 3

**AGGREGATE – BITUMINOUS PAVEMENTS – P-401**

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentage by Weight Passing Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gradation 2</td>
</tr>
<tr>
<td></td>
<td>(¾ inch Max)</td>
</tr>
<tr>
<td>No. 16</td>
<td>20-40</td>
</tr>
<tr>
<td>No. 30</td>
<td>14-30</td>
</tr>
<tr>
<td>No. 50</td>
<td>9-21</td>
</tr>
<tr>
<td>No. 100</td>
<td>6-16</td>
</tr>
<tr>
<td>No. 200</td>
<td>3-6</td>
</tr>
<tr>
<td>Stone or gravel</td>
<td>5.0-7.5</td>
</tr>
</tbody>
</table>

#### 401-3.3 RECLAIMED ASPHALT CONCRETE (RAP).

Reclaimed HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. Recycled asphalt shingles (RAS) shall not be allowed. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 1-1/2 inches. The reclaimed HMA mix shall be designed using procedures contained in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure. The job mix shall meet the requirements of paragraph 401-3.2. RAP should only be used for shoulder surface course mixes and for any intermediate courses. The use of RAP containing Coal Tar shall not be allowed. Coal Tar surface treatments must be removed prior to recycling underlying asphalt material. The amount of RAP shall be limited to 20 percent.

In addition to the requirements of paragraph 401-3.2, the job mix formula shall indicate the percent of reclaimed asphalt pavement and the percent and grade of new asphalt binder.

For the PG graded asphalt binder selected in 401-2.3, adjust as follows:

a. For 0-20% RAP, there is no change in virgin binder content.

#### 401-3.4 JOB MIX FORMULA (JMF) LABORATORY.

The Contractor’s laboratory used to develop the JMF shall be accredited in accordance with ASTM D3666. The laboratory accreditation must be current and listed on the accrediting authority’s website. All test methods required for developing the JMF must be listed on the lab accreditation. A copy of the laboratory’s current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

#### 401-3.5 TEST SECTION.

Prior to full production, the Contractor shall prepare and place a quantity of HMA according to the job mix formula. The amount of HMA shall be sufficient to construct a test section 300 feet long and 25 feet wide, placed in two lanes, with a longitudinal cold joint, and shall be of the same depth specified...
for the construction of the course which it represents. A cold joint is an exposed
construction joint at least 4 hours old or whose mat has cooled to less than 185°F.
The underlying grade or pavement structure upon which the test section is to be
constructed shall be the same as the remainder of the course represented by the
test section. The equipment used in construction of the test section shall be the
same type and weight to be used on the remainder of the course represented by
the test section. If night construction is required, the test section will be constructed
under the same lighting and timing restrictions as planned for production paving.

The Test Section shall be evaluated for acceptance as a single lot in accordance
with the acceptance criteria in paragraph 401-5.1 and 401-5.2. The test section
shall be divided into equal sublots. As a minimum the test section shall consist of
3 sublots.

The test section shall be considered acceptable if the average mat density of the
test section cores is greater than or equal to 96 percent and the average joint
density of the test section cores is greater than or equal to 96 percent.

If the initial test section should prove to be unacceptable, the necessary
adjustments to the job mix formula, plant operation, placing procedures, and/or
rolling procedures shall be made. A second test section shall then be placed. If
the second test section also does not meet specification requirements, both
sections shall be removed at the Contractor's expense. Additional test sections,
as required, shall be constructed and evaluated for conformance to the
specifications. Any additional sections that are not acceptable shall be removed
at the Contractor's expense. Full production shall not begin until an acceptable
section has been constructed and accepted in writing by the Engineer. Once an
acceptable test section has been placed, payment for the initial test section and
the section that meets specification requirements shall be made in accordance
with paragraph 401-8.1.

Job mix control testing shall be performed by the Contractor at the start of plant
production and in conjunction with the calibration of the plant for the job mix formula.
If the aggregates produced by the plant do not satisfy the gradation requirements
or produce a mix that meets the JMF, it will be necessary to reevaluate and
redesign the mix using plant-produced aggregates. Specimens shall be prepared
and the optimum bitumen content determined in the same manner as for the
original JMF tests.

Contractor will not be allowed to place the test section until the Contractor Quality
Control Program, showing conformance with the requirements of PR-10,
Contractor Quality Control Program, has been approved, in writing, by the
Engineer.

401-4

CONSTRUCTION METHODS

401-4.1 WEATHER LIMITATIONS. The HMA shall not be placed upon a wet
surface or when the surface temperature of the underlying course is less than
specified in Table 4. The temperature requirements may be waived by the
Engineer, if requested; however, all other requirements including compaction shall be met.

**TABLE 4**

<table>
<thead>
<tr>
<th>Mat Thickness</th>
<th>Deg. F (Deg. C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 in. or greater</td>
<td>40 (4)</td>
</tr>
<tr>
<td>Greater than 2 in. but less than 3 in.</td>
<td>45 7)</td>
</tr>
</tbody>
</table>

401-4.2 HMA PLANT. Plants used for the preparation of HMA shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 with the following changes:

**a. Requirements for All Plants Include:**

(1) **Truck Scales.** The JMA shall be weighed on approved scales furnished by the Contractor, or on certified public scales at the Contractor’s expense. Scales shall be inspected and sealed as often as the Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements of Caltrans Standard Specifications for truck scales.

In lieu of scales, and as approved by the Engineer, HMA weights may be determined by the use of an electronic weighing system equipped with an automatic printer that weighs the total HMA production and as often thereafter as requested by the Engineer.

(2) **Testing Facilities.** The Contractor shall ensure laboratory facilities are provided at the plant for the use of the Engineer. The lab shall have sufficient space and equipment so that both testing representatives (Engineer’s and Contractor’s) can operate efficiently. The lab shall meet the requirements of ASTM D 3666. including all necessary equipment, materials, and current reference standards to comply with the specifications and masonry saw with diamond blade for trimming pavement cores and samples.

The plant testing laboratory shall have a floor space area of not less than 200 square feet, with a ceiling height of not less than 7-½ feet. The laboratory shall be weather tight, sufficiently heated in cold weather, air-conditioned in hot weather to maintain temperatures for testing purposes of 70 degrees F +/- 5 degrees F. The plant testing laboratory shall be located on the plant site to provide an unobstructed view, from one of its windows, of the trucks being loaded with the plant mix materials.

In addition, the facility shall include as a minimum:

(a) Adequate artificial lighting
(b) Electrical outlets sufficient in number and capacity for operating the required testing equipment and drying samples.

(c) A minimum of two (2), Underwriter’s Laboratories approved fire extinguishers of the appropriate types and class

(d) Work benches for testing, minimum 2-½ feet by 10 feet.

(e) Desk with 2 chairs and file cabinet

(f) Sanitary facilities convenient to testing laboratory

(g) Exhaust fan to outside air, minimum 12 inch blade diameter

(h) A direct telephone line and telephone including a FAX machine operating 24 hours per day, seven days per week

(i) File cabinet with lock for Engineer

(j) Sink with running water, attached drain board and drain capable of handling separate material

(k) Metal stand for holding washing sieves

(l) Two element hot plate or other comparable heating device, with dial type thermostatic controls for drying aggregates

(m) Mechanical shaker and appropriate sieves (listed in JMF, Table 3) meeting the requirements of ASTM E-11 for determining the gradation of coarse and fine aggregates in accordance with ASTM C 136

(n) Marshall testing equipment meeting ASTM D 6926, ASTM D 6927, automatic compaction equipment capable of compacting three specimens at once and other apparatus as specified in ASTM C 127, D 2172, D 2726, and D 2041.

(o) Oven, thermostatically controlled, inside minimum 1 cubic foot

(p) Two volumetric specific gravity flasks, 500 CC

(q) Other necessary hand tools required for sampling and testing

(r) Library containing contract specifications, latest ASTM volumes 4.01, 4.02, 4.03 and 4.09, AASHTO standard specification parts I and II, and Asphalt Institute Publication MS-2.

(s) Equipment for Theoretical Specific Gravity testing including a 4,000 cc pycnometer, vacuum pump capable of maintaining 30 ml mercury pressure and a balance, 16-20 kilograms with accuracy of 0.5 grams
(t) Extraction equipment, centrifuge and reflux types and ROTOflex equipment

(u) A masonry saw with diamond blade for trimming pavement cores and samples

(v) Telephone

Failure to provide the specified facilities shall be sufficient cause for disapproving HMA plant operations.

Laboratory facilities shall be kept clean, and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect the Contractor’s laboratory facility and witness quality control activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

(3) **Inspection of Plant.** The Engineer, or Engineer’s authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

(4) **Storage Bins and Surge Bins.** The HMA stored in storage and surge bins shall meet the same requirements as HMA loaded directly into trucks and may be permitted under the following conditions:

(a) Stored in non-insulated bins for a period of time not to exceed 3 hours.

(b) Stored in insulated storage bins for a period of time not to exceed 8 hours.

If the Engineer determines that there is an excessive amount of heat loss, segregation or oxidation of the mixture due to temporary storage, no temporary storage will be allowed.

401-4.3 **HAULING EQUIPMENT.** Trucks used for hauling HMA shall have tight, clean, and smooth metal beds. To prevent HMA from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.
401-4.3.1 Material transfer vehicle (MTV). Material transfer Vehicles shall be required due to the improvement in smoothness and decrease in both physical and thermal segregation. To transfer the material from the hauling equipment to the paver, use a self-propelled, material transfer vehicle with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

401-4.4 HMA PAVERS. HMA pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of HMA that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

The paver shall have a receiving hopper of sufficient capacity to permit a continuous and uniform spreading operation. The hopper shall be equipped with a distribution system to place the HMA uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

401-4.4 Automatic Grade Control. The HMA paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices that will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within ±0.1%.

The controls shall be capable of working in conjunction with any of the following attachments:

- (5) Ski-type device of not less than 30 feet in length.
- (6) Taut stringline (wire) set to grade.
- (7) Short ski or shoe.
- (8) Laser control.

If, during construction, it is found that the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement and/or base course that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued and satisfactory equipment shall be provided by the Contractor.

401-4.5 ROLLERS. Rollers of the vibratory, steel wheel, and pneumatic-tired type shall be used. They shall be in good condition, capable of operating at slow speeds to avoid displacement of the HMA. The number, type, and weight of rollers shall be sufficient to compact the HMA to the required density while it is still in a workable condition.
All rollers shall be specifically designed and suitable for compacting hot mix bituminous concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used. Depressions in pavement surfaces caused by rollers shall be repaired by the Contractor at its own expense.

The use of equipment that causes crushing of the aggregate will not be permitted.

401-4.6 Density Device. The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall also supply a qualified technician during all paving operations to calibrate the density gauge and obtain accurate density readings for all new HMA. These densities shall be supplied to the Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

401-4.7 Preparation of Asphalt Binder. The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. The temperature of the unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325 degrees F (160 degrees C) when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F (175°C) when added to the aggregate.

401-4.8 Preparation of Mineral Aggregate. The aggregate for the HMA shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F (175 degrees C) when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

401-4.9 Preparation of Bituminous Mixture. The aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the job mix formula.

The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95 percent of coated particles.

For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all bituminous mixtures upon discharge shall not exceed 0.5 percent.
401-4.10 PREPARATION OF THE UNDERLYING SURFACE. Immediately before placing the HMA, the underlying course shall be cleaned of all dust and debris. A prime coat and/or tack coat shall be applied in accordance with Sections 63 and 64 of these specifications, Bituminous Prime Coat and Bituminous Tack Coat (FAA Items P-602 or P-603, respectively). A tack coat shall be applied in accordance with Section 64, Bituminous Tack Coat (FAA Item P-603) when paving on existing paved surfaces, including asphalt base course, and between all lifts of multiple lift asphalt paving.

401-4.11 LAYDOWN PLAN, TRANSPORTING, PLACING, AND FINISHING. Prior to the placement of the HMA, the Contractor shall prepare a laydown plan for approval by the Engineer. This is to minimize the number of cold joints in the pavement. The laydown plan shall specifically address the paving operations to be performed during night shifts or continuous full runway closures. This type of paving is generally called off peak paving and requires special considerations such as spare equipment, as discussed elsewhere, and a major cleanup effort at the end of each shift to return the runway surface to operation. The laydown plan shall include the sequence of paving laydown by stations, width of lanes, temporary ramp location(s), and laydown temperature. The laydown plan shall also include estimated time of completion for each portion of the work (i.e. milling, paving, rolling, cooling, etc.). Modifications to the laydown plan shall be approved by the Engineer.

The HMA shall be transported from the mixing plant to the site in vehicles conforming to the requirements of paragraph 401-4.3. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature.

The Contractor shall use a material transfer vehicle to deliver mix to the paver for all runway paving.

The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose for the first lift of all runway and taxiway pavements. Successive lifts of HMA surface course may be placed using a ski, or laser control per paragraph 401-4.4.1, provided grades of the first lift of bituminous surface course meet the tolerances of paragraphs 401-5.2b(5) as verified by a survey. Contractor shall survey each lift of HMA surface course and certify to Engineer that every lot of each lift meets the grade tolerances of paragraph 401-5.2b(5) before the next lift can be placed.

The initial placement and compaction of the HMA shall occur at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250°F (121°C). The Contractor shall provide a thermometer onsite to test the temperature of each truck load.

Edges of existing HMA pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and coated with asphalt tack coat before new material is placed against it.

Upon arrival, the mixture shall be placed to the full width by a bituminous paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the HMA mat. Unless
otherwise permitted, placement of the HMA shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 12.5 feet except where edge lanes require less width to complete the area. Additional screed sections shall not be attached to widen paver to meet the minimum lane width requirements specified above unless additional auger sections are added to match. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course.

Transverse joints in adjacent lanes shall be offset a minimum of 10 feet.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the HMA may be spread and luted by hand tools.

Areas of segregation in the course, as determined by the Engineer, shall be removed and replaced at the Contractor’s expense. The area shall be removed by saw cutting and milling a minimum of 2 inches deep. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet long.

401-4.12 COMPACTION OF HMA. After placing, the HMA shall be thoroughly and uniformly compacted by power rollers. The surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor.

The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be equipped with a scraper and kept properly moistened using a water soluble asphalt release agent approved by the Engineer. Excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power driven tampers. Tampers shall weigh not less than 275 pounds, have a tamping plate width not less than 15 inches, be rated at not less than 4,200 vibrations per minute, and be suitably equipped with a standard tamping plate wetting device.

Any HMA that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor’s expense. Skin patching shall not be allowed.

401-4.13 JOINTS. The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall
have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid HMA except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh HMA against the joint.

Longitudinal joints which have been left exposed for more than 4 hours, or whose surface temperature has cooled to less than 175°F; or are irregular, damaged, uncompacted, or otherwise defective shall be cut back 3 to 6 inches to expose a clean, sound surface for the full depth of the course. All cutback material shall be removed from the project. An asphalt tack coat or other product approved by the Engineer shall be applied to the clean, dry joint prior to placing any additional fresh HMA against the joint. Any laitance produced from cutting joints shall be removed by vacuuming and washing. The cost of this work shall be considered incidental to the cost of the HMA. The cost of this work and tack coat shall be considered incidental to the cost of the HMA.

401-4.14 DIAMOND GRINDING. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch (3-mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet (0.9 m) wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The depth of grinding shall not exceed 1/2 inch (13mm) and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. Areas that have been ground will be sealed as directed by the Engineer.

401-4.15 NIGHTTIME PAVING REQUIREMENTS. Paving during nighttime construction shall require the following:

b. All paving machines, rollers, distributor trucks and other vehicles required by the Contractor for his operations shall be equipped with artificial illumination sufficient to safely complete the work.

c. Minimum illumination level shall be twenty (20) horizontal foot candles and maintained in the following areas:

(1) An area of 30 feet wide by 30 feet long immediately behind the paving machines during the operations of the machines.

(2) An area 15 feet wide by 30 feet long immediately in front and back of all rolling equipment, during operation of the equipment.
An area 15 feet wide by 15 feet long at any point where an area is being tack coated prior to the placement of pavement.

d. As partial fulfillment of the above requirements, the Contractor shall furnish and use, complete artificial lighting units with a minimum capacity of 3,000 watt electric beam lights, affixed to all equipment in such a way to direct illumination on the area under construction.

e. A lighting plan must be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work.

f. In addition, the Contractor shall furnish portable floodlight units as necessary to achieve quality requirements. It shall be left to the Engineer’s sole judgment as to whether the Contractor has supplied a satisfactory amount of lighting units.

g. If the Contractor places any out of specification mix in the project work area, the Contractor is required to remove it at its own expense, to the satisfaction of the Engineer. If the Contractor has to continue placing non-payment bituminous concrete, as directed by the Engineer, to make the surfaces safe for aircraft operations, the Contractor shall do so to the satisfaction of the Engineer.

h. See PR-2, Work Sequence Phasing, for other requirements relative to opening night work areas to aircraft traffic after each shift. It is the Contractor’s responsibility to leave the facilities to be paved in a safe condition ready for aircraft operations. The Contractor shall allow sufficient time for the mat to cool to a surface temperature of 160° to mitigate rutting from aircraft loading. No consideration for extended closure time of the area being paved will be given. As a first order of work for the next paving shift, the Contractor shall remove all out of specification material and replace with approved material to the satisfaction of the Engineer. When the above situations occur, there will be no consideration given for additional construction time or payment for extra costs.

401-5 MATERIAL ACCEPTANCE

401-5.1 ACCEPTANCE SAMPLING AND TESTING. Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor.

Testing organizations performing these tests shall be accredited in accordance with ASTM D 3666. The laboratory accreditation must be current and listed on the accrediting authority’s website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory’s current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.
All equipment in Contractor furnished laboratories shall be calibrated by the testing organization prior to the start of operations.

a. **Hot Mixed Asphalt.** Plant-produced HMA shall be tested for air voids, stability and flow on a lot basis. Sampling shall be from material deposited into trucks at the plant or from trucks at the job site. Samples shall be taken in accordance with ASTM D 979.

A standard lot shall be equal to one day’s production or 2,000 tons whichever is smaller. If the day’s production is expected to exceed 2,000 tons, but less than 4,000 tons, the lot size shall be 1/2 day’s production. If the day’s production exceeds 4,000 tons, the lot size shall be an equal sized fraction of the day’s production, but shall not exceed 2,000 tons.

Where more than one plant is simultaneously producing HMA for the job, the lot sizes shall apply separately for each plant.

(1) **Sampling.** Each lot will consist of four equal sublots. Sufficient HMA for preparation of test specimens for all testing will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D3665. Samples will be taken in accordance with ASTM D979.

The sample of HMA may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to stabilize to compaction temperature. The compaction temperature of the specimens shall be as specified in the JMF.

(2) **Testing.** Sample specimens shall be tested for stability and flow in accordance with ASTM D 6927. Air voids will be determined by the Engineer in accordance with ASTM D 3203. One set of laboratory compacted specimens will be prepared for each subplot in accordance with ASTM D 6926 at the number of blows required by paragraph 401-3.2, Table 1. Each set of laboratory compacted specimens will consist of three test specimens prepared from the same sample. The manual hammer in ASTM D 6926 shall be used.

Prior to testing, the bulk specific gravity of each test specimen shall be measured by the Engineer in accordance with ASTM D 2726 using the procedure for laboratory-prepared thoroughly dry specimens for use in computing air voids and pavement density.

For air voids determination, the theoretical maximum specific gravity of the mixture shall be measured one time for each subplot in accordance with ASTM D 2041. The value used in the air voids computation for each subplot shall be based on theoretical maximum specific gravity measurement for the subplot.

The stability and flow for each subplot shall be computed by averaging the results of all test specimens representing that subplot.
(3) **Acceptance.** Acceptance of plant produced HMA for stability, flow, and air voids shall be determined by the Engineer in accordance with the requirements of paragraph 401-5.1.

b. **In-Place HMA.** HMA placed in the field shall be tested for mat and joint density on a lot basis. A standard lot shall be equal to one day’s production or 2,000 tons whichever is smaller. If the day’s production is expected to exceed 2,000 tons, but less than 4,000 tons, the lot size shall be 1/2 day’s production. If the day’s production exceeds 4,000 tons, the lot size shall be an equal sized fraction of the day’s production, but shall not exceed 2,000 tons.

(1) **Mat Density.** The lot size shall be the same as that indicated in paragraph 401-5.1a. The lot shall be divided into four equal sublots. One core of finished, compacted HMA shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D 3665. Cores shall not be taken closer than one foot from a transverse or longitudinal joint.

(2) **Joint Density** The lot size shall be the total length of longitudinal joints constructed by a lot of HMA as defined in paragraph 401-5.1a. The lot shall be divided into four equal sublots. One core of finished, compacted materials shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D 3665. All cores for joint density shall be taken centered on the joint. The minimum core diameter for joint density determination shall be 5 inches.

(3) **Sampling.** Samples shall be neatly cut with a diamond core drill bit. Samples will be taken in accordance with ASTM D 979. The minimum diameter of the sample shall be 5 inches. Samples that are defective, as a result of sampling, shall be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Cored pavement shall be cleaned and core holes shall be filled in a manner acceptable to the Engineer and within one day after sampling. Laitance produced by the coring operation shall be removed immediately. The top most lift of bituminous material shall be completely bonded to the underlying layers of bituminous material. If any of the cores reveal that the surface is not bonded to the bituminous layer immediately below the surface then additional cores shall be taken as directed by the Engineer in accordance with paragraph 401-5.1b to determine the extent of any delamination. All delaminated areas shall be completely removed by milling to the limits and depth and replaced as directed by the Engineer at no additional cost.
(4) **Testing.** The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D 2726. Samples will be taken in accordance with ASTM D 979. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each subplot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, as determined in paragraph 401-5.1a(2). The bulk specific gravity used to determine the joint density at joints formed between different lots shall be the lowest of the bulk specific gravity values from the two different lots.

(5) **Acceptance.** Acceptance of field placed HMA for mat density will be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b(1). Acceptance for joint density will be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b(2).

c. **Partial Lots HMA.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or when the Contractor and Engineer agree in writing to allow overages or other minor tonnage placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

The last batch produced where production is halted will be sampled, and its properties shall be considered as representative of the particular subplot from which it was taken. In addition, an agreed to minor placement will be sampled, and its properties shall be considered as representative of the particular subplot from which it was taken. Where three sublots are produced, they shall constitute a lot. Where one or two sublots are produced, they shall be incorporated into the next lot, and the total number of sublots shall be used in the acceptance plan calculation, i.e., \( n = 5 \) or \( n = 6 \), for example. Partial lots at the end of asphalt production on the project shall be included with the previous lot. The lot size for field placed material shall correspond to that of the plant material, except that, in no cases, shall less than three (3) cored samples be obtained, that is, \( n = 3 \).

**401-5.2 ACCEPTANCE CRITERIA.**

a. **General.** Acceptance will be based on the following characteristics of the bituminous mixture and completed pavement and test results:

(1) Air Voids
(2) Mat density
(3) Joint density
(4) Thickness
(5) Smoothness

(6) Grade

(7) Stability

(8) Flow

Mat density will be evaluated for acceptance in accordance with paragraph 401-5.2b(1). Stability and flow will be evaluated for acceptance in accordance with paragraph 401-5.1. Joint density will be evaluated for acceptance in accordance with paragraph 401-5.2b(2).

Thickness will be evaluated by the Engineer for compliance in accordance with paragraph 401-5.2b(3). Acceptance for smoothness will be based on the criteria contained in paragraph 401-5.2b(4). Acceptance for grade will be based on the criteria contained in paragraph 401-5.2b(5).

The Engineer may at any time reject and require the Contractor to dispose of any batch of HMA which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

b. Acceptance Criteria.

(1) Mat Density. Acceptance of each lot of plant produced material for mat density shall be based on the average of all of the densities taken from the sublots. If the average mat density of the lot so established equals or exceeds 96 percent, the lot shall be acceptable. If the average mat density of the lot is below 96 percent, the lot shall be removed and replaced at the Contractor’s expense.

(2) Joint Density. Acceptance of each lot of plant produced HMA for joint density shall be based on the average of all of the joint densities taken from the sublots. If the average joint density of the lot so established equals or exceeds 96 percent, the lot shall be acceptable. If the average joint density of the lot is less than 96 percent, the Contractor shall stop production and evaluate the method of compacting joints. Production may resume once the reason for poor compaction has been determined and appropriate measures have been taken to ensure proper compaction.

(3) Thickness. Thickness of each course shall be evaluated by the Engineer for compliance to the requirements shown on the plans.
Measurements of thickness shall be made by the Engineer using the cores extracted for each sublot for density measurement. The maximum allowable deficiency at any point shall not be more than ¼ inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness. Where thickness deficiency exceeds the specified tolerances, the lot or sublot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the Engineer to circumscribe the deficient area.

(4) **Smoothness.** The final surface shall be free from roller marks. After final rolling, but not later than 24 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness to reveal all surface irregularities exceeding the tolerances specified. The Contractor shall furnish paving equipment and employ methods that produce a surface for each pavement lot such that the finished surface course of the pavement shall not vary more than 1/4 inch (6mm) when evaluated with a 12-foot (3.7m) straightedge. When the surface course smoothness exceeds specification tolerances which cannot be corrected by diamond grinding of the surface course, full depth removal and replacement of surface course corrections shall be to the limit of the longitudinal placement. Corrections involving diamond grinding will be subject to the final pavement thickness tolerances specified. The Contractor shall apply a surface treatment per Item P-608 to all areas that have been subject to grinding as directed by the Engineer.

(a) **Transverse Measurements.** Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet (15m) or more often as determined by the Engineer.

(1) Testing shall be continuous across all joints, starting with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. Deviations on final
surface course > 1/4 inch (6mm) in transverse direction shall be corrected with diamond grinding per paragraph 401-4.13 or by removing and replacing full depth of surface course. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

(2) The joint between lots shall be tested separately to facilitate smoothness between lots. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface, with half the straightedge on one side of the joint and the other half of the straightedge on the other side of the joint. Measure the maximum gap between the straightedge and the pavement surface in the area between these two high points. One measurement shall be taken at the joint every 50 feet (15m) or more often if directed by the Engineer. Deviations on final surface course > 1/4 inch (6mm) in transverse direction shall be corrected with diamond grinding per paragraph 401-4.13 or by removing and replacing full depth of surface course. Each measurement shall be recorded and a copy of the data shall be furnished to the Engineer at the end of each days testing

(3) Longitudinal Measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6m); and the third points of paving lanes when widths of paving lanes are 20 ft (6m) or greater. The finished surface shall not vary more than 1/4 inch (6mm) when evaluated with a 12-foot (3.7m) straightedge. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. Testing shall be continuous across all joints, starting with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the
pavement surface in the area between these two high points. Deviations on final surface course > 1/4 inch (6mm) in longitudinal direction will be corrected with diamond grinding per paragraph 401-4.13 or by removing and replacing full depth of surface course. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding. The primary purpose of smoothness testing is to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. If the contractor’s machines and/or methods are producing significant areas that need corrective actions then production should be stopped until corrective measures can be implemented. If corrective measures are not implemented and when directed by the Engineer, production shall be stopped until corrective measures can be implemented.

(5) **Grade.** Grade shall be evaluated on the first day of placement and then daily at a minimum to allow adjustments to paving operations if measurements do not meet specification requirements. The Contractor must submit the survey data to the Engineer by the following day after measurements have been taken. The finished surface of the pavement shall not vary from the gradeline elevations and cross sections shown on the plans by more than ½ inch. The finished grade of each lot will be determined by running levels at intervals of 50 feet or less longitudinally and all breaks in grade transversely (not to exceed 50 feet) to determine the elevation of the completed pavement. The Contractor shall pay the cost of surveying of the level runs that shall be performed by a licensed surveyor. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer. The lot size shall be 2,000 square yards. When more than 15 percent of all the measurements within a lot are outside the specified tolerance, or if any one shot within the lot deviates ¾ inch or more from planned grade, the Contractor shall remove the deficient area to the depth of the final course of pavement and replace with new material. Skin patching shall not be permitted. Isolated high points may be ground off providing the course thickness complies with the thickness specified on the plans. High point grinding will be limited to 15 square yards. The surface of the ground pavement shall have a texture consisting of grooves between 0.090 and 0.130 inches wide. The peaks and ridges shall be approximately 1/32 inch higher than the bottom of the grooves. The pavement shall be left in a clean condition. The removal of all of the slurry resulting from the grinding operation shall be continuous. The grinding operation should be controlled so the residue from the operation does not flow across other lanes of pavement. Areas in excess of 15 square yards will
require removal and replacement of the pavement in accordance with the limitations noted above. Contractor shall apply a surface treatment per P-608 to all areas that have been subject to grinding.

c. **Percentage of material within specification limits (PWL).** The PWL shall be determined in accordance with procedures specified in Section 110 of the General Provisions. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 5.

Table 5. Marshall Acceptance Limits For Stability, Flow, Air Voids, Density

<table>
<thead>
<tr>
<th>TEST PROPERTY</th>
<th>Pavements Designed for Aircraft Gross Weights of 60,000 lbs (27216 kg) or More or Tire Pressures of 100 psi or More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Blows</td>
<td>75 blows</td>
</tr>
<tr>
<td></td>
<td><strong>Specification Tolerance Limits</strong></td>
</tr>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Stability, minimum (lbs)</td>
<td>1800</td>
</tr>
<tr>
<td>Flow, 0.01-in</td>
<td>8</td>
</tr>
<tr>
<td>Air Voids Total Mix (%)</td>
<td>2</td>
</tr>
<tr>
<td>Surface Course Mat Density (%)</td>
<td>96</td>
</tr>
<tr>
<td>Base Course Mat Density (%)</td>
<td>96</td>
</tr>
<tr>
<td>Joint density (%)</td>
<td>96</td>
</tr>
</tbody>
</table>

d. **Outliers.** All individual tests for mat density and air voids shall be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers shall be discarded, and the PWL shall be determined using the remaining test values. The criteria in Table 5 is based on production processes which have a variability with the following standard deviations: Surface Course Mat Density (%), 1.30; Base Course Mat Density (%), 1.55; Joint Density (%), 2.1.

The Contractor should note that (1) 90 PWL is achieved when consistently producing a surface course with an average mat density of at least 98% with 1.30% or less variability, (2) 90 PWL is achieved when consistently producing a base course with an average mat density of at least 97.5% with 1.55% or less variability, and (3) 90 PWL is achieved
when consistently producing joints with an average joint density of at least 96% with 2.1% or less variability.

401-5.3 RESAMPLING PAVEMENT FOR MAT DENSITY

a. **General.** Resampling of a lot of pavement will only be allowed for mat density and then, only if the Contractor requests same in writing, within 48 hours after receiving the written test results from the Engineer. A retest will consist of all the sampling and testing procedures contained in paragraphs 401-5.1. Only one resampling per lot will be permitted.

   (1) A redefined mat density shall be calculated for the resampled lot. The number of tests used to calculate the redefined mat density shall include the initial tests made for that lot plus the retests.

   (2) The cost for resampling and retesting shall be borne by the Contractor.

b. **Payment for Resampled Lots.** The redefined PWL for a resampled lot shall be used to calculate the payment for that lot in accordance with Table 6.

c. **Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%.

401-5.4 LEVELING COURSE. Section not used.

401-6 CONTRACTOR QUALITY CONTROL

401-6.1 GENERAL. The Contractor shall perform quality control sampling, testing, and inspection during all phases of the work and shall perform them at a rate sufficient to ensure that the work conforms to the contract requirements, and at minimum test frequencies required by paragraph 401-6.3, including but not limited to:

a. **Mix Design**

b. **Aggregate Grading**

c. **Quality of Materials**

d. **Stockpile Management**

e. **Proportioning**

f. **Mixing and Transportation**

g. **Placing and Finishing**
The Contractor shall perform quality control sampling, testing, and inspection during all phases of the work and shall perform them at a rate sufficient to ensure that the work conforms to the contract requirements, and at minimum test frequencies required by paragraph 401-6.3 and Project Requirements Section PR-10. As a part of the process for approving the Contractor’s plan, the Engineer may require the Contractor’s technician to perform testing of samples to demonstrate an acceptable level of performance.

No partial payment will be made for materials that are subject to specific quality control requirements without an approved plan.

401-6.2 CONTRACTOR TESTING LABORATORY. The lab shall meet the requirements of ASTM D3666 including all necessary equipment, materials, and current reference standards to comply with the specifications.

401-6.3 QUALITY CONTROL TESTING. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to the specifications and as set forth in the approved Quality Control Program. The testing program shall include, but not necessarily limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction and surface smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

All testing may be witnessed by the Engineer and/or by the City of Los Angeles Standards Division.

a. **Asphalt Content.** A minimum of two asphalt content tests shall be performed per lot in accordance with ASTM D 6307 of ASTM D 2172 if the correction factor in ASTM D 6307 is greater than 1.0. The asphalt content for the lot will be determined by averaging the test results.

b. **Gradation.** Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D 5444 and ASTM C 136, and ASTM C 117.

c. **Moisture Content of Aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.
d. **Moisture Content of HMA.** The moisture content of the HMA shall be determined once per lot in accordance with ASTM D 1461 or AASHTO T329.

e. **Temperatures.** Temperatures shall be checked, at least four times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the HMA at the plant, and the HMA at the job site.

f. **In-Place Density Monitoring.** The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D 2950.

g. **Additional Testing.** Any additional testing that the Contractor deems necessary to control the process may be performed at the Contractor’s option.

h. **Monitoring.** The Engineer reserves the right to monitor any or all of the above testing.

401-6.4 **SAMPLING.** When directed by the Engineer, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

401-6.5 **CONTROL CHARTS.** The Contractor shall maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each sublot will be calculated and monitored by the Quality Control laboratory.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor’s test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor’s projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may suspend production or acceptance of the material.

a. **Individual Measurements.** Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content and VMA. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:
CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Action Limit</th>
<th>Suspension Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 inch</td>
<td>±6%</td>
<td>±9%</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>±6%</td>
<td>±9%</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>±6%</td>
<td>±9%</td>
</tr>
<tr>
<td>No. 4</td>
<td>±6%</td>
<td>±9%</td>
</tr>
<tr>
<td>No. 16</td>
<td>±5%</td>
<td>±7.5%</td>
</tr>
<tr>
<td>No. 50</td>
<td>±3%</td>
<td>±4.5%</td>
</tr>
<tr>
<td>No. 200</td>
<td>±2%</td>
<td>±3%</td>
</tr>
<tr>
<td>Asphalt Content</td>
<td>±0.45%</td>
<td>±0.70%</td>
</tr>
<tr>
<td>VMA</td>
<td>-1.00%</td>
<td>-1.5%</td>
</tr>
</tbody>
</table>

b. **Range.** Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of \( n = 2 \). Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for \( n = 3 \) and by 1.27 for \( n = 4 \).

CONTROL CHART LIMITS BASED ON RANGE(Based on \( n = 2 \))

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Suspension Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 inch</td>
<td>11 %</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>11 %</td>
</tr>
<tr>
<td>No. 4</td>
<td>11 %</td>
</tr>
<tr>
<td>No. 16</td>
<td>9 %</td>
</tr>
<tr>
<td>No. 50</td>
<td>6 %</td>
</tr>
<tr>
<td>No. 200</td>
<td>3.5 %</td>
</tr>
<tr>
<td>Asphalt Content</td>
<td>0.8 %</td>
</tr>
</tbody>
</table>

c. **Corrective Action.** The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or
(2) Two points in a row fall outside the Action Limit line for individual measurements.

401-6.6 QUALITY CONTROL REPORTS. The Contractor shall maintain records and shall submit reports of quality control activities daily per Project Requirements 14, Quality Control Program.

401-7 METHOD OF MEASUREMENT. See Section 62-8.

401-8 BASIS OF PAYMENT. See Section 62-8.

Table 6. Price adjustment schedule

<table>
<thead>
<tr>
<th>Percentage of material within specification limits (PWL)</th>
<th>Lot pay factor (percent of contract unit price)</th>
</tr>
</thead>
<tbody>
<tr>
<td>96 – 100</td>
<td>106</td>
</tr>
<tr>
<td>90 – 95</td>
<td>PWL + 10</td>
</tr>
<tr>
<td>75 – 89</td>
<td>0.5 PWL + 55</td>
</tr>
<tr>
<td>55 – 74</td>
<td>1.4 PWL – 12</td>
</tr>
<tr>
<td>Below 55</td>
<td>Reject 2</td>
</tr>
</tbody>
</table>

1 Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project payment limitation specified in paragraph 401-8.1.

2 The lot shall be removed and replaced. However, the Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50% of the contract unit price and the total project payment shall be reduced by the amount withheld for the rejected lot.

401-9 TESTING REQUIREMENTS

ASTM C 29       Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 88       Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117      Materials Finer than 75μm (No.200) Sieve in Mineral Aggregates by Washing
ASTM C 127      Specific Gravity and Absorption of Coarse Aggregate
ASTM C 131      Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136      Sieve Analysis of Fine and Coarse Aggregates
ASTM C 183      Sampling and the Amount of Testing of Hydraulic Cement
Los Angeles International Airport
Runway 25R Reconstruction Project
Attachment 3(f)  May 15, 2017

ASTM C 566  Total Evaporable Moisture Content of Aggregate by Drying
ASTM D 75   Sampling Aggregates
ASTM D 979  Sampling Bituminous Paving Mixtures
ASTM D 1073 Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1074 Compressive Strength of Bituminous Mixtures
ASTM D 1461 Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 2041 Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172 Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419 Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489 Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 2950 Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 3665 Random Sampling of Construction Materials
ASTM D 3666 Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 4125 Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4791 Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867 Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444 Mechanical Size Analysis of Extracted Aggregate
ASTM D 5581 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6” Diameter Specimen)
ASTM D 6307 Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method
ASTM D 6752 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
401-10 MATERIAL REQUIREMENTS

ASTM D 242  Mineral Filler for Bituminous Paving Mixtures
ASTM D 946  Penetration Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3381  Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4552  Classifying Hot-Mix Recycling Agents
ASTM D 6373  Specification for Performance Graded Asphalt Binder

END OF ITEM P-401

62-5 ASPHALT CONCRETE (GREENBOOK/BROWNBOOK)


62-5.2 MATERIALS.

a. Surface or Base Course Mixes shall be as follows:
   1. Type C2
b. Binder shall be PG 64-10.
62-5.3 CONSTRUCTION. All provisions of Section 302-5 – Asphalt Concrete Pavement, of the Standard Specifications for Public Works Construction shall apply, except that the compacted mix shall conform to the acceptance criteria in Sections of 401-4.1, 401-4.2 and 401-4.3, herein.

62-6 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Job Mix Formula
   1. Aggregates
   2. Bitumen
b. Plant and Equipment
c. Laboratory Certifications
d. Testing Facility Certification
e. Laydown Plan

62-7 TEST STRIP

Prior to being given approval to begin production paving for the Asphalt Concrete (P-401) pavement, the Contractor shall construct a 100 feet x 200 feet test section (“test strip”) or the dimensions shown on the plans, using the materials, equipment and methods intended for use for the main production for the project. The test section shall be constructed at the location, and to the dimensions, lines and grades shown on the plans, or at a location mutually agreeable to the Engineer and Contractor, and shall include construction of all subsurface layers as shown on the plans.

The intent of the test section is to allow the Contractor to demonstrate that asphalt concrete satisfying all project requirements can be batched, mixed, hauled, placed, and compacted within the specified conditions. The Contractor is expected to adjust the mix, adjust equipment, and modify procedures such that by the end of the test strip the best possible product is attained.

The Contractor shall demonstrate mixing, transporting, placing, compaction, protection, and the performance of the quality control functions specified. The Contractor shall place asphalt concrete using the people, procedures, and equipment which will be used on the work. Any adjustments made to the mix, or to placing and compaction procedures to meet field conditions, will be coordinated with the Engineer prior to implementation by the Contractor.

The Engineer will observe the construction of the test section. The Contractor shall obtain written approval of the test section, from the Engineer, before proceeding with production work. If the test section, or any part thereof, is rejected, the cause shall be documented and reasons for rejection provided. The test section approval/rejection will be issued by the Engineer at the end of the day on which the test section is placed. The work will not proceed until the Contractor can demonstrate the placement and finish of an acceptable test section.

Asphalt concrete placed within a test section that is not accepted shall be removed and replaced, at the sole expense of the Contractor unless other arrangements are approved by the Engineer.
The quality of all approved aspects of the accepted test section shall be used throughout the project as the standard of quality against which pavement will be judged for acceptability.

62-8 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. Asphalt Concrete (P-401)
2. Asphalt Concrete (Greenbook/Brownbook)

END OF SECTION 62
SECTION 63 – BITUMINOUS PRIME COAT (FAA P-602) AND DUST PALLIATIVE

63-1 GENERAL. The Contractor shall provide bituminous prime coat on unbound base layers (i.e.: aggregate base) prior to paving with asphalt surface course. Application of bituminous prime coat shall be in accordance with the FAA Specification Item P-602, as included and modified hereafter. Prime coat shall be required on compacted aggregate base course prior to paving bituminous concrete.

Under this section the Contractor shall also provide spray application of dust palliative material as necessary to control fugitive dust in order to alleviate air quality issues. Dust Palliative shall conform to subsection 63-5.

63-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

63-3 RELATED SECTIONS

Section 24 - Watering

Other Sections, Tests, Specifications, and Standards referenced herein.

63-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-602 BITUMINOUS PRIME COAT

602-1 DESCRIPTION. This item shall consist of an application of bituminous material on the prepared base course in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

602-2 MATERIALS

602-2.1 BITUMINOUS MATERIAL. The bituminous material shall be an emulsified asphalt indicated in ASTM D 3628 as a bituminous application for prime coat appropriate to local conditions or as designated by the Engineer.

Table 1 Bituminous Material

<table>
<thead>
<tr>
<th>Type and Grade</th>
<th>Specification</th>
<th>Application Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Deg. F</td>
</tr>
<tr>
<td>Emulsified Asphalt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type and Grade</td>
<td>Specification</td>
<td>Application Temperature</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deg. F</td>
</tr>
<tr>
<td>SS-1h</td>
<td>ASTM D 977</td>
<td>75-130</td>
</tr>
<tr>
<td>CSS-1h</td>
<td>ASTM D 2397</td>
<td>75-130</td>
</tr>
<tr>
<td>PG Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64-10</td>
<td>MP-320</td>
<td></td>
</tr>
</tbody>
</table>

602-3 CONSTRUCTION METHODS

602-3.1 WEATHER LIMITATIONS. The prime coat shall be applied only when the existing surface is dry; the atmospheric temperature is 50°F (10°C) or above, and the temperature has not been below 35°F (2°C) for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer.

602-3.2 EQUIPMENT. The equipment shall include a self-powered pressure bituminous material distributor and equipment for heating bituminous material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi (4.5 kg/sq cm) of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard (0.23 to 9.05 L/square meter), with a pressure range of 25 to 75 psi (172.4 to 517.1 kPa) and with an allowable variation from the specified rate of not more than ±5%, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner.

A power broom and power blower suitable for cleaning the surfaces to which the bituminous coat is to be applied shall be provided.
602-3.3 APPLICATION OF BITUMINOUS MATERIAL

Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

The bituminous material shall be uniformly applied with a bituminous distributor at the rate of 0.15 to 0.30 gallons per square yard depending on the base course surface texture. The type of bituminous material, application temperature, and application rate shall be approved by the Engineer prior to application.

Following the application of the bituminous material and prior to application of the succeeding layer of pavement, allow the bituminous coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough sand to effectively blot up and cure excess bituminous material. Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner.

602-3.4 TRIAL APPLICATIONS.

Before providing the complete bituminous coat, the Contractor shall apply three lengths of at least 100 feet (30 m) for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied with the equipment. Apply three different trial application rates of bituminous materials within the application range specified in paragraph 602-3.3. Other trial applications will be made using various amounts of material as deemed necessary by the Engineer.

602-3.5 BITUMINOUS MATERIAL CONTRACTOR’S RESPONSIBILITY

The Contractor shall provide a statement of source and character of the proposed bituminous material which must be submitted to and approved by the Engineer before any shipment of bituminous materials to the project. The Contractor shall furnish vendor’s certified test reports for each carload, or equivalent, of bituminous material shipped to the project. The test reports shall be provided to and approved by the Engineer before the bituminous material is applied. If the bituminous material does not meet the specifications, it shall be replaced at the Contractor’s expense. Furnishing the vendor’s certified test report for the bituminous material shall not be interpreted as basis for final acceptance.

602-3.6 FREIGHT AND WEIGH BILLS

The Contractor shall submit waybills and delivery tickets during the progress of the work. Before the final estimate is allowed, file with the Engineer certified
waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the contract. Do not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

602-4  **METHOD OF MEASUREMENT.**  See Section 63-7.

602-5  **BASIS OF PAYMENT.**  See Section 63-8.

602-6  **MATERIAL REQUIREMENTS**

ASTM D 977  Emulsified Asphalt

ASTM D 2028  Standard Specification for Cutback Asphalt (Rapid-Curing Type)

ASTM D 2397  Cationic Emulsified Asphalt

ASTM D 3628  Selection and Use of Emulsified Asphalts

602-7  **TESTING REQUIREMENTS**


END OF ITEM P-602

63-5  **DUST PALLIATIVE**

63-5.1  **DUST PALLIATIVE – GENERAL.**  Monitor air quality and provide dust control measures to limit dust as required by the specifications and as directed by the Engineer. See Section 24 of these specifications, Watering, for additional information regarding dust control.

63-5.2  **DUST PALLIATIVE - MATERIALS**

63-5.3  Dust control binders or dust palliative must be either miscible in water or a material that is directly applied to the surface without mixing with water. Binders that are miscible in water must be one of the following types:

a.  Resin emulsion composed from 57 to 63 percent of semiliquid petroleum resin and the remainder shall be composed of water to which a suitable emulsifying agent has been added. Resin emulsion must comply with the following:

   1.  Resin emulsion must be readily miscible with water and when diluted with any hard water in the proportions of 1 part emulsion to 10 parts water must show no signs of breakdown or separation of the petroleum resin base.
2. Resin emulsion that has been stored in closed containers at temperatures above freezing for a period up to 3 months must show no signs of separation.

3. Resin emulsion that has been stored for more than 3 months must not be used until tested and approved by the Engineer.

b. Asphal tic emulsion complying with the material specifications for asphaltic emulsions, Grade SS1.

c. Binder materials composed of lignin sulfonate.

d. Binder material that is noncorrosive, effective as a dust palliative, and miscible in water in the proportions specified below.

Binders that are directly applied to the surface without mixing with water must be a product prepared from crude petroleum that is effective as a dust palliative.

63-5.4 DUST PALLIATIVE - CONSTRUCTION METHODS

a. General. Monitor conditions and apply dust palliative for dust control as described and as ordered. Dust control may be required at any time.

b. Mixing. Mix binders that are miscible in water with additional water at a rate of 4 to 19 parts water to 1 part binder. The exact rate shall be approved by the Engineer. Accomplish mixing by placing the binder and water in the spreading equipment simultaneously or by another mixing method that produces equivalent results.

c. Application. Apply binders that are miscible in water with pressure type water distributor trucks equipped with a spray system or pressure type asphalt distributors that comply with mixing and application specifications in subsection 602-3.2., above. Apply material at an approximate rate of 0.2 to 0.8 gal/sq yd.

d. Apply binders that are directly applied to the surface without mixing with water using authorized equipment. Apply binder at a rate of 0.10 to 0.25 gal/sq yd.

63-6 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Bituminous Prime Coat

b. Spraying Equipment

c. Dust Palliatives

63-7 METHOD OF MEASUREMENT

The bituminous material for prime coat and will not be measured for payment but is considered incidental to the construction for which it is required.

The material for Dust Palliative will not be measured for payment but is considered incidental to other construction and no separate payment will be made.
63-8 BASIS OF PAYMENT

Bituminous Prime Coat is considered incidental to other items of construction and no separate payment will be made.

Dust Palliative is considered incidental to other items of construction and no separate payment will be made.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 63
SECTION 64 – BITUMINOUS TACK COAT (FAA P-603)

64-1 GENERAL. The Contractor shall perform all work required by the plans for application of bituminous tack coat in accordance FAA Specification Item P-603, as included and modified hereafter, and as shown on the Plans or as directed by the Engineer.

Tack coat shall be required prior to paving bituminous concrete on Portland cement concrete or asphalt concrete pavement, and on underlying lifts of multiple-lift asphalt paving. Both horizontal and vertical faces shall be tacked, including vertical surfaces of structures penetrating asphalt surfacing, such as utility vaults, manholes, concrete curbs, etc.

64-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

64-3 RELATED SECTIONS

Section 62 – Hot Mix Asphalt (HMA) – Surface and Base Course (FAA P-401 & Greenbook/Brownbook)

Other Sections, Tests, Specifications, and Standards referenced herein.

64-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-603 BITUMINOUS TACK COAT

603-1 DESCRIPTION. This item shall consist of preparing and treating a bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

603-2 MATERIALS

603-2.1 BITUMINOUS MATERIALS. The bituminous material shall be an emulsified asphalt, indicated in ASTM D 3628 as a bituminous application for tack coat appropriate to local conditions or as designated by the Engineer.

Table 1 Bituminous Material

<table>
<thead>
<tr>
<th>Type and Grade</th>
<th>Specification</th>
<th>Application Temperature Deg. F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsified Asphalt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS-1h</td>
<td>ASTM D 977</td>
<td>75-130</td>
</tr>
<tr>
<td>CSS-1h</td>
<td>ASTM D 2397</td>
<td>75-130</td>
</tr>
</tbody>
</table>
603-3 CONSTRUCTION METHODS

603-3.1 WEATHER LIMITATIONS. The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50°F (10°C) or above; the temperature has not been below 35°F (2°C) for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer.

603-3.2 EQUIPMENT. The Contractor shall provide equipment for heating and applying the bituminous material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi (4.5 kg/sq cm) of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard (0.23 to 9.05 L/square meter), with a pressure range of 25 to 75 psi (172.4 to 517.1 kPa) and with an allowable variation from the specified rate of not more than ±5%, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the tack operations shall be started and stopped on building paper. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner.

A power broom and/or power blower suitable for cleaning the surfaces to which the bituminous tack coat is to be applied shall be provided.

603-3.3 APPLICATION OF BITUMINOUS MATERIAL

Immediately before applying the tack coat, the full width of surface to be treated shall be swept with a power broom and/or power blower to remove all loose dirt and other objectionable material. Each lift and edge shall have tack coat application.

Emulsified asphalt shall be diluted by the addition of water when directed by the Engineer and shall be applied a sufficient time in advance of the paver to ensure
that all water has evaporated before the overlying mixture is placed on the tacked surface.

The bituminous material including vehicle shall be uniformly applied with a bituminous distributor at the rate of 0.05 to 0.10 gallons per square yard for emulsions depending on the condition of the existing surface. The type of bituminous material and application rate shall be approved by the Engineer prior to application.

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the Engineer.

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time as may be necessary to permit drying out and setting of the tack coat. This period shall be determined by the Engineer, however, in instances where 48 hours has elapsed or the surface has been exposed to a rain event, the Contractor shall evaluate to guarantee that adequate bond can be achieved. The Contractor shall protect the tack coat and maintain and/or repair the surface until the overlying course has been placed. Suitable precautions shall be taken by the Contractor to protect the surface against damage during this interval. The Contractor shall complete repairs as necessary at no additional cost to the Owner.

**603-3.4 BITUMINOUS MATERIAL CONTRACTOR’S RESPONSIBILITY**

Samples of the bituminous material that the Contractor proposes to use, together with a statement as to its source and character, must be submitted and approved before use of such material begins. The Contractor shall require the manufacturer or producer of the bituminous material to furnish material subject to this and all other pertinent requirements of the contract. Only satisfactory materials so demonstrated by service tests, shall be acceptable.

The Contractor shall furnish the vendor’s certified test reports for each carload, or equivalent, of bituminous material shipped to the project. The tests reports shall contain all the data required by the applicable specification. If the Contractor applies the material prior to receipt of the tests reports, payment for the material shall be withheld until they are received. If the material does not pass the specifications it shall be replaced at the Contractor’s expense. The report shall be delivered to the Engineer before permission is granted for use of the material. The furnishing of the vendor’s certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. All such test reports shall be subject to verification by testing samples of material received for use on the project.

**603-4 METHOD OF MEASUREMENT.** See Section 64-6.

**603-5 BASIS OF PAYMENT.** See Section 64-7.
603-6  MATERIAL REQUIREMENTS

ASTM D 633  Volume Correction Table for Road Tar
ASTM D 977  Emulsified Asphalt
ASTM D 1250  Petroleum Measurement Tables
AASHTO M320  Standard Spec. for Performance-Graded Asphalt Binder

Asphalt Institute Manual MS-6
Asphalt Pocketbook of Useful Information (Temperature-Volume Corrections for Emulsified Asphalts) Table IV-3

END ITEM P-603

64-5  SUBMITTALS. Submittals required for this item include, but are not limited to:

a.  Bituminous Tack Coat
b.  Spraying Equipment

64-6  METHOD OF MEASUREMENT

Bituminous material for tack coat will not be measured for payment but is considered incidental to the pavement construction for which it is required.

64-7  BASIS OF PAYMENT

Bituminous Tack Coat is considered incidental to the pavement being constructed, and no separate payment will be made.

No separate payment will be made for performing the work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 64
SECTION 70 – PORTLAND CEMENT CONCRETE PAVEMENT (FAA P-501)

70-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of jointed portland cement concrete pavement for runways, taxiways and aprons as shown on the Plans, and in accordance with FAA Specification Item P-501 as included and modified hereafter.

All testing under this section shall be the responsibility of the Contractor and witnessed by the Engineer. Tests shall include Flexural Strength, Thickness Coring, Thickness, Smoothness, Straightedge, Profiligraph, Grade, Edge Slump, etc.

70-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

70-3 RELATED SECTIONS
   a. Project Requirements 14 – Quality Control Program (FAA 100)
   b. Section 21 – Method of Determining Percentage within Specified Limits (PWL) (FAA 110)
   c. Section 71 – Concrete Repair
   d. Section 72 – Compression Joint Seals for Concrete Pavements (FAA P-604)
   e. Section 73 – Joint Sealing Filler (FAA P-605)
   f. Other Sections, Tests, Specifications, and Standards referenced herein.

70-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-501 PORTLAND CEMENT CONCRETE PAVEMENT

DESCRIPTION

501-1.1 This work shall consist of pavement composed of portland cement concrete (PCC), with and without reinforcement constructed on a prepared underlying surface in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross-sections shown on the plans.
MATERIALS

501-2.1 Aggregates.

a. Reactivity. Fine and Coarse aggregates to be used in all concrete shall be evaluated and tested by
the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Aggregate and mix proportion reactivity tests shall be performed for each project.

(1) Coarse and fine aggregate shall be tested separately in accordance with ASTM C1260. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.10% at 28 days (30 days from casting).

(2) Combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) Concrete Research Division (CRD) C662. If lithium nitrate admixture is used, it shall be nominal 30% ±0.5% weight lithium nitrate in water.

(3) If the expansion of the proposed combined materials test specimens, tested in accordance with ASTM C1567, modified for combined aggregates, or COE CRD C662, does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion of the proposed combined materials test specimens is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

b. Fine aggregate. Fine aggregate shall conform to the requirements of ASTM C33. Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and shall have a fineness modulus of not less than 2.50 nor more than 3.40. The soundness loss shall not exceed 10% when sodium sulfate is used or 15% when magnesium sulfate is used, after five cycles, when tested per ASTM C88.

The amount of deleterious material in the fine aggregate shall not exceed the following limits:

<table>
<thead>
<tr>
<th>Deleterious material</th>
<th>ASTM</th>
<th>Percentage by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay Lumps and friable particles</td>
<td>ASTM C142</td>
<td>1.0</td>
</tr>
<tr>
<td>Material finer than 0.075mm (No. 200 sieve)</td>
<td>ASTM C117</td>
<td>3.0</td>
</tr>
<tr>
<td>Lightweight particles</td>
<td>ASTM C123 using a medium with a density of Sp. Gr. of 2.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Total of all deleterious Material</td>
<td></td>
<td>3.0</td>
</tr>
</tbody>
</table>

c. Coarse aggregate. Gradation, within the separated size groups, shall meet the coarse aggregate grading requirements of ASTM C33 when tested in accordance with ASTM C136. When the nominal maximum size of the aggregate is greater than one inch (25 mm), the aggregates shall be furnished in two size groups.
Aggregates delivered to the mixer shall consist of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. The aggregates should be free of ferrous sulfides, such as pyrite, that would cause “rust” staining that can bleed through pavement markings. Steel blast furnace slag shall not be permitted. The aggregate shall be composed of clean, hard, uncoated particles. Dust and other coating shall be removed from the aggregates by washing.

Contractor shall verify that aggregates do not contain ferrous sulfides and iron oxides which can cause stains on exposed concrete surfaces.

Contractor shall test to identify staining particles by immersion of the aggregate in a lime slurry. If staining particles are present, a blue-green gelatinous precipitate will form within five (5) to 10 minutes, rapidly changing to a brown color on exposure to air and light. The reaction should be complete in 30 minutes. If no brown gelatinous precipitate forms, there is little chance of reaction in concrete. (Portland Concrete Association, Design and Control of Concrete Mixtures, 15th edition).

The percentage of wear shall be no more than 40% when tested in accordance with ASTM C131.

The quantity of flat, elongated, and flat and elongated particles in any size group coarser than 3/8 sieve (9 mm) shall not exceed 8% by weight when tested in accordance with ASTM D4791. A flat particle is defined as one having a ratio of width to thickness greater than 5. An elongated particle is one having a ratio of length to width greater than 5.

The soundness loss shall not exceed 12% when sodium sulfate is used or 18% when magnesium sulfate is used, after five cycles, when tested per ASTM C88.

The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

<table>
<thead>
<tr>
<th>Deleterious material</th>
<th>ASTM</th>
<th>Percentage by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay Lumps and friable particles</td>
<td>ASTM C142</td>
<td>1.0</td>
</tr>
<tr>
<td>Material finer than No. 200 sieve (0.075mm)</td>
<td>ASTM C117</td>
<td>1.0</td>
</tr>
<tr>
<td>Lightweight particles</td>
<td>ASTM C123 using a medium with a density of Sp. Gr. of 2.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Chert (less than 2.40 Sp Gr.)</td>
<td>ASTM C123 using a medium with a density of Sp. Gr. of 2.40)</td>
<td>1.0</td>
</tr>
<tr>
<td>Total of all deleterious Material</td>
<td></td>
<td>3.0</td>
</tr>
</tbody>
</table>
Table 1. Gradation For Coarse Aggregate

(ASTM C33)

<table>
<thead>
<tr>
<th>Sieve Designations (square openings)</th>
<th>Percentage by Weight Passing Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 1-1/2 inch to No. 4 (38 mm - 4.75 mm)</td>
<td>From 1 inch to No. 4 (25.0 mm-4.75 mm)</td>
</tr>
<tr>
<td>inch</td>
<td>mm</td>
</tr>
<tr>
<td>2-1/2</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>1-1/2</td>
<td>38</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>3/4</td>
<td>19</td>
</tr>
<tr>
<td>1/2</td>
<td>13</td>
</tr>
<tr>
<td>3/8</td>
<td>9</td>
</tr>
<tr>
<td>No. 4</td>
<td>4.75</td>
</tr>
<tr>
<td>No. 8</td>
<td>2.36</td>
</tr>
</tbody>
</table>

The Contractor shall submit complete mixture information necessary to calculate the volumetric components of the mixture.

(1) Aggregate susceptibility to durability (D) cracking. Aggregates that have a history of D-cracking shall not be used.

Coarse aggregate may be accepted from sources that have a 20 year service history for the same gradation to be supplied with no durability issues. Aggregates that do not have a record of 20 years of service without major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless it meets the following:

(a) Material currently being produced shall have a durability factor \( \geq 95 \) using ASTM C666 procedure B. Coarse aggregates that are crushed granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite or trap rock are considered to meet the D-cracking test but must meet all other quality tests. Aggregates meeting State Highway Department material specifications may be acceptable.

(b) The Contractor shall submit a current certification that the aggregate does not have a history of D-cracking and that the aggregate meets the state specifications for use in PCC pavement for use on interstate highways. Certifications, tests and any history reports must be for the same gradation as being proposed for use on the project. Certifications which are not dated or which are over one (1) year old or which are for different gradations will not be accepted. Test results will only be accepted when
tests were performed by a State Department of Transportation (DOT) materials laboratory or an accredited laboratory.

(2) Combined aggregate gradation. The combined aggregate grading shall meet the following requirements:

(a) The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.

(b) The CF shall be determined from the following equation:

\[
CF = \frac{\text{cumulative percent retained on the 3/8 in. sieve}}{\text{cumulative percent retained on the No. 8 sieve}} (100)
\]

(c) The Workability Factor WF is defined as the percent passing the No. 8 (2.36 mm) sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds (42 kg) of cementitious material per cubic meter yard greater than 564 pounds per cubic yard (335 kg per cubic meter).

(d) A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.


501-2.2 Cement. Cement shall conform to the requirements of ASTM C150 Type II or Type V.

Total Alkalies (Na2O and K2O) of the cement secured for the production of concrete shall be independently verified in accordance with ASTM C114.

If cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

501-2.3 Cementitious materials.

a. Fly ash. Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash for use in mitigating alkali-silica reactivity shall have a Calcium Oxide (CaO) content of less than 13% and a total available alkali content less than 3% per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the mix design, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Engineer.

b. Slag cement (ground granulated blast furnace(GGBF)). Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

c. Raw or calcined natural pozzolan. Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling
Alkali-Silica reaction and shall have a loss on ignition not exceeding 6%. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total available alkali content less than 3%.

d. Ultrafine fly ash and ultrafine pozzolan. UltraFine Fly Ash (UFFA) and UltraFine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

   (1) The strength activity index at 28 days of age shall be at least 95% of the control specimens.
   (2) The average particle size shall not exceed 6 microns.

501-2.4 Joint seal. The joint seal for the joints in the concrete pavement shall meet the requirements of Item P-604 and shall be of the type specified in the plans.

501-2.5 Isolation joint filler. Premolded joint filler for isolation joints shall conform to the requirements of ASTM D1751 and shall be where shown on the plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Engineer. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the Engineer. Contractor shall provide certification from the manufacturers that the submitted joint filler is compatible with the submitted joint sealants.

501-2.6 Steel reinforcement. Reinforcing shall consist of deformed carbon steel bars conforming to the requirements of ASTM A615.

501-2.7 Dowel and tie bars. Dowel bars shall be plain steel bars conforming to ASTM A615 and shall be free from burring or other deformation restricting slippage in the concrete. Before delivery to the construction site each dowel bar shall be epoxy coated per ASTM A1078, Type II. The dowels shall be coated with a bond-breaker recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the grout hardens.

Tie bars shall be deformed steel bars and conform to the requirements of ASTM A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for construction requiring bent bars.

501-2.8 Water. Water used in mixing or curing shall be potable, clean, free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product, except that non-potable water, or water from concrete production operations, may be used if it meets the requirements of ASTM C1602.

501-2.9 Material for curing concrete. Curing materials shall conform to the following specifications:

   a. Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class B, or Class A if wax base only.

501-2.10 Admixtures. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

   a. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.
b. **Water-reducing admixtures.** Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

c. **Other admixtures.** The use of set retarding, and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

d. **Lithium Nitrate.** The lithium admixture shall be a nominal 30% aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon (1.2 kg/L), and shall have the approximate chemical form as shown below:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Limit (Percent by Mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LiNO₃ (Lithium Nitrate)</td>
<td>30 ±0.5</td>
</tr>
<tr>
<td>SO₄ (Sulfate Ion)</td>
<td>0.1 (max)</td>
</tr>
<tr>
<td>Cl (Chloride Ion)</td>
<td>0.2 (max)</td>
</tr>
<tr>
<td>Na (Sodium Ion)</td>
<td>0.1 (max)</td>
</tr>
<tr>
<td>K (Potassium Ion)</td>
<td>0.1 (max)</td>
</tr>
</tbody>
</table>

Provide a trained manufacturer’s representative to supervise the lithium nitrate admixture dispensing and mixing operations.

**501-2.11 Epoxy-resin.** All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching materials for complete filling of spalls shall be Delpatch™ Elastomeric Concrete or an approved equal.

c. Material for use for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

**501-2.12 Material acceptance.** Prior to use of materials, the Contractor shall submit certified test reports to the Engineer for those materials proposed for use during construction. The certification shall show the appropriate ASTM test for each material, the test results, and a statement that the material passed or failed.

The Engineer may request samples and/or testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

**MIX DESIGN**

**501-3.1. General.** No concrete shall be placed until the mix design has been submitted to the Engineer for review and the Engineer has taken appropriate action. The Engineer’s review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

**501-3.2 Proportions.** The laboratory preparing the mix design shall be accredited in accordance with ASTM C1077. The mix design for all Portland cement concrete placed under P-501 shall be stamped or sealed by the responsible professional Engineer of the laboratory. Concrete shall be proportioned to
achieve a 28-day flexural strength that meets or exceeds the acceptance criteria contained in paragraph 501-5.2 for a flexural strength of 650 psi per ASTM C78. The mix shall be developed using the procedures contained in the Portland Cement Association’s (PCA) publication, “Design and Control of Concrete Mixtures”.

The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash, or slag cement) shall be 564 pounds per cubic yard (336 kg per cubic meter). The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall not be more than 0.45 by weight.

Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C78. The mix determined shall be workable concrete having a maximum allowable slump between one and two inches (25mm and 50 mm) as determined by ASTM C143. For slip-form concrete, the slump shall be between 1/2 inch (12 mm) and 1-1/2 inch (38 mm). At the start of the project, the Contractor shall determine a maximum allowable slump for slip-form pavement which will produce in-place pavement to control the edge slump. The selected slump shall be applicable to both pilot and fill-in lanes.

Before the start of paving operations and after approval of all material to be used in the concrete, the Contractor shall submit a mix design showing the proportions and flexural strength obtained from the concrete at three (3), seven (7), fourteen (14) and 28 days. The mix design shall include copies of test reports, including test dates, and a complete list of materials including type, brand, source, and amount of cement, fly ash, ground slag, coarse aggregate, fine aggregate, water, and admixtures. The mix design shall be submitted to the Engineer at least 60 days prior to the start of operations. The submitted mix design and related test data shall not be more than 90 days old. Production shall not begin until the mix design is approved in writing by the Engineer.

If a change in sources is made, or admixtures added or deleted from the mix, a new mix design must be submitted to the Engineer for approval.

The results of the mix design shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard (meter) basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The recommended mixture proportions shall be accompanied by test results demonstrating that the proportions selected will produce concrete of the qualities indicated. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in PCA’s publication, Design and Control of Concrete Mixtures, modified as necessary to accommodate flexural strength.

The submitted mix design shall be stamped or sealed by the responsible Professional Engineer of the laboratory and shall include the following items as a minimum:

a. Coarse, fine, and combined aggregate gradations and plots including fineness modulus of the fine aggregate.

b. Reactivity Test Results.

c. Coarse aggregate quality test results, including deleterious materials.

d. Fine aggregate quality test results, including deleterious materials.

e. Mill certificates for cement and supplemental cementitious materials.

f. Certified test results for all admixtures, including Lithium Nitrate if applicable.
g. Specified flexural strength, slump, and air content.

h. Recommended proportions/volumes for proposed mixture and trial water-cementitious materials ratio, including actual slump and air content.

i. Flexural and compressive strength summaries and plots, including all individual beam and cylinder breaks.

j. Correlation ratios for acceptance testing and Contractor Quality Control testing, when applicable.

k. Historical record of test results documenting production standard deviation, when applicable.

501-3.3 Cementitious materials.

a. Fly ash. When fly ash is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If fly ash is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

b. Slag cement (ground granulated blast furnace (GGBF)). Slag cement may be used. The slag cement, or slag cement plus fly ash if both are used, may constitute between 25 to 55% of the total cementitious material by weight. If the concrete is to be used for slipforming operations and the air temperature is expected to be lower than 55°F (13°C) the percent slag cement shall not exceed 30% by weight.

c. Raw or calcined natural pozzolan. Natural pozzolan may be used in the mix design. When pozzolan is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If pozzolan is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

d. Ultrafine fly ash (UFFA) and ultrafine pozzolan (UFP). UFFA and UFP may be used in the mix design with the Engineer’s approval. When UFFA and UFP is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between seven (7) and 16% by weight of the total cementitious material.

501-3.4 Admixtures.

a. Air-entraining admixtures. Air-entraining admixture are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be 2.5% for a maximum aggregate size of 1-1/2 inch or 3.0% if the maximum aggregate size is 1 inch. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

b. Water-reducing admixtures. Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted on trial mixes, with the materials to be used in the work, in accordance with ASTM C494.
c. Other admixtures. Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted on trial mixes, with the materials to be used in the work, in accordance with ASTM C 494.

d. Lithium nitrate. Lithium nitrate shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements in accordance with paragraph 501-2.10d.

501-3.5 Concrete mix design laboratory. The Contractor’s laboratory used to develop the concrete mix design shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority’s website. All test methods required for developing the concrete mix design must be listed on the lab accreditation. A copy of the laboratory’s current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

501-3.6 Pavement construction test section. Prior to being given approval to begin production paving for the PCC full slab replacement pavement, the Contractor shall construct a 100 feet x 200 feet test section (“test strip”) as shown on the plans, using the materials, equipment and methods intended for use for the main production for the project. The test section shall be constructed at the location, and to the dimensions, lines and grades shown on the plans, or at a location mutually agreeable to the Engineer and Contractor, and shall include construction of all subsurface layers as shown on the plans, including subgrade preparation, subgrade stabilization, subbases, bases and surfacing as shown in the typical sections. Construction of the test section will include construction of joints at the locations, and of the types, shown on the plans or approved by the Engineer.

The intent of the test section is to allow the Contractor to demonstrate that concrete satisfying all project requirements can be batched, mixed, hauled and placed within the specified conditions, including meeting all quality assurance and quality control testing requirements. The Contractor is expected to adjust the mix, adjust equipment, and modify procedures such that by the end of the test strip the best possible product is attained. Concrete corings will required by the contractor in order to demonstrate proper consolidation. In addition, the contractor shall demonstrate methods for acceptable dowel placement (including internal transverse dowels and drilled longitudinal dowels).

The Contractor shall demonstrate batch plant mixing per ASTM C94, transporting, placing, finishing, application of cure, protection, construction of joints, and the performance of the quality control functions specified. The Contractor shall place and finish concrete using the people, procedures, and equipment which will be used on the work. Vibratory frequency and amplitude shall be recorded. A minimum of 2 hours of mixing and placing concrete, at anticipated production capacity, shall be incorporated into the test section. Any adjustments made to the mix, or to placing or finishing procedures to meet field conditions, will be coordinated with the Engineer prior to implementation by the Contractor.

The Engineer will observe the construction of the test section. The Contractor shall obtain written approval of the test section, from the Engineer, before proceeding with production work. If the test section, or any part thereof, is rejected, the cause shall be documented and reasons for rejection provided. The work will not proceed until the Contractor can demonstrate the placement and finish of an acceptable test section.
Concrete placed within a test section that is not accepted shall be removed and replaced, at the sole expense of the Contractor unless other arrangements are approved by the Engineer.

Prior to the use of any placement method other than that used for the approved Test Section, a separate test section will be required for each method of placement (slipform, side-form, hand-placement). Location and size of the test section shall be as directed by the Engineer.

The quality of all approved aspects of the accepted test section shall be used throughout the project as the standard of quality against which pavement will be judged for acceptability.

CONSTRUCTION METHODS

501-4.1 Equipment. Equipment necessary for handling materials and performing all parts of the work shall be approved by the Engineer, but does not relieve the Contractor of the responsibility for the proper operation of equipment and maintaining the equipment in good working condition. The equipment shall be at the jobsite sufficiently ahead of the start of paving operations to be examined thoroughly and approved.

a. Batch plant and equipment. The batch plant and equipment shall conform to the requirements of ASTM C94 and the National Ready Mix Concrete Association. The Contractor shall provide a current certificate of compliance with the NRMCA Plant and Truck Certification Program.

b. Mixers and transportation equipment.

(1) General. Concrete may be mixed at a central plant, or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer’s nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

(2) Central plant mixer. Central plant mixers shall conform to the requirements of ASTM C94 and the National Ready Mix Concrete Association. Performance/Uniformity testing shall be made on the batch plant and approved mix design to identify mixing time per ASTM C94, prior to batching and placing the test section and production paving. The mixer shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch (19 mm) or more. The Contractor shall have a copy of the manufacturer’s design on hand showing dimensions and arrangement of blades in reference to original height and depth.

(3) Truck mixers and truck agitators. Truck mixers used for mixing and hauling concrete and truck agitators used for hauling central-mixed concrete shall conform to the requirements of ASTM C94 and the National Ready Mix Concrete Association. The Contractor shall provide a current certificate of compliance with the NRMCA Plant and Truck Certification Program.

(4) Nonagitator trucks. Nonagitating hauling equipment shall not be allowed for concrete delivery.

(5) Transfer and spreading equipment. Equipment for transferring concrete from the transporting equipment to the paving lane in front of the paver shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will transfer and spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

c. Finishing equipment. The standard method of constructing concrete pavements shall be with an approved slip-form paving equipment designed and operated to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine so that the end result is a dense and
homogeneous pavement which is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements. It shall weigh at least 2,200 lbs per foot (3274 kg/m) of paving lane width and powered by an engine having at least 6.0 horsepower per foot of lane width.

On projects requiring less than 200 square yard (167 sq m) of cement concrete pavement or requiring individual placement areas of less than 200 square yard (167 sq m), or irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement may be placed with approved placement and finishing equipment using stationary side forms. Hand screeding and float finishing may only be used on small irregular areas as allowed by the Engineer.

d. **Vibrators.** Vibrator shall be the internal type. Operating frequency for internal vibrators shall be between 8,000 and 12,000 vibrations per minute. Average amplitude for internal vibrators shall be 0.025-0.05 inch (0.06 - 0.13 cm).

The number, spacing, and frequency shall be as necessary to provide a dense and homogeneous pavement and meet the recommendations of American Concrete Institute (ACI) 309, Guide for Consolidation of Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The Contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two times per day or when requested by the Engineer.

Hand held vibrators may be used in irregular areas only, but shall meet the recommendations of ACI 309R, Guide for Consolidation of Concrete.

e. **Concrete saws.** The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations. Early-entry saws may be used, subject to demonstration and approval of the Engineer.

f. **Side forms.** Straight side forms shall be made of steel and shall be furnished in sections not less than 10 feet (3 m) in length. Forms shall have a depth equal to the pavement thickness at the edge, and a base width equal to or greater than the depth. Flexible or curved forms of proper radius shall be used for curves of 100-foot (31 m) radius or less. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by the Engineer.

The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by the Engineer.

g. **Pavers.** The paver shall be fully energized, self-propelled, and designed for the specific purpose of placing, consolidating, and finishing the concrete pavement, true to grade, tolerances, and cross-section. It shall be of sufficient weight and power to construct the maximum specified concrete paving lane width as shown in the plans, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. The paver shall be equipped with electronic or hydraulic horizontal and vertical control devices.

501-4.2 **Form setting.** Forms shall be set sufficiently in advance of the concrete placement to ensure continuous paving operation. After the forms have been set to correct grade, the underlying surface shall be thoroughly tamped, either mechanically or by hand, at both the inside and outside edges of the base of
the forms. Forms shall be staked into place sufficiently to maintain the form in position for the method of placement.

Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/8 inch (3 mm) at any joint. Forms shall be so set that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the placing of concrete.

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete.

501-4.3 Conditioning of underlying surface. The compacted underlying surface on which the pavement will be placed shall be widened approximately 3 feet (1 m) to extend beyond the paving machine track to support the paver without any noticeable displacement. After the underlying surface has been placed and compacted to the required density, the areas that will support the paving machine and the area to be paved shall be trimmed or graded to the plan grade elevation and profile by means of a properly designed machine. The grade of the underlying surface shall be controlled by a positive grade control system using lasers, stringlines, or guide wires. If the density of the underlying surface is disturbed by the trimming operations, it shall be corrected by additional compaction and retested at the option of the Engineer before the concrete is placed except when stabilized subbases are being constructed. If damage occurs on a stabilized subbase, it shall be corrected full depth by the Contractor. If traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placement of concrete. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. The underlying surface shall be protected so that it will be entirely free of frost when concrete is placed.

501-4.4 Conditioning of underlying surface, side-form and fill-in lane construction. The prepared underlying surface shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from the concrete. Damage caused by hauling or usage of other equipment shall be corrected and retested at the option of the Engineers. If damage occurs to a stabilized subbase, it shall be corrected full depth by the Contractor. A template shall be provided and operated on the forms immediately in advance of the placing of all concrete. The template shall be propelled only by hand and not attached to a tractor or other power unit. Templates shall be adjustable so that they may be set and maintained at the correct contour of the underlying surface. The adjustment and operation of the templates shall be such as will provide an accurate retest of the grade before placing the concrete thereon. All excess material shall be removed and wasted. Low areas shall be filled and compacted to a condition similar to that of the surrounding grade. The underlying surface shall be protected so that it will be entirely free from frost when the concrete is placed. The use of chemicals to eliminate frost in the underlying surface shall not be permitted.

The template shall be maintained in accurate adjustment, at all times by the Contractor, and shall be checked daily.

501-4.5 Handling, measuring, and batching material. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant.

Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or
binned for draining at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage.

Batching plants shall be equipped to proportion aggregates and bulk cement, by weight, automatically using interlocked proportioning devices of an approved type. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, such as a chute, boot, or other approved device, to prevent loss of cement. The device shall be arranged to provide positive assurance that the cement content specified is present in each batch.

501-4.6 Mixing concrete. The concrete may be mixed at the work site in a central mix plant. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are emptied into the drum. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94.

Mixed concrete from the central mixing plant shall be transported in truck mixers or truck agitators. The elapsed time from the addition of cementitious material to the mix until the concrete is deposited in place (on grade) at the work site shall not exceed 90 minutes when the concrete is hauled in truck mixers or truck agitators. Non agitating trucks are precluded for concrete deliveries. Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified in the approved mix design is not exceeded, and approved by the Engineer.

501-4.7 Limitations on mixing and placing. No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

a. Cold weather. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F (4°C) and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F (2°C).

The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F (10°C) at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F (66°C). The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

Additional information regarding cold weather concreting practices may be found in ACI 306R, Cold Weather Concreting and is included by reference here.

b. Hot weather. During periods of hot weather when the maximum daily air temperature exceeds 85°F (30°C), the following precautions shall be taken.

The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F (32°C). The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

The finished surfaces of the newly laid pavement shall be kept damp by applying a water-fog or mist with approved spraying equipment until the pavement is covered by the curing medium. When necessary,
wind screens shall be provided to protect the concrete from an evaporation rate in excess of 0.2 psf (0.98 kg/m² per hour) per hour. When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. Such measures shall consist of wind screens, more effective fog sprays, and similar measures commencing immediately behind the paver. If these measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

Additional information regarding hot weather concreting practices may be found in ACI 305R, Hot Weather Concreting and is included by reference here.

c. Temperature management program. Prior to the start of paving operation for each day of paving, the Contractor shall provide the Engineer with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. As a minimum the program shall address the following items:

   (1) Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.
   (2) Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Figure 11-8, PCA, Design and Control of Concrete Mixtures.
   (3) Anticipated timing of initial sawing of joint.
   (4) Anticipated number and type of saws to be used.

501-4.8 Placing concrete. At any point in concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 feet (1 m). The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches a flexural strength of 550 psi (3792 kPa), based on the average of four field cured specimens per 2800 square yards of concrete placed. Also, subgrade and subbase planers, concrete pavers, and concrete finishing equipment may be permitted to ride upon the edges of previously constructed pavement when the concrete has attained a minimum flexural strength of 400 psi (2757 kPa).

The Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

a. Slip-form construction. The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the
pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 9 inches (23 cm) for slipform and at the end of the dowels for the fill-in lanes. The spacing of internal units shall be uniform and shall not exceed 18 inches (0.5 m).

The term internal vibration means vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be within 8000 to 12000 cycles per minute and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least one foot (30 cm). The frequency of vibration or amplitude shall vary proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

Not more than 15% of the total free edge of each 500 foot (150 m) segment of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch (6 mm), and none of the free edge of the pavement shall have an edge slump exceeding 3/8 inch (9 mm). The total free edge of 500 feet (150 m) of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to any existing pavement; that is, 500 feet (150 m) of paving lane originally constructed as a separate lane will have 1,000 feet (300 m) of free edge, 500 feet (150 m) of fill-in lane will have no free edge, etc.). The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches (0.5 m) from the edge. When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump shall be removed and replaced at the expense of the Contractor as directed by the Engineer.

b. Side-form construction. Side form sections shall be straight, free from warps, bends, indentations, or other defects. Defective forms shall be removed from the work. Metal side forms shall be used except at end closures and transverse construction joints where straight forms of other suitable material may be used.

Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such build-up is attached to the top of metal forms, the build-up shall also be metal.

Width of the base of all forms shall be equal to or greater than the specified pavement thickness.

Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with adjoining forms, that springing will not occur under the weight of subgrading and paving equipment or from the pressure of the concrete. The Contractor shall provide sufficient forms so that there will be no delay in placing concrete due to lack of forms.
Before placing side forms, the underlying material shall be at the proper grade. Side forms shall have full bearing upon the foundation throughout their length and width of base and shall be placed to the required grade and alignment of the finished pavement. They shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.

Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

Side forms shall be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.

Concrete shall be spread, screeded, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery.

Concrete for the full paving width shall be effectively consolidated by internal vibrators without causing segregation. Internal type vibrators’ rate of vibration shall be not less than 7,000 cycles per minute. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than one foot (30 cm) from the vibrating element. The Contractor shall furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete.

c. Consolidation. Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than inches (50 mm). Excessive vibration shall not be permitted. If the vibrators cause visible tracking in the paving lane, the paving operation shall be stopped and equipment and operations modified to prevent it. Concrete in small, odd-shaped slabs or in isolated locations inaccessible to the gang-mounted vibration equipment shall be vibrated with an approved hand-operated immersion vibrator operated from a bridge spanning the area. Vibrators shall not be used to transport or spread the concrete. Hand-operated vibrators shall not be operated in the concrete at one location for more than 20 seconds. Insertion locations for hand-operated vibrators shall be between 6 to 15 inches (150 to 400 mm) on centers. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the Engineer.
If a lack of consolidation of the concrete is suspected by the Engineer, referee testing may be required. Referee testing of hardened concrete will be performed by the Engineer by cutting cores from the finished pavement after a minimum of 24 hours curing. Density determinations will be made by the Engineer based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one for each 500 cubic yards (382 m³) of pavement, or fraction. The Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

The average density of the cores shall be at least 97% of the original mix design density, with no cores having a density of less than 96% of the original mix design density. Failure to meet the referee tests will be considered evidence that the minimum requirements for vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

501-4.9 Strike-off of concrete and placement of reinforcement. Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the plans and to an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown on the plans. When reinforced concrete pavement is placed in two layers, the bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screeded. If any portion of the bottom layer of concrete has been placed more than 30 minutes without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with freshly mixed concrete at the Contractor’s expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable ASTM specification requirements.

501-4.10 Joints. Joints shall be constructed as shown on the plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the plans. Joints shall not vary more than 1/2 inch (12 mm) from their designated position and shall be true to line with not more than 1/4 inch (6 mm) variation in 10 feet (3 m). The surface across the joints shall be tested with a 12 feet (3 m) straightedge as the joints are finished and any irregularities in excess of 1/4 inch (6 mm) shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.

a. Construction. Longitudinal construction joints shall be slip-formed or formed against side forms as shown in the plans.

Transverse construction joints shall be installed at the end of each day’s placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.

b. Contraction. Contraction joints shall be installed at the locations and spacing as shown on the plans. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the
top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer’s instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the plans.

c. Isolation (expansion). Isolation joints shall be installed as shown on the plans. The premolded filler of the thickness as shown on the plans, shall extend for the full depth and width of the slab at the joint, except for space for sealant at the top of the slab. The filler shall be securely staked or fastened into position perpendicular to the proposed finished surface. A cap shall be provided to protect the top edge of the filler and to permit the concrete to be placed and finished. After the concrete has been placed and struck off, the cap shall be carefully withdrawn leaving the space over the premolded filler. The edges of the joint shall be finished and tooled while the concrete is still plastic. Any concrete bridging the joint space shall be removed for the full width and depth of the joint.

d. Tie bars. Tie bars shall consist of deformed bars installed in joints as shown on the plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals shown on the plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth. When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.

e. Dowel bars. Dowel bars or other load-transfer units of an approved type shall be placed across joints as shown on the plans. They shall be of the dimensions and spacings as shown and held rigidly in the middle of the slab depth in the proper horizontal and vertical alignment by an approved assembly device to be left permanently in place. The dowel or load-transfer and joint devices shall be rigid enough to permit complete assembly as a unit ready to be lifted and placed into position. The dowels shall be coated with a bond-breaker or other lubricant recommended by the manufacturer and approved by the Engineer.

f. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

g. Placing dowels and tie bars. The method used in installing and holding dowels in position shall ensure that the error in alignment of any dowel from its required horizontal and vertical alignment after the pavement has been completed will not be greater than 1/8 inch per feet (3 mm per 0.3 m). Except as otherwise specified below, horizontal spacing of dowels shall be within a tolerance of ±5/8 inch (16 mm). The vertical location on the face of the slab shall be within a tolerance of ±1/2 inch (12 mm). The vertical alignment of the dowels shall be measured parallel to the designated top surface of the pavement, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The horizontal alignment shall be checked with a framing square. Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar or tie bar length to the planned joint line. If the last regularly spaced longitudinal dowel or tie bar is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar or tie bar length, but not closer than 6 inches (150 mm) to its nearest neighbor. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.
(1) **Contraction joints.** Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires.

(2) **Construction joints.** Install dowels and tie bars by the cast-in-place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms. The spacing of dowels and tie bars in construction joints shall be as indicated.

(3) **Dowels installed in isolation joints and other hardened concrete.** Install dowels for isolation joints and in other hardened concrete by bonding the dowels into holes drilled into the hardened concrete. The concrete shall have cured for seven (7) days or reached a minimum flexural strength of 400 psi (3.1 MPa) before drilling commences. Holes 1/8 inch (3 mm) greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur to the concrete joint face. Modification of the equipment and operation shall be required if, in the Engineer’s opinion, the equipment and/or operation is causing excessive damage. Depth of dowel hole shall be within a tolerance of ±1/2 inch (12 mm) of the dimension shown on the drawings. On completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic grout retention ring fitted around the dowel. Dowels required to be installed in any joints between new and existing concrete shall be grouted in holes drilled in the existing concrete, all as specified above.

h. **Sawing of joints.** Joints shall be cut as shown on the plans. Equipment shall be as described in paragraph 501-4.1. The circular cutter shall be capable of cutting a groove in a straight line and shall produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the plans. The top of the slot shall be widened by sawing to provide adequate space for joint sealers as shown on the plans. Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have been sawn. The joints shall be sawn at the required spacing. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial sawcut and maintained for the remaining cure period.

501-4.11 **Finishing.** Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Any operations which produce more than 1/8 inch (3 mm) of mortar-rich surface (defined as deficient in plus U.S. No. 4 (4.75 mm) sieve size aggregate) shall be halted immediately and the equipment, mixture, or procedures modified as necessary. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during...
hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way, except for fog (mist) sprays specified to prevent plastic shrinkage cracking.

**a. Machine finishing with slipform pavers.** The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled non-rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. If there is concrete slurry or fluid paste on the surface that runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such slurry. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

**b. Machine finishing with fixed forms.** The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

**c. Other types of finishing equipment.** Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Engineer’s approval.

Bridge deck finishers shall have a minimum operating weight of 7500 pounds (3400 kg) and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

**d. Hand finishing.** Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Use hand finishing operations only as specified below.

**1. Equipment and screed.** In addition to approved mechanical internal vibrators for consolidating the concrete, provide a strike-off and tamping screed and a longitudinal float for hand finishing. The screed shall be at least one foot (30 cm) longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet (3 m) long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom. Grate tampers (jitterbugs) shall not be used.

**2. Finishing and floating.** As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross-section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. In addition to previously specified complete coverage with handheld immersion vibrators, the entire surface shall be tamped with the strike-off and tamping template, and the tamping operation continued until the required compaction and
reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed, consolidated and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

   **e. Straightedge testing and surface correction.** After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a Contractor furnished 12-foot (3.7-m) straightedge swung from handles 3 feet (1 m) longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 inch (3 mm) thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements of paragraph 501-5.2e(3). Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross-section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment. This straight-edging is not a replacement for the straightedge testing of paragraph 501-5.2e(3), Smoothness.

501-4.12 Surface texture. The surface of the pavement shall be finished with either a brush or broom, burlap drag, or artificial turf finish for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. Any imperfections resulting from the texturing operation shall be corrected to the satisfaction of the Engineer.

   **a. Burlap drag finish.** If a burlap drag is used to texture the pavement surface, it shall be at least 15 ounces per square yard (555 grams per square meter). To obtain a textured surface, the transverse threads of the burlap shall be removed approximately one foot (30 cm) from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface. The corrugations shall be uniform in appearance and approximately 1/16 inch (2 mm) in depth.

501-4.13 Curing. Immediately after finishing operations are completed and marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour during the curing period.

When a two-sawcut method is used to construct the contraction joint, the curing compound shall be applied to the sawcut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

Curing shall be applied after the bleed water is gone from the surface.

   **a. Impervious membrane method.** The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall. Curing
compound shall be applied by mechanical sprayers under pressure at the rate of one gallon (4 liters) to not more than 150 sq ft (14 sq m). The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the Engineer, a double application rate shall be used to ensure coverage. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved means. Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface. Curing shall be applied immediately after the bleed water is gone from the surface.

d. Concrete protection for cold weather. The concrete shall be maintained at an ambient temperature of at least 50°F (10°C) for a period of 72 hours after placing and at a temperature above freezing for the remainder of the curing time. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor’s expense.

e. Concrete protection for hot weather. Concrete should be continuous moisture cured for the entire curing period and shall commence as soon as the surfaces are finished and continue for at least 24 hours. However, if moisture curing is not practical beyond 24 hours, the concrete surface shall be protected from drying with application of a liquid membrane-forming curing compound while the surfaces are still damp. Other curing methods may be approved by the Engineer.

501-4.14 Removing forms. Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing. After the forms have been removed, the sides of the slab shall be cured as per the methods indicated in paragraph 501-4.13. Major honeycombed areas shall be considered as defective work and shall be removed and replaced in accordance with paragraph 501-5.2(f).

501-4.15 Saw-cut grooving. If shown on the plans, grooved surfaces shall be provided in accordance with the requirements of Item P-621.

501-4.16 Sealing joints. The joints in the pavement shall be sealed in accordance with Item P-604.

501-4.17 Protection of pavement. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor’s employees and agents until accepted by the Engineer. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor’s expense.

Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven (7) days old, or for a longer period if directed by the Engineer.

In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days and the joints have been sealed or otherwise protected, and the concrete has attained a minimum field cured flexural strength of 550 psi (37928 kPa) and approved means are furnished to prevent damage to the slab edge.
All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately upon occurrence.

Damaged pavements shall be removed and replaced at the Contractor’s expense. Slabs shall be removed to the full depth, width, and length of the slab.

501-4.18 Opening to construction traffic. The pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 550 lb / square inch (3.8 kPa) when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

501-4.19 Repair, removal, or replacement of slabs.

a. General. New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable shall be removed and replaced or repaired, as directed by the Engineer and as specified hereinafter at no cost to the Owner. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The Engineer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be 4 inch (100 mm) diameter, shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the Owner. All epoxy resin used in this work shall conform to ASTM C881, Type V. Repair of cracks as described in this section shall not be allowed if in the opinion of the Engineer the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper 1/8 inch (3 mm) of the pavement surface.

b. Shrinkage cracks. Shrinkage cracks, which do not exceed 4 inches (100 mm) in depth, shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1, using procedures as approved by the Engineer. Care shall be taken to assure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the Engineer. Shrinkage cracks, which exceed 4 inches (100 mm) in depth, shall be treated as full depth cracks in accordance with paragraphs 4.19b and 4.19c.

c. Slabs with cracks through interior areas. Interior area is defined as that area more than 6 inches (150 mm) from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than 4 inches (100 mm) in depth, that extend into the interior area.

d. Cracks close to and parallel to joints. All cracks essentially parallel to original joints, extending full depth of the slab, and lying wholly within 6 inches (150 mm) either side of the joint shall be treated as specified here. Any crack extending more than 6 inches (150 mm) from the joint shall be treated as specified above in subparagraph e.

(1) Full depth cracks present, original joint not opened. Both of the affected slab(s) shall be removed by the procedures specified in Section 71.
(2) Full depth cracks present, original joint also cracked. At a joint, if there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced for the full lane width and length.

e. Removal and replacement of full slabs. Where it is necessary to remove full slabs, the removal shall be performed in accordance with Section 71.

Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material (unless it is stabilized) shall be re-compacted and shaped as specified in the appropriate section of these specifications. The surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels or tie bars. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

f. Repairing spalls along joints. Where directed, spalls along joints of new slabs, and along parallel cracks used as replacement joints, shall be performed in accordance with Section 71.

g. Diamond grinding of PCC surfaces. Diamond grinding of the hardened concrete with an approved diamond grinding machine should not be performed until the concrete is 14 days or more old and concrete has reached full minimum strength. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch (3-mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet (0.9 m) wide. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The area corrected by diamond grinding the surface of the hardened concrete should not exceed 10% of the total area of any sublot. The depth of diamond grinding shall not exceed 1/2 inch (13 mm) and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, may require removing and replacing in conformance with paragraph 501-4.19.

501-4.20 Existing concrete pavement removal and repair.

All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface.

a. Removal of existing pavement slab.

When it is necessary to remove existing concrete pavement and leave adjacent concrete in place, the removal shall be in accordance with Section 71. The Contractor shall then install new dowels, of the size and spacing used for other similar joints, by epoxy resin bonding them in holes drilled in the joint face as specified in paragraph 501-4.10g. All this shall be at no additional cost to the Owner. Dowels of the size and spacing indicated shall be installed as shown on the drawings by epoxy resin bonding them in holes drilled in the joint face as specified in paragraph 501-4.10g. The joint face shall be sawed or otherwise trimmed so that there is no abrupt offset in any direction greater than 1/2 inches (12 mm) and no gradual offset greater than one inch (25 mm) when tested in a horizontal direction with a 12-foot (3.7-m) straightedge.
b. Edge repair.

The edge of existing concrete pavement against which new pavement abuts shall be protected from
damage at all times. Areas that are damaged during construction shall be repaired at no cost to the Owner.

(1) Spall repair. Spalls shall be repaired where indicated and where directed by the Engineer.
Repair materials and procedures shall be as previously specified in subparagraph 501-4.19f.

(2) Underbreak repair. All underbreak shall be repaired. First, all delaminated and loose
material shall be carefully removed. Next, the underlying material shall be recompacted, without addition
of any new material. Finally, the void shall be completely filled with paving concrete, thoroughly
consolidated. Care shall be taken to produce an even joint face from top to bottom. Prior to placing
concrete, the underlying material shall be thoroughly moistened. After placement, the exposed surface
shall be heavily coated with curing compound.

(3) Underlying material. The underlying material adjacent to the edge and under the existing
pavement which is to remain in place shall be protected from damage or disturbance during removal
operations and until placement of new concrete, and shall be shaped as shown on the drawings or as
directed. Sufficient material shall be kept in place outside the joint line to prevent disturbance (or
sloughing) of material under the pavement that is to remain in place. Any material under the portion of
the concrete pavement to remain in place, which is disturbed or loses its compaction shall be carefully
removed and replaced with concrete as specified in paragraph 501-4.20b(2). The underlying material
outside the joint line shall be thoroughly compacted and moist when new concrete is placed.

MATERIAL ACCEPTANCE

501-5.1 Acceptance sampling and testing. All acceptance sampling and testing will be performed onsite
by a certified Concrete Testing Laboratory provided by the Contractor. The City of Los Angeles
Standards Division technicians shall witness the testing by the Concrete Testing Laboratory. The
Engineer shall be permitted unrestricted access to inspect the Contractor’s Testing facilities and witness
quality control activities and acceptance testing. The Contractor shall be responsible for sampling, curing,
handling, and testing of concrete beams. Coring for thickness determination, necessary to determine
conformance with the requirements specified in this section, will be performed by the Contractor at
locations designated by the Engineer.

Testing organizations performing these tests shall be accredited in accordance with ASTM C1077. The
laboratory accreditation must be current and listed on the accrediting authority’s website. All test methods
required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the
laboratory’s current accreditation and accredited test methods shall be submitted to the Engineer prior to
the start of construction. The Contractor shall bear the cost of providing curing facilities and onsite
Concrete Testing Laboratory for all required sampling, curing, strength specimen tests, per P-501-5.1a
and coring and filling operations per P-501-5.1b. The Engineer or Standards representative must be
present during testing for flexural strength and thickness measurements.

Concrete shall be accepted for strength and thickness on a lot basis.
A lot shall consist of a day’s production not to exceed 2800 square yards.

A lot shall consist of a half days production where the day’s production is expected to exceed 2800 square
yards.

a. Flexural strength.
(1) **Sampling.** Each lot shall be divided into four equal sublots. One sample shall be taken for each sublot from the plastic concrete delivered to the job site. Sampling locations shall be determined by the Engineer in accordance with random sampling procedures contained in ASTM D3665. The concrete shall be sampled in accordance with ASTM C172.

(2) **Testing.** Two (2) specimens shall be made from each sample. Specimens shall be made in accordance with ASTM C31 and the flexural strength of each specimen shall be determined in accordance with ASTM C78. The flexural strength for each sublot shall be computed by averaging the results of the two test specimens representing that sublot.

Immediately prior to testing for flexural strength, the beam shall be weighed and measured for determination of a sample unit weight. Measurements shall be made for each dimension; height, depth, and length, at the mid-point of the specimen and reported to the nearest 1/10 inch (3 mm). The weight of the specimen shall be reported to the nearest 0.1 pound (45 gm). The sample unit weight shall be calculated by dividing the sample weight by the calculated volume of the sample. This information shall be reported as companion information to the measured flexural strength for each specimen.

The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method.

Slump, air content, and temperature tests will also be conducted by the quality assurance laboratory for each set of strength test samples, per ASTM C31.

(3) **Curing.** The Contractor shall provide adequate facilities for the initial curing of beams. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F (16° to 27°C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

(4) **Acceptance.** Acceptance of pavement for flexural strength will be determined by the Engineer in accordance with paragraph 501-5.2b.

Preventing loss of moisture is extremely important since relatively small amounts of surface drying of flexural specimens can induce tensile stresses in the extreme fibers that will markedly reduce the indicated flexural strength.

**b. Pavement thickness.**

(1) **Sampling.** Each lot shall be divided into four equal sublots and one core shall be taken by the Contractor for each sublot. Sampling locations shall be determined by the Engineer in accordance with random sampling procedures contained in ASTM D3665. Areas, such as thickened edges, with planned variable thickness, shall be excluded from sample locations.

Cores shall be neatly cut with a core drill. The Contractor shall furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes shall be filled by the Contractor with a non-shrink grout approved by the Engineer within one day after sampling.

(2) **Testing.** The thickness of the cores shall be determined by the Engineer by the average caliper measurement in accordance with ASTM C174.

(3) **Acceptance.** Acceptance of pavement for thickness shall be determined by the Engineer in accordance with paragraph 501-5.2c.

**c. Partial lots.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or when the Contractor and Engineer agree in writing to allow
overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three sublots have been produced, they shall constitute a lot. Where one or two sublots have been produced, they shall be incorporated into the next lot or the previous lot and the total number of sublots shall be used in the acceptance criteria calculation, that is, \( n=5 \) or \( n=6 \).

d. **Outliers.** All individual flexural strength tests within a lot shall be checked for an outlier (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers shall be discarded, and the percentage of material within specification limits (PWL) shall be determined using the remaining test values.

### 501-5.2 Acceptance criteria.

a. **General.** Acceptance will be based on the following characteristics of the completed pavement discussed in paragraph 501-5.2e:

1. Flexural strength
2. Thickness
3. Smoothness
4. Grade
5. Edge slump
6. Dowel bar alignment and position

Flexural strength and thickness shall be evaluated for acceptance on a lot basis using the method of estimating PWL. Acceptance using PWL considers the variability (standard deviation) of the material and the testing procedures, as well as the average (mean) value of the test results to calculate the percentage of material that is above the lower specification tolerance limit (L).

Acceptance for flexural strength will be based on the criteria contained in accordance with paragraph 501-5.2e(1). Acceptance for thickness will be based on the criteria contained in paragraph 501-5.2e(2). Acceptance for smoothness will be based on the criteria contained in paragraph 501-5.2e(3). Acceptance for grade will be based on the criteria contained in paragraph 501-5.2e(4).

The Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

b. **Flexural strength.** Acceptance of each lot of in-place pavement for flexural strength shall be based on PWL. The Contractor shall target production quality to achieve 90 PWL or higher.

c. **Pavement thickness.** Acceptance of each lot of in-place pavement shall be based on PWL. The Contractor shall target production quality to achieve 90 PWL or higher.

d. **Percentage of material within limits (PWL).** The PWL shall be determined in accordance with procedures specified in Section 110 of the General Provisions.

The lower specification tolerance limit (L) for flexural strength and thickness shall be:
e. Acceptance criteria.

(1) **Flexural Strength.** If the PWL of the lot equals or exceeds 90%, the lot shall be acceptable. Acceptance and payment for the lot shall be determined in accordance with paragraph 501-8.1.

(2) **Thickness.** If the PWL of the lot equals or exceeds 90%, the lot shall be acceptable. Acceptance and payment for the lot shall be determined in accordance with paragraph 501-8.1.

(3) **Smoothness.** As soon as the concrete has hardened sufficiently, but not later than 48 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness to reveal all surface irregularities exceeding the tolerances specified. The Contractor shall furnish paving equipment and employ methods that produce a surface for each section of pavement having an average profile index meeting the requirements of paragraph 501-8.1c when evaluated with a profilograph; and the finished surface of the pavement shall not vary more than 1/4 inch (6mm) when evaluated with a 12-foot (3.7m) straightedge. When the surface smoothness exceeds specification tolerances which cannot be corrected by diamond grinding of the pavement, full depth removal and replacement of pavement shall be to the limit of the longitudinal placement. Corrections involving diamond grinding will be subject to the final pavement thickness tolerances specified.

   (a) Transverse measurements. Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet (15m) or more often as determined by the Engineer.

      (i) Testing shall be continuous across all joints, starting with one-half the length of the straight edge at the edge of pavement section being tested and then moved ahead one-half the length of the straight edge for each successive measurement. Smoothness readings will not be made across grade changes or cross slope transitions; at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. Deviations on final pavement > 1/4 inch (6mm) in transverse direction shall be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of pavement. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

      (ii) The joint between lots shall be tested separately to facilitate smoothness between lots. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface, with half the straightedge on one side of the joint and the other half of the straightedge on the other side of the joint. Measure the maximum gap between the straightedge and the pavement surface in the area between these two high points. One measurement shall be taken at the joint every 50 feet (15m) or more often if directed by the Engineer. Maximum gap on final pavement surface > 1/4 inch (6mm) in transverse direction shall be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of surface. Each measurement shall be recorded and a copy of the data shall be furnished to the Engineer at the end of each days testing.
(b) Longitudinal measurements. Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6m); and at the one third points of paving lanes when widths of paving lanes are 20 ft (6m) or greater.

(i) Longitudinal Short Sections. Longitudinal Short Sections are when the longitudinal lot length is less than 200 feet (60m) and areas not requiring a profilograph. When approved by the Engineer, the first and last 15 feet (4.5m) of the lot can also be considered as short sections for smoothness. The finished surface shall not vary more than 1/4 inch (6mm) when evaluated with a 12-foot (3.7m) straightedge. Smoothness readings will not be made across grade changes or cross slope transitions, at these transition areas, the straightedge position shall be adjusted to measure surface smoothness and not design grade or cross slope transitions. Testing shall be continuous across all joints, starting with one-half the length of the straight edge at the edge of pavement section being tested and then moved ahead one-half the length of the straight edge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. Deviations on final pavement surface > 1/4 inch (6mm) in longitudinal direction will be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of surface. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

(ii) Profilograph Testing. Profilograph testing shall be performed by the contractor using approved equipment and procedures as described as ASTM E1274. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate “must grind” bumps and the Profile Index for the pavement using a 0.2 inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches (10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved operator. Profilograms shall be recorded on a longitudinal scale of one inch (25 mm) equals 25 feet (7.5 m) and a vertical scale of one inch (25 mm) equals one inch (25 mm). A copy of the reduced tapes shall be furnished to the Engineer at the end of each days testing.

The pavement must have an average profile index meeting the requirements of paragraph 501-8.1c. Deviations on final surface in longitudinal direction shall be corrected with diamond grinding per paragraph 501-4.19g or by removing and replacing full depth of pavement. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The area corrected by grinding should not exceed 10% of the total area and these areas shall be retested after grinding.

Where corrections are necessary, second profilograph runs shall be performed to verify that the corrections produced an average profile index of 15 inches (38 cm) per mile or less. If the initial average profile index was less than 15 inches (38 cm), only those areas representing greater than 0.4 inch (10 mm) deviation will be re-profiled for correction verification.

(iii) Final profilograph of runway. Final profilograph, full length of runway, shall be performed to facilitate testing of smoothness between lots. Profilograph testing shall be performed by the contractor using approved equipment and procedures as described as ASTM E1274. The pavement must have an average profile index meeting the requirements of paragraph 501-8.1c. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate “must grind” bumps and the Profile Index for the pavement using a 0.2 inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches (10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch (25 mm) equals 25 feet (7.5 m) and a vertical scale of one inch (25 mm)
equals one inch (25 mm). A copy of the reduced tapes shall be furnished to the Engineer at the end of each days testing. Profilograph of final runway shall be performed one foot right and left of runway centerline and 15 feet right and left of centerline. Any areas that indicate “must grind” will be corrected as directed by the Engineer.

Smoothness testing indicated in the above paragraphs except paragraph (iii) shall be performed within 48 hours of placement of material. Smoothness testing indicated in paragraph (iii) shall be performed within 48 hours final paving completion. The primary purpose of smoothness testing is to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. If the contractor’s machines and/or methods are producing significant areas that need corrective actions then production should be stopped until corrective measures can be implemented. If corrective measures are not implemented and when directed by the Engineer, production shall be stopped until corrective measures can be implemented.

(4) Grade. An evaluation of the surface grade shall be made by the Engineer for compliance to the tolerances contained below. The finish grade will be determined by running levels at intervals of 50 feet (15 m) or less longitudinally and all breaks in grade transversely (not to exceed 50 feet (15 m)) to determine the elevation of the completed pavement. The Contractor shall pay the costs of surveying the level runs, and this work shall be performed by a licensed surveyor. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer.

(a) Lateral deviation. Lateral deviation from established alignment of the pavement edge shall not exceed ±0.10 feet (30 mm) in any lane.

(b) Vertical deviation. Vertical deviation from established grade shall not exceed ±0.04 feet (12 mm) at any point.

(5) Edge slump. When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump shall be removed and replaced at the expense of the Contractor as directed by the Engineer in accordance with paragraph 501-4.8a.

(6) Dowel Bar alignment and position. Dowel bar assembly and alignment shall be checked for position and alignment. Any dowel alignment determined to be out of tolerance as specified in Section 501-4.10e that cannot be corrected before the concrete has hardened, the slabs shall be removed and replaced at the expense of the Contractor as directed by the Engineer.

f. Removal and replacement of concrete. Any area or section of concrete that is removed and replaced shall be removed and replaced back to planned joints. The Contractor shall replace damaged dowels and the requirements for doweled longitudinal construction joints in paragraph 501-4.10 shall apply to all contraction joints exposed by concrete removal. Removal and replacement shall be in accordance with paragraph 501-4.20.

CONTRACTOR QUALITY CONTROL

501-6.1 Quality control program. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements that affect the quality of the pavement including but not limited to:

a. Mix Design
b. Aggregate Gradation
c. Quality of Materials
d. Stockpile Management
Los Angeles International Airport   Technical Specifications
Runway 25R Reconstruction Project   Bid Set
Attachment 3(f)  May 15, 2017

1. Proportioning
2. Mixing and Transportation
3. Placing and Consolidation
4. Joints
5. Dowel Placement and Alignment
6. Flexural or Compressive Strength
7. Finishing and Curing
8. Surface Smoothness

501-6.2 Quality control testing. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to this specification and as set forth in the Quality Control Program. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. All test results shall be recorded and included in the Daily QC Reports.

A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

a. Fine aggregate.

(1) Gradation. A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

b. Coarse Aggregate.

(1) Gradation. A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, eight tests shall be made per day. Tests shall be made in accordance with ASTM C566.

c. Slump. Four slump tests shall be performed for each lot of material produced in accordance with the lot size defined in paragraph 501-5.1. One test shall be made for each sublot. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

In addition to the slump tests at the project site, slump tests shall be taken at the batch plant at the frequency defined above. Random samples shall be taken directly material being discharged from the batch plant into trucks.

d. Air content. Four air content tests, shall be performed for each lot of material produced in accordance with the lot size defined in paragraph 501-5.1. One test shall be made for each sublot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate.
and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

e. Four unit weight and yield tests shall be made in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

f. Determination of Combined Grading. The mathematical calculation of the combined aggregate grading, using the actual gradations and production percentages, shall be used to determine the coarseness and workability factors. This will be done a minimum of twice daily and concurrent with each aggregate gradation sampling. Each calculation result shall be plotted on a combined aggregate proportioning guide as part of Section 6.3.

g. Mixer Performance. Before the start of concrete production the uniformity of the mixed concrete shall be determined and the mix time adjusted in accordance with ASTM C94, Alternative Proceedure 2. Adjustments in the mixer shall be accomplished until the variation in the control parameters are within allowed limits. Mixer performance shall be validated after repair of a mechanical breakdown or evidence of wear which affects the mixing characteristics of the plant, or when there is variability in the fresh concrete.

h. Scales. The accuracy of the scales shall be determined and scales shall be certified prior to the start of production of concrete and every 60 days there after.

i. Aggregate Testing. The testing requirements for aggregates are dependent upon the source of stockpile development. Aggregate stockpiles developed as project dedicated sources shall be sampled and tested as the material is delivered to the stockpile. At fixed plant sites and when stockpiles are to be developed from existing stockpiles, the quantities required for the project shall be identified and stockpiled to other locations. Relocated stockpiles shall be treated as new stockpiles. Stockpiles shall be established and maintained in recognized methods for protecting the stockpile from segregation and contamination. Each deliver of aggregates shall be tested for all the same acceptance parameters in P-501-2.1 inclusive of deleterious materials.

j. Cement and Fly Ash Testing. Cement and Fly Ash shall be sampled and tested from the project stockpiles or deliveries weekly. Cement shall be tested for the chemical analysis in accordance with ASTM C114. Fly Ash shall be tested in accordance with ASTM C618.

501-6.3 Control charts. The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, moisture content and air content.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and suspension Limits, or Specification limits, applicable to each test parameter, and the Contractor’s test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor’s projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.

a. Fine and coarse aggregate gradation. The Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Specification limits contained in the Lower Specification Tolerance Limit (L) table above and the Control Chart Limits table below shall be superimposed on the Control Chart for job control.

b. Slump and air content. The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.
## Control Chart Limits

<table>
<thead>
<tr>
<th>Control Parameter</th>
<th>Individual Measurements</th>
<th>Range Suspension Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Action Limit</td>
<td>Suspension Limit</td>
</tr>
<tr>
<td><strong>Slip Form:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slump</td>
<td>+0 to -1 inch (0-25 mm)</td>
<td>+0.5 to -1.5 inch (13-38 mm)</td>
</tr>
<tr>
<td>Air Content</td>
<td>±1.2%</td>
<td>±1.8%</td>
</tr>
<tr>
<td><strong>Side Form:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slump</td>
<td>+0.5 to -1 inch (13-25 mm)</td>
<td>+1 to -1.5 inch (25-38 mm)</td>
</tr>
<tr>
<td>Air Content</td>
<td>±1.2%</td>
<td>±1.8%</td>
</tr>
</tbody>
</table>

The individual measurement control charts shall use the mix design target values as indicators of central tendency.

**501-6.4 Corrective action.** The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of control. The Contractor Quality Control Program shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

- **a. Fine, coarse and combined aggregate gradation.** When two consecutive averages of five tests are outside of the specification limits in paragraph 501-2.1, or the combined aggregate gradation plots outside the WF-CF parallelogram immediate steps, including a halt to production, shall be taken to correct the grading.

- **b. Fine and coarse aggregate moisture content.** Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

- **c. Slump.** The Contractor shall halt production and make appropriate adjustments whenever:
  1. one point falls outside the Suspension Limit line for individual measurements or range
  2. two points in a row fall outside the Action Limit line for individual measurements.

- **d. Air content.** The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:
  1. one point falls outside the Suspension Limit line for individual measurements or range
  2. two points in a row fall outside the Action Limit line for individual measurements.

Whenever a point falls outside the Action Limits line, the air-entraining admixture dispenser shall be calibrated to ensure that it is operating correctly and with good reproducibility.

**e. Fine and Course Aggregate Materials-** When testing from P-501-6.2 i above shows the delivered aggregates no longer met the acceptance requirements the
material will be segregated and rejected and not incorporated into the project
stockpiles and/or project. If these aggregates are found to be incorporated into
the project the affected pavement will be removed and replaced at no additional
cost to the Owner.

TESTING REQUIREMENTS

ASTM C31  Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39  Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C70  Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C78  Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88  Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C136  Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138  Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142  Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143  Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C172  Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173  Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174  Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C231  Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C289  Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
ASTM C295  Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C114  Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C311  Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
ASTM C566  Standard Test Method for Total Evaporable Moisture Content of Aggregates by Drying
ASTM C642  Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM C666  Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D3665 Standard Practice for Random Sampling of Construction Materials
ASTM D4791 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM E178  Standard Practice for Dealing With Outlying Observations
ASTM E1274 Standard Test Method for Measuring Pavement Roughness Using a Profilograph

U.S. Army Corps of Engineers (USACE) Concrete Research Division (CRD) C662 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

**MATERIAL REQUIREMENTS**

ASTM A184  Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615  Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704  Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706  Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A714  Standard Specification for High-Strength Low-Alloy Welded and Seamless Steel Pipe
ASTM A775  Standard Specification for Epoxy-Coated Steel Reinforcing Bars
70-5  SUBMITTALS. Submittals required for this item include, but are not limited to:

- ASTM A934: Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
- ASTM A996: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
- ASTM A1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- ASTM A1078: Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
- ASTM C33: Standard Specification for Concrete Aggregates
- ASTM C94: Standard Specification for Ready-Mixed Concrete
- ASTM C171: Standard Specification for Sheet Materials for Curing Concrete
- ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- ASTM C494: Standard Specification for Chemical Admixtures for Concrete
- ASTM C595: Standard Specification for Blended Hydraulic Cements
- ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- ASTM C989: Standard Specification for Slag Cement for Use in Concrete and Mortars
- ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- ASTM D1752: Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving And Structural Construction
- ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- ACI 305R: Guide to Hot Weather Concreting
- ACI 306R: Guide to Cold Weather Concreting
- ACI 309R: Guide for Consolidation of Concrete
- AC 150/5320-6: Airport Pavement Design and Evaluation
- PCA: Design and Control of Concrete Mixtures

END ITEM P-501
a. **Aggregate submittals (See 501-2)**
   1. Aggregate Properties (See 501-2.1.b; 501-2.1.c)
   2. ASR Testing (See 501-2.1.a)

b. **Other mix components (See 501-2)**
   1. Cement (See 501-2.2)
   2. Fly Ash (See 501-2.3)
   3. Admixtures (See 501-2.10)

c. **Miscellaneous (See 501-2)**
   1. Premolded Joint Filler (See 501-2.4)
   2. Steel Reinforcement (See 501-2.6)
   3. Dowels (See 501-2.7)
   4. Curing Materials (See 501-2.9)
   5. Epoxy Resin (See 501-2.11)

d. **Mix design (See 501-3)**

e. **Laboratory certifications (See 501-3.5)**

f. **Equipment and plant information (See 501-4.1)**

g. **Temperature management plan (See 501-4.7)**

### 70-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

1. 19-inch PCC Pavement (650 psi - 28 day) shall be measured and paid for as described in Project Requirements – 4 of these specifications.
2. 19-inch Reinforced PCC Pavement (650 psi - 28 day) shall be measured and paid for as described in Project Requirements – 4 of these specifications.
3. 22-inch PCC Pavement (650 psi - 28 day) shall be measured and paid for as described in Project Requirements – 4 of these specifications.
4. 22-inch Reinforced PCC Pavement (650 psi - 28 day) shall be measured and paid for as described in Project Requirements – 4 of these specifications.

**END OF SECTION 70**
SECTION 71 – CONCRETE REPAIR

71-1 GENERAL

71-1.1 DESCRIPTION

This specification covers the repair of existing concrete pavement, as identified by the Engineer within the project site. The following specification addresses these situations, and gives the requirements for such repairs. Spalls along existing PCC joints pavement shall be repaired as specified by the Engineer.

No additional payment will be made for any repairs or slab replacement to new concrete placed by the Contractor. The Engineer maintains the right to ultimately require complete removal and replacement of the defective slab should he find that the repairs undertaken are unacceptable. Nothing in this specification obligates the Engineer to accept the Contractor’s request to attempt repair of damaged or defective pavement in lieu of full slab removal and replacement.

New pavement slabs that are broken or contain cracks shall be removed and replaced or repaired, as specified herein, at the Contractor’s expense. Spalls along joints shall be repaired as specified. Spalls on new concrete placed by the Contractor or that result from the Contractor’s operations (including but not limited to bituminous concrete paving operations) on existing concrete shall be repaired at the contractor's expense.

Removal of partial slabs is not permitted. The Engineer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be 4-inch diameter, shall be drilled by the Contractor, and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin, using approved procedures. Drilling of cores and refilling holes shall be at the Contractor’s expense.

71-1.2 IDENTIFICATION

In each phase/work area, prior to commencing repair work in each work on the concrete pavement, the Contractor, in the company of the Engineer, shall inspect the existing concrete to identify proposed spall repair locations and mark any areas that shall be repaired. Identification of defects approved for repair shall be at the sole discretion of the Engineer.

71-2 ELASTOMERIC CONCRETE

Spall repair material used for pavement surface repair areas shall be an elastomeric concrete consisting of a fluid base or binder with suitable reinforcing agents to provide a product which mixes in five minutes or less, flows readily, strongly, adheres to concrete, requires no external application of heat for curing and cures within one hour of application.

This material shall be “DelPatchTM” as manufactured by the D.S. Brown Company, or approved equal.

71-2.1 PROPERTIES

The material shall meet the properties in Table 1:
### TABLE 1

<table>
<thead>
<tr>
<th>Properties</th>
<th>Requirement</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>600 psi, min</td>
<td>ASTM D 412 (Mod)</td>
</tr>
<tr>
<td>Elongation at break</td>
<td>25 %, min</td>
<td>ASTM D 412 (Mod)</td>
</tr>
<tr>
<td>Hardness, Type D Durometer</td>
<td>50 pts, min</td>
<td>ASTM D2240</td>
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<tr>
<td><strong>Compression-Deflection Properties</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress (psi) 5% Deflection</td>
<td>800 min/1400 max</td>
<td>D 695</td>
</tr>
<tr>
<td>Resilience, 5% Deflection</td>
<td>95 min</td>
<td>D 695 (Mod)</td>
</tr>
<tr>
<td>Impact Ball Drop @ -20oF</td>
<td>&gt;10 ft</td>
<td>D 3029 (Mod)</td>
</tr>
<tr>
<td>Adhesion to Concrete (psi)</td>
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<td></td>
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<tr>
<td>Dry Bond</td>
<td>400 min</td>
<td></td>
</tr>
<tr>
<td>Wet Bond</td>
<td>250 min</td>
<td></td>
</tr>
</tbody>
</table>

### 71-2.2 Application.** Spall repair materials shall be weighed and mixed in accordance with the manufacturer’s recommendations. The material shall be placed into the area to be repaired in layers up to finished grade within four minutes of the initial mixing. The material shall be allowed to cure two hours before opening to construction traffic.**

### 71-2.3 Epoxy Resin. All epoxy resin used for crack repair shall conform to ASTM C 881, Type IV, of the various grades specified.

### 71-2.4 Other Materials. Unless otherwise specified herein, materials used for concrete pavement repair shall conform to the material requirements set forth in Section 70 of these Specifications, Portland Cement Concrete Pavements (FAA P-501).

### 71-3 REPAIR OF CRACKS

#### 71-3.1 Cracks That Do Not Exceed 4 Inches in Depth. Except as otherwise specified below, cracks less than 4 inches deep (including plastic shrinkage cracks) shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1, using procedures as approved. Care shall be taken to assure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the Engineer.

#### 71-3.2 Cracks Greater than 4 Inches in Depth.

   a. Slabs with any cracks greater than 4 inches deep that extend into the interior area, regardless of direction, shall be removed and replaced at the Contractor’s expense.

### 71-4 FULL DEPTH REPAIRS

Full depth slab repairs will not be allowed. Where spall repair or other deficiencies are identified that extend more than one-half the slab depth, the entire slab shall be removed and replaced at the Contractor’s expense.
71-5 REMOVAL AND REPLACEMENT OF FULL SLABS

Where it is necessary to remove full slabs all edges of the slab (unless otherwise shown on the drawings) shall be cut full depth with a concrete saw. All saw cuts shall be perpendicular to the slab surface. An additional saw cut shall be made full depth and 24 inches from the edge.

The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and approved safe lifting devices used for attachment to the slabs. The narrow strips along keyed or doweled edges shall be carefully broken up and removed using light, hand-held jackhammers, 30 pounds or less, or other approved similar equipment. Care shall be taken to prevent damage to the dowels, tie bars, or keys or to concrete to remain in place. The joint face below keys or dowels shall be carefully trimmed so that there is not abrupt offset in any direction greater than 1/2 inch and no gradual offset greater than 1 inch when tested in a horizontal direction with a 12 foot straightedge. No mechanical impact breakers, other than the above hand-held equipment shall be used for any removal of slabs. If underbreak between 1-1/2 and 4 inches deep occurs at any point along any edge, the area shall be repaired as directed before replacing the removed slab. Procedures directed will be similar to those specified for surface spalls, modified as necessary. If underbreak over 4 inches deep occurs, the entire slab containing the underbreak shall be removed and replaced.

Where there are no dowels, tie bars, or keys on an edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four edges of the new slab shall contain dowels. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material (unless it is stabilized) shall be recompressed and shaped as specified in the appropriate section of these Specifications. The surfaces of all four joint faces shall be cleaned of all loose material.

If sawcutting extends into joints between existing slabs to remain, the existing joint treatment (expansion material and sealant) shall be restored. If sawcuts extend into the concrete of existing slabs that are otherwise intended to remain, these slabs shall be completely replaced by the Contractor, at no cost to the Owner.

When a slab is replaced, new dowels shall be installed on joints as detailed for the original construction. On doweled joints with existing slabs, the new dowels will be offset horizontally from the original positions. The holes drilled in adjacent slabs for the new dowels shall be at the midpoints between the halves of the dowels remaining from the original construction. The spacing of new dowels from the slab corners shall be determined by the Engineer.

Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material shall be recompressed and shaped as specified in the appropriate section of these specifications, and the surfaces of all four joint faces shall be cleaned of all loose material. Care shall be taken to prevent any curing compound from contacting dowels. The resulting joints around the new slab shall be prepared and scaled as specified for original construction.
71-6 TESTING AND QUALITY CONTROL

Unless otherwise specified herein, quality control testing and evaluation required for repair of concrete pavement shall conform to the testing requirements set forth in Section 70 of these Specifications, Portland Cement Concrete Pavements (FAA P-501). All costs for testing associated with effecting repairs under this section shall be borne solely by the Contractor.

71-7 SPALL REPAIR OF PAVEMENT

Spall repair shall consist of sawing concrete behind the spalled area, removing concrete pavement to expose sound pavement throughout the repair area, preparing and installing repair material, and sealing of the sawn joint.

71-7.1 Cutting the Repair Limits. Corners of repair limits shall be drilled to a minimum depth of 2 inches using 4-inch or larger diameter core drills. Diamond blade sawcuts shall then be made along the tangents of these cores, square to the slab edges, to establish the removal area. The depth of sawcut shall be a minimum of 2 inches. When the boundaries of multiple partial depth repairs areas are closer than 24 inches, the repair areas shall be combined as one repair. Where repairs abut previously sealed joints, a sawcut of minimum depth shall be made along the joint face to remove old joint sealant and to make a clean vertical face at the joint.

71-7.2 Removal of Existing Concrete. Existing concrete within the boundaries of the repair shall be removed by chipping with pneumatic tools. Pavement breakers or hydraulic rams shall not be used. Concrete shall be removed to the depth of the sawcut or to at least ½ inch beyond sound concrete, whichever is deeper. The depth of total removal shall be at least 3 inches. Sounding within the limits of the repair will ensure that all damaged and unsound concrete has been removed. When the depth of the unsound concrete exceeds one-half of the slab depth, the slab may be removed and replaced, at the discretion of the Engineer. Under no circumstances will a partial depth repair be allowed to rest on a dowel bar.

71-7.3 Preparation of Cavity. The cavity thus formed shall be thoroughly cleaned with high pressure water jets supplemented with compressed air to remove all loose material. The concrete surface preparation and patch installation shall be accomplished in accordance with the material manufacturer’s recommendations. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens.

71-7.4 Placement of Filler. An insert or other bond-breaking medium shall be used to prevent bond at the joint face and to shape a reservoir for the joint sealant. The cavity shall be filled with elastomeric concrete.

71-7.5 Repair Penalty. Any pavement deficiencies that must be corrected will result in future maintenance costs that will be borne by LAWA. Therefore, the Contractor will be assessed a penalty of One Thousand ($1,000) dollars for each spall that was caused by Contractor’s construction or lack of protecting pavement during construction. This penalty will be assessed on top of the cost borne by the contractor to repair the spall to the satisfaction of LAWA. This penalty will be deducted by LAWA from the funds otherwise due the contractor.

71-8 SMALL AND LARGE REPAIRS
Small spall repairs on existing pavement are to be an Engineer identified spall of size up to 2.5 square feet by up to 4 inches deep.

Large spall repairs on existing pavement are to be an Engineer identified spall from 2.5 up to 7 square feet by up to 6 inches deep.

71-9  JOINT FILLER MATERIAL

Shall conform to Section 73, Joint Sealing Filler (FAA P-605) or Section 72, Compression Joint Seals for Concrete Pavement (FAA P-604).

71-10  METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Spall Repair - Small shall be measured and paid for as described in Project Requirements – 4 of these specifications.

Spall Repair - Large shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 71
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SECTION 72 – COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS (FAA P-604)

72-1 GENERAL

The Contractor shall perform all work required by the plans and specifications for construction of Portland Cement Concrete (PCC) pavement joints in accordance with the Standard Specifications, except as specified otherwise in FAA Specification Item P-604, as included and modified hereafter, and as shown on the Plans. If joint sealer is proposed for pavement joints, it shall conform to the requirements set forth in Section 73 of these Specifications.

ITEM P-604 COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS

604-1 DESCRIPTION

604-1.1 This item shall consist of preformed polychloroprene compression seals used for sealing joints of rigid pavements.

604-2 MATERIALS

604-2.1 PREFORMED SEALS. Preformed joint seal materials shall be a vulcanized elastomeric compound using polychloroprene as the only base polymer. The material and the manufactured seal itself shall conform to ASTM D 2628 and CRD C 548. The joint seal shall be a labyrinth type seal with the uncompressed depth of the seal greater than the uncompressed width of the seal, except that for seals 1 in or greater in width, the depth need be only 1 in or greater. The actual width of the uncompressed seal shall be 13/16 in and 1-1/4 in within a tolerance of plus 1/8 in and minus 1/16 in.

604-2.2 LUBRICANT/ADHESIVE. Lubricant/adhesive used for the preformed elastomeric joint seal shall be a one-component compound conforming to ASTM D 2835.

604-2.3 DELIVERY AND STORAGE. Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided at the job site to protect materials from weather and to maintain them at temperatures as recommended by the manufacturer.

604-2.4 SUBMITTALS. Certified copies of test results shall be provided 60 days prior to use of material on the project.

a. Construction Equipment List. List of proposed equipment to be used in the performance of construction work, including descriptive data shall be provided to the engineer 60 days prior to use on the project.

b. Manufacturer’s Instructions. Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer’s recommendations, printed copies of these recommendations shall be
furnished to the engineer 60 days prior to use on the project. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be a cause for rejection of the material.

c. **Samples.** Regardless of testing responsibility, samples of the materials shall be submitted by the contractor to the engineer for written approval 60 days prior to use on the project. Written or printed directions from the manufacturer giving recommended criteria for installation shall be furnished to the engineer at the same time, plus certification from the manufacturer that the seal selected is recommend for the installation involved on this project. No material will be allowed to be used until it has been approved.

**604-2.5 TEST REQUIREMENTS.** Each lot of preformed joint seal and lubricant/adhesive produced for this project shall be sampled, adequately identified, and tested for conformance with the referenced applicable material specification. A lot of preformed seal shall consist of one day’s production or 20,000 linear feet for each cross section, whichever is less. A lot of lubricant/adhesive shall consist of one day’s production. Each lot shall be tested by the supplier and results shall be submitted prior to installation. Samples of the preformed joint seal and lubricant/adhesive material shall be submitted and will be tested by the Engineer. No material shall be used at the project prior to receipt of written notice that the materials meet the laboratory requirements. The cost of testing the samples from each original lot supplied will be borne by the Contractor. If the sample fails to meet specification requirements, the materials represented by the sample shall be replaced and the new materials tested. The Contractor shall furnish additional samples of materials, in sufficient quantity to be tested, upon request. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will also be based on the performance of the in-place materials.

**604-3 CONSTRUCTION METHODS**

**604-3.1 EQUIPMENT.** Machines, tools, and equipment used in the performance of the work required by this section shall be approved by the engineer before the work is started and shall be maintained by the contractor in satisfactory condition at all times.

a. **Joint Cleaning Equipment.**

1. **Concrete Saw.** A self-propelled power saw with water-cooled diamond or abrasive saw blades shall be provided for cutting joints to the depths and widths specified or for removing other material embedded in the joints or adhered to the joint faces.

2. **Sandblasting Equipment.** Sandblasting is not allowed.
(3) **Waterblasting Equipment.** Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, a wand with safety release cutoff controls, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary water resupply equipment shall be sufficient capacity to permit continuous operations. The pumps, hoses, wand, and nozzle shall be of sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width of at least 1/2 in on either side of the joint. The pump shall be capable of supplying a pressure of at least 3,000 psi. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch at which the equipment is operating.

b. **Sealing Equipment.** Equipment used to install the preformed seal shall place the preformed seal to the prescribed depths within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. The equipment shall not stretch or compress the seal more than 2.0 percent longitudinally during installation. The machine shall be an automatic self-propelled joint seal application equipment and shall be engine powered and shall be approved by the joint manufacture providing the jointing material. A Single-axle type seal application equipment should not be permitted. The machine shall include a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides the preformed seal or the sidewalls of the joint, a reel capable of holding one full spool of preformed seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. The equipment shall also include a guide to maintain the proper course along the joint being sealed. The machine shall at all times be operated by an experienced operator.

604-4 **CONSTRUCTION METHODS**

604-4.1 **ENVIRONMENTAL CONDITIONS.** The ambient temperature and the pavement temperature within the joint wall shall be at least 35 °F and rising at the time of installation of the materials. Sealant application will not be permitted if moisture or any foreign material is observed in the joint.

604-4.2 **TRIAL JOINT SEAL AND LUBRICANT/ADHESIVE INSTALLATION.** Prior to the cleaning and sealing of the joints for the entire project, a test section at least 200 feet long shall be prepared at a location directed in the project pavement using the specified materials and the approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the trial length and before any other joint is sealed, the trial joints will be inspected by the Engineer to determine that the materials and installation meet the requirements specified. If materials or installation do not meet requirements the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the owner. No other joints shall be sealed until the test installation has been approved. If the
trial section is approved, it may be incorporated into the permanent work and paid for at the contract unit prices per linear foot for sealing items scheduled. All other joints shall be sealed in the manner approved for sealing the trial joints. If the sawn or formed joint exceeds the tolerance as specified in the plans, contractor will be required to provide a larger compression seal per joint seal manufacturer recommendation.

604-4.3 PREPARATION OF JOINTS. Immediately before installation of the preformed joint seal, the joints shall be thoroughly cleaned to remove all laitance, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. All cuttings shall be flushed from the reservoir and disposed of offsite. Any irregularity in the joint face that would prevent uniform contact between the joint seal and the joint face shall be corrected by repairing the joint prior to the installation of the joint seal.

a. Sawing. Joints shall be sawed to clean and to open them to the full specified width and depth. Immediately following the sawing operation, the joint faces and opening shall be thoroughly cleaned using a water jet to remove all saw cuttings or debris remaining on the faces or in the joint opening. Compression seal shall be installed within 5 calendar days of the time the individual joint cavity is sawed. Depth of sawing the cavity shall be as recommended by the manufacturer. Submit printed copies of manufacturers’ instructions 60 days prior to use on the project. The saw cut for the joint seal cavity shall at all locations be centered over the joint line. The nominal width of the sawed joint seal cavity shall be as follows; the actual width shall be within a tolerance of plus or minus 1/16 in:

(1) The nominal width of the saw cut shown on the plans shall apply only when the pavement temperature at the time of sawing is between 50 and 155 °F. If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16 in. If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16 in. The pavement temperature shall be measured and recorded in the presence of the Engineer. Measurement shall be made each day before commencing sawing and at any other time during the day when the temperature appears to be moving out of the allowable sawing range.

b. Sandblast Cleaning. Sandblasting is not allowed.

c. Waterblast Cleaning. The concrete joint faces and pavement surfaces extending at least 1/2 in from the joint edges shall be waterblasted clean. A multiple pass technique shall be used until the surfaces are free of dust, direct, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately
prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

d. Rate of Progress. The stages of joint preparation which includes sandblasting or waterblasting of the joint faces and air pressure cleaning of the joints shall be limited to only the linear footage of joint that can be sealed during the same workday.

604-4.4  INSTALLATION OF THE PREFORMED SEAL.

a. Time of Installation. Joints shall be sealed within 5 calendar days of sawing the joint seal cavity and immediately following concrete cure and the final cleaning of the joint walls. Open joints ready for sealing that cannot be sealed under the conditions specified herein shall be provided with an approved temporary seal to prevent infiltration of foreign material. When rain interrupts the sealing operations, the joints shall be washed, air pressure cleaned and allowed to dry prior to installing the lubricant/adhesive and preformed seal.

b. Sequence of Installation. Longitudinal joints shall be sealed first, followed by transverse joints and then all other joints. The reservoirs shall be complete in both directions prior to installation. Seals in longitudinal joints shall be cut with a knife and not sawed so that all transverse joint seals will be intact from edge to edge of the pavement. Intersections shall be made monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Extender pieces of seal shall not be used at intersections. Any seal falling short of the intersection shall be removed and replaced with new seal at no additional cost to the owner.

c. Manufacturer’s Technical Representative. A manufacturer’s technical representative of the preformed polychloroprene compression joint seal and compression seal installation equipment must be on site for a minimum of the first three days during its installation and until the engineer is satisfied that the seals are being properly installed.

604-4.5  SEALING OF JOINTS. The joint seal shall be installed using the equipment specified in paragraph 604-3.1b EQUIPMENT. The sides of the joint seal or the sides of the joint shall be covered with a coating of lubricant/adhesive and the seal installed in such a manner as to conform to all requirements specified. Butt joints and seal intersections shall be coated with liberal applications of lubricant/adhesive. Lubricant/adhesive spilled on the pavement shall be removed immediately to prevent setting on the pavement. An in-place joint seal shall be in an upright position and free from twisting, distortion, cuts, and stretching or compression in excess of 2.0 percent. The joint seal shall be placed at a uniform depth within the tolerances specified. In-place joint seal that fails to meet the specified requirements shall be removed and replaced with new joint seal in a satisfactory manner at no additional cost to the owner. The preformed joint seal shall be placed to a depth per the plans. No part of the seal shall be allowed to project above the surface of the pavement or above the edge.
of the bevel or radius. The seal shall be installed in the longest practicable lengths in longitudinal joints and shall be cut at the joint intersections so as to provide continuous installation of the seal in the transverse joints. The lubricant/adhesive in the longitudinal shall be allowed to set for 1 hour prior to cutting at the joint intersections to reduce the possibility of shrinkage. For all transverse joints, the minimum length of the preformed joint seal shall be the pavement width from edge to edge.

604-4.6 CLEAN-UP. Upon completion of the project, all unused materials shall be removed from the site, all lubricant/adhesive on the pavement surface shall be removed, and the pavement shall be left in clean condition.

604-4.7 QUALITY CONTROL PROVISIONS.

a. **Equipment.** The application equipment shall be inspected to assure uniform application of lubricant/adhesive to the sides of the preformed joint seal or the walls of the joint. If any equipment causes cutting, twisting, nicking, excessive stretching or compressing of the preformed seal, or improper application of the lubricant/adhesive, the operation shall be suspended until causes of the deficiencies are determined and corrected by the contractor.

b. **Procedures.**

(1) Quality control provisions shall be provided during the joint cleaning process to prevent or correct improper equipment and cleaning techniques that damage the concrete in any manner. Cleaned joints shall be approved by the Engineer prior to installation of the lubricant/adhesive and preformed joint seal.

(2) Conformance to stretching and compression limitations shall be determined by the engineer. After installation, the distance between the marks shall be measured on the pavement. If the stretching or compression exceeds the specified limit, the seal shall be removed and replaced with new joint seal at no additional cost to the owner. The seal shall be removed up to the last correct measurement. The seal shall be inspected a minimum of once per 100 feet of seal for compliance to the shrinkage or compression requirements. Measurements shall also be made as directed to determine conformance with depth and width installation requirements. All preformed seal that is not in conformance with specification requirements shall be removed and replaced with new joint seal at no additional cost to the owner.

c. **Product.** The joint sealing system (preformed seal and lubricant/adhesive) shall be inspected by the engineer for proper rate of cure and bonding to the concrete, cuts, twists, nicks, and other deficiencies. Seals exhibiting any defects, at any time prior to final acceptance of the project, shall be removed from the joint, wasted, and replaced in a satisfactory manner, as determined by the engineer.
604-5  METHOD OF MEASUREMENT  See Section 72.2.

604-6  BASIS OF PAYMENT  See Section 72.2.

604-7  TESTING REQUIREMENTS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in this text by basic designation only.

<table>
<thead>
<tr>
<th>Publication</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ASTM D 2628</td>
<td>Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements</td>
</tr>
<tr>
<td>ASTM D 2835</td>
<td>Lubricant for Installation of Preformed Compression Seals in Concrete Pavements</td>
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</table>

END OF ITEM P-604

72-2  METHOD OF MEASUREMENT AND BASIS OF PAYMENT

For **new PCC construction** bid items utilizing joint compression seal, the joint compression seal shall be considered incidental to the bid item. The bid item price shall be full compensation for furnishing all materials and for all preparation, delivery and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item. No separate measurement or allowances shall be made for joint compression seal in place, completed, and accepted.

For **Existing PCC joint rehabilitation**, the item “1-1/4 Inch Compression Joint Seal” shall be measured and paid for as described in Project Requirements PR–4 of these specifications.

END OF SECTION 72
SECTION 73 – JOINT SEALING FILLER (FAA P-605)

73-1 GENERAL

The Contractor shall perform all work required by the plans and specifications for construction of portland cement (PCC) and asphalt (AC) pavement joints in accordance with the Standard Specifications, except as specified otherwise in FAA Specification Item P-605, as included and modified hereafter, and as shown on the Plans. If pre-molded joint sealer is proposed for PCC pavement joints, it shall conform to the requirements set forth in Section 73 of these Specifications.

ITEM P-605 JOINT SEALING FILLER

DESCRIPTION

605-1.1 This item shall consist of providing and installing a resilient and adhesive joint sealing filler capable of effectively sealing joints and cracks in pavements.

MATERIALS

605-2.1 JOINT SEALERS. Joint sealing material shall be SIKASIL 728 SL, manufactured by Sika Corporation, or approved equal. It shall be a self-leveling polyurethane joint sealant specifically designed for use in sealing joints in concrete and asphalt pavement. Sealant shall conform to Federal Specification S-00230C, Type 1, Class A, and ASTM C920, Type S, Grade P, Class 100/50. Test results from a certified laboratory shall confirm that submitted alternates have the following properties:

(a) Color: Grey.

(b) Service Range: Minus 40 to 170 degrees F.

(c) Curing Rate: Tack Free 1-2 hours, final cure 3-5 days.

(d) Recovery: Greater than 90 percent.

(e) Shore “A” Hardness (ASTM D2240) 21-Day: 45.

(f) Tensile Properties (ASTM D412):

1) Tensile Strength: 550 psi.

2) Elongation at Break: 700 percent.

3) Modulus of Elasticity 100 Percent: 150 psi.

(g) Adhesion Peel (ASTM C794) (Substrate Concrete):
1) Peel Strength: Greater than 30 psi.

2) Adhesion Loss: 0 percent.

(h) Joint Movement: Plus or minus 25 percent.

Each lot or batch of sealant shall be delivered to the jobsite in the manufacturer’s original sealed container. Each container shall be marked with the manufacturer’s name, batch or lot number, the safe heating temperature, and shall be accompanied by the manufacturer’s certification stating that the sealant meets the requirements of this specification.

Contractor shall store sealing materials from inclement weather and maintain material temperatures as recommended by manufacturer. Store sealers as required by applicable materials specifications.

605-2.2 BACKER ROD. Preformed backer rod shall be installed in all pavement construction, expansion, and contraction joints as shown in the Plans.

The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant. The material shall have a water absorption of not more than 5% when tested in accordance with ASTM C509. The backer-rod material shall be 25% ± 5% larger in diameter than the nominal width of the joint or crack.

605-2.3 BACKUP MATERIALS. Provide backup material that is a compressible, nonshrinking, nonstaining, nonabsorbing material, nonreactive with the joint sealant. The material shall have a melting point at least 5°F (3°C) greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The material shall have a water absorption of not more than 5% of the sample weight when tested in accordance with ASTM C509. The backup material shall be 25% ± 5% larger in diameter than the nominal width of the joint or crack.

605-2.4 BOND BREAKING TAPES. Provide a bond breaking tape or separating material that is a flexible, nonshrinking, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5°F (3°C) greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately 1/8 inch (3 mm) wider than the nominal width of the joint and shall not bond to the joint sealant.

CONSTRUCTION METHODS

605-3.1 TIME OF APPLICATION. Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be
50°F (10°C) and rising at the time of installation of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

605-3.2 EQUIPMENT. Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, at least 15 days prior to use on the project.

(a) Tractor-Mounted Routing Tool. Provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

(b) Concrete Saw. Provide a self-propelled power saw, with watercooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not provide a clean joint.

(c) Sandblasting Equipment. Include with the sandblasting equipment an air compressor, hose, and longwearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening should not exceed 1/4 inch (6 mm). The air compressor shall be portable and capable of furnishing not less than 150 cfm (71 L/s) and maintaining a line pressure of not less than 90 psi (621 kPa) at the nozzle while in use. Demonstrate compressor capability, under job conditions, before approval. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately one inch (25 mm) above the pavement surface. Adjust the height, angle of inclination and the size of the nozzle as necessary to secure satisfactory results.

(d) Waterblasting Equipment. Include with the waterblasting equipment a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. Provide water tank and auxiliary resupply equipment of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately one inch (25 mm) above the pavement surface. Adjust the height, angle of inclination and the size of the nozzle as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in psi (kPa) at which the equipment is operating.

(e) Hand Tools. Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.
(f) **Hot-Poured Sealing Equipment.** The unit applicators used for heating and installing ASTM D6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

(g) **Two-Component, Cold-Applied, Machine Mix Sealing Equipment.** Provide equipment used for proportioning, mixing, and installing Federal Specification SS-S-200 Type M joint sealants designed to deliver two semifluid components through hoses to a portable mixer at a preset ratio of one (1) to one (1) by volume using pumps with an accuracy of ±5% for the quantity of each component. The reservoir for each component shall be equipped with mechanical agitation devices that will maintain the components in a uniform condition without entrapping air. Incorporate provisions to permit thermostatically controlled indirect heating of the components, when required. However, immediately prior to proportioning and mixing, the temperature of either component shall not exceed 90°F (32°C). Provide screens near the top of each reservoir to remove any foreign particles or partially polymerized material that could clog fluid lines or otherwise cause misproportioning or improper mixing of the two components. Provide equipment capable of thoroughly mixing the two components through a range of application rates of 10 to 60 gallons (37.8 to 189 L) per hour and through a range of application pressures from 50 to 1500 psi (345 kPa to 10.3 MPa) as required by material, climatic, or operating conditions. Design the mixer for the easy removal of the supply lines for cleaning and proportioning of the components. The mixing head shall accommodate nozzles of different types and sizes as may be required by various operations. The dimensions of the nozzle shall be such that the nozzle tip will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier’s instructions, and unaltered in any way without obtaining prior approval.

(h) **Two-Component, Cold-Applied, Hand-Mix Sealing Equipment.** Mixing equipment for Federal Specification SS-S-200 Type H sealants shall consist of a slow-speed electric drill or air-driven mixer with a stirrer in accordance with the manufacturer’s recommendations. Submit printed copies of manufacturer’s recommendations at least 15 days prior to use on the project where installation procedures, or any part thereof, are required to be in accordance with those recommendations. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
(i) Cold-Applied, Single-Component Sealing Equipment. The equipment for installing ASTM D5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

605-3.3 PREPARATION OF JOINTS.

(a) Sawing. All joints shall be sawed in accordance with specifications and plan details. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.

(b) Sealing. Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, and other foreign material. Cleaning shall be accomplished by sandblasting as specified in paragraph 605-3.2. The newly exposed concrete joint faces and the pavement surface extending a minimum of 1/2 inch (12 mm) from the joint edge shall be sandblasted clean. Sandblasting shall be accomplished in a minimum of two passes. One pass per joint face with the nozzle held at an angle directly toward the joint face and not more than 3 inches (75 mm) from it. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water. The joint faces shall be surface dry when the seal is applied.

Prior to resealing joints, the existing joint material shall be removed to the depth as shown on the Plans. If joint sealer other than that originally used is specified, all existing joint sealer shall be removed.

(c) Back-Up Material. When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a back-up material to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

(d) Bond-Breaking Tape. Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond-breaker separating tape to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.
605-3.4 INSTALLATION OF SEALANTS. Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the Engineer before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

Cold Applied Sealants. Cold applied joint sealing compound shall be applied by means of pressure equipment that will force the sealing material to the bottom of the joint and completely fill the joint without spilling the material on the surface of the pavement. A backing material shall be placed as shown on the plans and shall be nonadhesive to the concrete or the sealant material. Sealant that does not bond to the concrete surface of the joint walls, contains voids, or fails to set to a tack-free condition will be rejected and replaced by the Contractor at no additional cost. Before sealing the joints, the Contractor shall demonstrate that the equipment and procedures for preparing, mixing, and placing the sealant will produce a satisfactory joint seal. This shall include the preparation of two small batches and the application of the resulting material. Any sealant spilled on the surface of the pavement, structures and/or lighting fixtures, shall be removed immediately.

(a) Unless otherwise specified, seal joints as soon as feasible after completion of curing period and before pavement is opened to traffic, including construction equipment.

1) Do not apply joint sealing compound in wet joints, when atmospheric and pavement temperatures are below 50 degrees F, or when weather is rainy or foggy.

(b) Immediately before sealing, sandblast joints to remove laitance, curing compound, and other foreign material.

1) Remove laitance, curing compound, and other foreign materials from upper edges of joint to distance not less than 1 inch from each side of joint edge on pavement surface.

2) Sand shall be of proper size and quality necessary for Work.

3) Nozzle shall be of proper size and of long-wearing type. Nozzles enlarged by wear shall be replaced as necessary.

4) Sandblast at air pressure or not less than 90 psi using minimum of 300 cubic feet of air per minute.

(c) Following sandblasting, clean joints using air blowing nozzle.

1) Air compressors shall be portable and capable of furnishing not less than 90 pounds per square inch pressure.

2) Employ suitable traps to maintain compressed air free of oil and free of moisture. Presence of oil or free moisture in compressed
air will necessitate cessation of operations until suitable adjustments are made.

(d) Remove foreign material and other debris from joints or cracks from pavement surface by means of power sweeper or hand broom and immediately remove from designated area.

1) Remove debris before beginning joint sealing operation.

2) Remove sandblasting residue from joint.

3) Remove sealant spilled on surface of pavement immediately.

(e) Under no circumstances shall liquid membrane curing compound be applied in joints.

(f) Use curing tape, backer rod, or approved bond-breakers as shown on the Plans at expansion joints to isolate joint filler from joint seal.

(g) Fill joint with continuous body of sealing compound free of voids, blisters, and foreign particles. Top of compound shall be 1/8- to 1/4-inch from top surface of pavement, unless otherwise detailed on the Plans. Excess sealer on surface of pavement shall be removed and surface left in clean condition.

(h) Seal all cracks in existing asphalt prior to installing the asphalt overlay. No direct payment will be made as the sealing will be considered an incidental.

Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Engineer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer’s instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

605-3.5 INSPECTION. The Contractor shall inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, disposed of off airport property, and replaced as specified at no additional cost to the Owner.

605-3.6 CLEAN-UP. Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.
METHOD OF MEASUREMENT

605-4.1 See Section 73-2.

BASIS OF PAYMENT

605-5.1 See Section 73-3.

TESTING REQUIREMENTS

ASTM D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension


ASTM D 1644 Test Methods for Nonvolatile Content of Varnishes

MATERIAL REQUIREMENTS

AC 150/5340-30 Design and Installation Details for Airport Visual Aids

ASTM D 789 Standard Test Method for Determination of Relative Viscosity of Polyamide (PA)

ASTM D 5893 Standard Specifications for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

ASTM D 6690 Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements

END ITEM P-605

73-2 METHOD OF MEASUREMENT

No separate measurement of joint sealing filler as described herein shall be made.

73-3 BASIS OF PAYMENT

No separate payment will be made for joint sealing filler, which cost is considered incidental to associated bid items.
END OF SECTION 73
SECTION 74 – SAW CUT GROOVES (FAA P-621)

74-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of sawcut grooves in asphalt concrete or Portland cement concrete pavement in accordance with FAA Specification Item P-621 as included and modified hereafter, and as shown on the Plans.

The Contractor shall be responsible for all testing under this section, including Measurements, Width, Depth, and Center to Center Spacing measurements. All Contractor performed tests shall be witnessed by the Engineer.

74-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

74-3 RELATED SECTIONS
Section 70 – Portland Cement Concrete Pavement (FAA P-501)
Other Sections, Tests, Specifications, and Standards referenced herein.

74-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-621 SAW-CUT GROOVES

621-1 DESCRIPTION. This item consists of providing a skid resistant surface that prevents hydroplaning during wet weather in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer.

621-2 CONSTRUCTION METHODS.

621-2.1 PROCEDURES. The Contractor shall submit to the Engineer the grooving sequence and method of placing guide lines to control grooving operation. Transverse grooves saw-cut in the pavement must form a 1/4 inch (+1/16 inch, -0 inch) wide by 1/4 inch (±1/16 inch) deep by 1-1/2 inch (-1/8 inch, +0 inch) center-to-center configuration. The grooves must be continuous for the entire runway length. They must be saw-cut transversely (perpendicular to centerline) in the runway pavement to not less than 10 feet from the runway pavement edge to allow adequate space for equipment operation.

The saw-cut grooves must meet the following tolerances. The tolerances apply to each day's production and to each piece of grooving equipment used for production. The Contractor is responsible for all controls and process
adjustments necessary to meet these tolerances. The Contractor shall routinely
spot check for compliance each time the equipment aligns for a grooving pass.

a. **Alignment tolerance.** The grooves shall not vary more than plus or
minus 1-1/2 inches in alignment for 75 feet along the runway length,
allowing for realignment every 500 feet along the runway length.

b. **Groove Tolerance.**

   (1) **Groove Depth.** The standard depth is 1/4 inch. At least 90 percent
   of the grooves must be at least 3/16 inch, at least 60 percent of the
   grooves must be at least 1/4 inch, and not more than 10 percent of
   the grooves may exceed 5/16 inch.

   (2) **Groove Width.** The standard width is 1/4 inch. At least 90 percent
   of the grooves must be at least 3/16 inch, at least 60 percent of the
   grooves must be at least 1/4 inch, and not more than 10 percent of
   the grooves may exceed 5/16 inch.

c. **Center-to-Center Spacing.**
Saw-cut grooves must not be closer than 3 inches or more than 9 inches from
transverse joints in concrete pavements. Grooves must not be closer than 6
inches and no more than 18 inches from in-pavement light fixtures. Grooves may
be continued through longitudinal construction joints. Where neoprene
compression seals have been installed and the compression seals are recessed
sufficiently to prevent damage from the grooving operation, grooves may be
continued through the longitudinal joints. Where lighting cables are installed,
grooving through longitudinal or diagonal saw kerfs shall not be allowed.

621-2.2 **ENVIRONMENTAL REQUIREMENTS.** Grooving operations will
not be permitted when freezing conditions prevent the immediate removal of
debris and/or drainage of water from the grooved area. Discharge and disposal
of waste slurry shall be the Contractor’s responsibility.

621-2.3 **TEST SECTION.** Groove a test section in an area of the
pavement outside of the trafficked area, as approved by the Engineer. The area
shall be 50 feet long by two lanes wide, or as directed by the Engineer.
Demonstrate the setup and alignment process, the grooving operation, and the
waste slurry disposal.

621-2.4 **EXISTING PAVEMENTS.** Bumps, depressed areas, bad or
faulted joints, and badly cracked and/or spalled areas in the pavement shall not
be grooved until such areas are adequately repaired or replaced.

621-2.5 **NEW PAVEMENTS.** Permit new Portland cement concrete
pavements to cure for a minimum of 28 days before grooving. Spalling along or
tearing or raveling of the groove edges shall not be allowed.

621-2.6 **GROOVING MACHINE.** Provide a grooving machine that is
power driven, self-propelled, specifically designed and manufactured for
pavement grooving, and has a self-contained and integrated continuous slurry vacuum system as the primary method for removing waste slurry. The grooving machine shall be equipped with diamond-saw cutting blades, and capable of making at least 18 inches in width of multiple parallel grooves in one pass of the machine. Thickness of the cutting blades shall be capable of making the required width and depth of grooves in one pass of the machine. The cutting head shall not contain a mixture of new and worn blades or blades of unequal wear or diameter. Match the blade type and configuration with the hardness of the existing airfield pavement. The wheels on the grooving machine shall be of a design that will not scar or spall the pavement. Provide the machine with devices to control depth of groove and alignment.

621-2.7 WATER SUPPLY. Water for the grooving operation shall be provided by the Contractor.

621-2.8 CLEAN-UP. During and after installation of saw-cut grooves, the Contractor must remove from the pavement all debris, waste, and by-products generated by the operations to the satisfaction of the Engineer. Cleanup of waste material must be continuous during the grooving operation. Flush debris produced by the machine to the edge of the grooved area or pick it up as it forms. The dust coating remaining shall be picked up or flushed to the edge of the area if the resultant accumulation is not detrimental to the vegetation or storm drainage system. Accomplish all flushing operations in a manner to prevent erosion on the shoulders. Waste material must be disposed of in an approved manner. Waste material must not be allowed to enter the airport storm or sanitary sewer system. The Contractor must dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

621-2.9 REPAIR OF DAMAGED PAVEMENT. Grooving must be stopped and damaged pavement repaired at the Contractor's expense when, in the opinion of the Engineer, the result of the grooving operation is not in compliance with this specification.

621-2.10 PRODUCTION RATE. The Contractor shall furnish sufficient equipment to complete grooving within the contract time limits specified.

621-3 ACCEPTANCE

621-3.1 ACCEPTANCE TESTING. Grooves will be accepted based on results of zone testing. All acceptance testing necessary to determine conformance with the groove tolerances specified will be performed by the Engineer.

Instruments for measuring groove width and depth must have a range of at least 0.5 inches and a resolution of at least 0.005 inches. Instruments shall be provided by the Contractor. Gage blocks or gages machined to standard grooves width, depth, and spacing may be used.
Instruments for measuring center-to-center spacing must have a range of at least 3 inches and a resolution of at least 0.02 inches.

The Engineer will measure grooves in five zones across the pavement width. Measurements will be made at least THREE times during each day’s production. Measurements in all zones will be made for each cutting head on each piece of grooving equipment used for each day’s production.

The five zones are shown in Table 1:

<table>
<thead>
<tr>
<th>TABLE 1. JOINT ACCEPTANCE ZONES</th>
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<tbody>
<tr>
<td>Zone 1</td>
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<td>Zone 2</td>
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<td>Zone 3</td>
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<td>Zone 4</td>
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<td>Zone 5</td>
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</table>

At a random location within each zone, five consecutive grooves sawed by each cutting head on each piece of grooving equipment will be measured for width, depth, and spacing. The five consecutive measurements must be located about the middle blade of each cutting head plus or minus 4 inches. Measurements will be made along a line perpendicular to the grooves.

a. Width or depth measurements less than 0.170 inches shall be considered less than 3/16 inches.

b. Width or depth measurements more than 0.330 inches shall be considered more than 5/16 inches.

c. Width or depth measurements more than 0.235 inches shall be considered more than 1/4 inches.

Production must be adjusted when more than one groove on a cutting head fails to meet the standard depth, width, or spacing in more than one zone.

The Engineer may require a written report indicating the percentage of grooves that meet tolerances and may require a report indicating how many times production was adjusted. Blade wear and surface variability may require more testing than the minimum of three per day per equipment. It is expected that the Contractor will routinely spot check for compliance each time the equipment aligns for a grooving pass.

621-4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT. See Section 74-6.

END OF ITEM P-162

74-5 SUBMITTALS. Submittals required for this item include, but are not limited to:
a. Equipment

74-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

“Sawcut Grooving” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 74
SECTION 75 – STRUCTURAL BRIDGE MODIFICATIONS

75-1 GENERAL

The bridge work to be completed consists, in general, of strengthening the existing Sepulveda Boulevard Tunnel. This includes removal of 150 feet of existing 3-foot thick strengthened slab and the adjacent approach slabs along the Tunnel, and reconstruction of new strengthened slabs and approach slabs over the tunnel.

Except as noted otherwise, the performance of all work and the property and quality of all materials for bridge reconstruction shall conform to the Standard Plans and the applicable sections of Standard Specifications of the State of California, Department of Transportation, 2010 edition, hereinafter designated as Caltrans Standard Specifications. Unless specifically referenced in Sections 75-1 through 75-7 of these Technical Specifications, the Project Requirements and General Conditions take precedence over sections 1 through 10 of the Caltrans Standard Specifications.

Unless the context otherwise requires, wherever in the specifications and other contract documents the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as provided in Section 1, "Definitions and Terms," of the Caltrans Standard Specifications and these Technical Specifications.

1. The State – The Los Angeles World Airports
2. The Department – The Los Angeles World Airports
3. The Director – The Deputy Executive Director of Project and Facilities Department
4. The District – The Los Angeles World Airports
5. The District Director – The Deputy Executive Director of Project and Facilities Department
6. The Project – The Los Angeles International Airport Runway 7L-25R Safety Area Improvements and Pavement Rehabilitation Project
7. The Engineer – The Chief Airports Engineer of LAWA or designee. May also be referred to as the Chief Airports Engineer or the Agency in the Specification
8. Laboratory – The City of Los Angeles Department of Standards, or LAWA designee
75-1.1 Submittals
Shop drawings shall conform to the requirements in Section 5-1.23 "SUBMITTALS"," of the Caltrans Standard Specifications and these Technical Specifications. Working drawings shall include supplements and calculations that are in addition to drawings.

Shop drawings shall be submitted in accordance with PR-9, Submittal Procedures of these specifications.

75-1.2 Supplemental Project Information

Plans of the existing bridges may be requested at Los Angeles World Airports, Engineering and Project Management, 7301 World Way West, 8th Floor, Los Angeles, CA 90045.

As-built drawings may not show existing dimensions and conditions. Where new construction dimensions are dependent on existing bridge dimensions, verify the field dimensions and adjust dimensions of the work to fit existing conditions.

75-2 CALTRANS STANDARD PLANS

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.

JOINT SEALS
B6-21 Joint Seals (Maximum Movement Rating = 2")

75-3 ITEM LIST

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Item Description</th>
<th>Applicable Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>192003</td>
<td>STRUCTURE EXCAVATION (BRIDGE)</td>
<td>19</td>
</tr>
<tr>
<td>510053</td>
<td>STRUCTURAL CONCRETE, BRIDGE</td>
<td>51</td>
</tr>
<tr>
<td>510080</td>
<td>STRUCTURAL CONCRETE, APPROACH SLAB</td>
<td>51</td>
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<td>JOINT SEAL (MR 1/2&quot;)</td>
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<td>519088</td>
<td>JOINT SEAL (MR 1&quot;)</td>
<td>51</td>
</tr>
<tr>
<td>520102</td>
<td>BAR REINFORCING STEEL (BRIDGE)</td>
<td>52</td>
</tr>
<tr>
<td>600114</td>
<td>BRIDGE REMOVAL (PORTION)</td>
<td>60</td>
</tr>
</tbody>
</table>

75-4 BRIDGE REMOVAL (PORTION)
75-4.1 GENERAL
Removing portions of bridge shall conform to the provisions in Section 60-2.02, "Bridge Removal," of the Caltrans Standard Specifications and these Technical Specifications.

Bridge removal (portion) work shall not proceed prior to Caltrans concurrence of all related submittals.

Bridge removal (portion) shall include, but not be limited to, the following items as shown on the plans:

- Portion of existing reinforced concrete slab
- Removal of formwork debris on top of existing reinforced concrete rigid frame structure
- Portion of existing approach slab
- Portion of variable thickness asphalt

Removal of formwork debris may include, but is not limited to, broken glass and wood formwork.

75-4.2 CONSTRUCTION METHOD

Removed materials that are not to be salvaged or used in the reconstruction shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 23 - Removal of these specifications.

Excess of removed concrete shall be disposed off the State and Airport properties.

The Contractor shall submit a complete bridge removal plan to the Engineer, detailing procedures, sequences, and all features required to perform the removal in a safe and controlled manner. The removal procedure shall not damage the existing reinforced concrete rigid frame structure deck slab. Demolition and bridge removal shall be completed by full depth saw cutting of the existing reinforced concrete slab. Demolition and removal within 6” of the existing reinforced concrete frame to be protected in place shall be accomplished using hand tools only.

The Contractor shall submit working drawings with design calculations to the Engineer for the proposed bridge removal plan, and the bridge removal plan shall be prepared and signed by an engineer who is registered as a Civil Engineer in the State of California.

The Contractor's registered engineer shall be present at all times when bridge removal operations are in progress. The Contractor's registered engineer shall inspect the bridge removal operation and report in writing on a daily basis the progress of the operation and the status of the remaining structure. A copy of the daily report shall be available at the site of the work at all times. Should an unplanned event occur or the bridge operation deviate from the approved bridge removal plan, the Contractor's registered engineer shall submit immediately to the Engineer for approval the procedure of operation proposed to correct or remedy the occurrence.

Prior to removal of concrete, the Contractor shall have all workers, materials and equipment on the site necessary to complete the removal of concrete.

After removing the existing reinforced concrete slab, the Contractor shall provide the Engineer five (5) working days to inspect the top of the existing reinforced concrete rigid frame structure deck.

75-5 CONCRETE STRUCTURES

75-5.1 General
Portland cement concrete structures shall conform to the provisions in Section 51, "Concrete Structures," of the Caltrans Standard Specifications and these Technical Specifications.

The Contractor shall provide a method for the Engineer to verify that the structural gap between the top of existing deck slab and the bottom of the new deck slab conforms to the requirements shown on the plans, after the form material is removed.

**Replace the 2nd paragraph of section 51-1.01C(1) with:**
Submit a deck placement plan for concrete bridge decks. Include in the placement plan your method and equipment for ensuring that the concrete bridge deck is kept damp by misting immediately after finishing the concrete surface.

**Add to section 51-1.02B:**
Concrete for concrete bridge decks must contain polymer fibers. Each cubic yard of concrete must contain at least 1 pound of microfibers and at least 3 pounds of macrofibers.

Concrete for concrete bridge decks must contain a shrinkage reducing chemical admixture. Each cubic yard of concrete must contain at least 3/4 gallon of a shrinkage reducing admixture. If you use the maximum dosage rate shown on the Authorized Material List for the shrinkage reducing admixture, your submitted shrinkage test data does not need to meet the shrinkage limitation specified.

**Replace the 2nd paragraph of section 51-1.03H with:**
Cure the top surface of bridge decks by (1) misting and (2) the water method using a curing medium under section 90-1.03B(2). After strike off, immediately and continuously mist the deck with an atomizing nozzle that forms a mist and not a spray. Continue misting until the curing medium has been placed and the application of water for the water method has started. At the end of the curing period, remove the curing medium and apply curing compound on the top surface of the bridge deck during the same work shift under section 90-1.03B(3). The curing compound must be curing compound no. 1.

**Delete the 4th paragraph of section 51-1.03H.**

**Add to section 90-1.01C:**

90-1.01C(11) Polymer Fibers
Submit fiber manufacturer's product data and instructions for use.
Submit a certificate of compliance for each shipment and type of fibers.

**Replace 1st table in Section 90-1.02A of the Caltrans Standard Specifications with:**

<table>
<thead>
<tr>
<th>Type of Work</th>
<th>Maximum length change of laboratory cast specimens at 28 days drying (average of 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paving and approach slab concrete</td>
<td>0.050</td>
</tr>
<tr>
<td>Bridge deck concrete</td>
<td>0.032</td>
</tr>
</tbody>
</table>
Add to section 90-1.02:

**90-1.02K Polymer Fibers**

Fibers must comply with ASTM D 7508. Microfibers must be from 1/2 to 2 inches long. Macrofibers must be from 1 to 2-1/2 inches long.

Bar reinforcing steel must comply with section 52 of the Caltrans Standard Specifications.

**75-5.2 Deck Closure Pours**

Deck closure pours shall be placed no earlier than 2 weeks after the concrete deck placement is completed and structural gap falsework is removed, unless otherwise directed by the Engineer.

**75-5.3 Bridge Deck Surface Texture**

Replace Section 51-1.03F(5)(b)(i) General of the Caltrans Standard Specifications with the following:

Texture surfaces of bridge decks, and approach slabs transversely by grinding and grooving.

Replace section 51-1.03F(5)(b)(ii) Grinding and Grooving of the Caltrans Standard Specifications with the following:

1. Grinding must not reduce the concrete cover on reinforcing steel to less than 3 inches.
2. Groove the ground surfaces transversely under section 74 Saw Cut Grooves (FAA P-621) of these specifications. The grooves must be perpendicular to the Runway centerline.

**75-6 STRUCTURE APPROACH SLABS**

This work shall consist of constructing reinforced concrete approach slabs, and leveling course at structure approaches in conformance with the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Caltrans Standard Specifications, and these Technical Specifications.

For leveling course material, placement requirements, see Section 62 – Asphalt Pavements Base Course (FAA P-403) of these Technical Specifications.

**75-7 EARTHWORK**

Structure Excavation (Bridge) shall include, but not be limited to, the following items as shown on the plans:

- Portion of variable thickness asphalt

**75-8 SELECT AMENDMENTS TO 2015 CALTRANS 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*.

5 CONTROL OF WORK

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

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.

5-1.36D 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.

DIVISION V SURFACINGS AND PAVEMENTS

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

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.

51 CONCRETE STRUCTURES
01-20-17
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.

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.

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

DIVISION XI  MATERIALS

90  CONCRETE

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

Method 2
END SELECT AMENDMENTS TO 2015 CALTRANS STANDARD SPECIFICATIONS

75-9 MEASUREMENT AND PAYMENT
“Sepulveda Bridge Modifications” shall be measured and paid for in accordance with Project Requirements - 4 of these specifications.

END OF SECTION 75
SECTION 80 – PIPE FOR STORM DRAIN AND CULVERTS (FAA D-701)

80-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of pipe for storm drains and underground infiltration systems as shown on the Plans, and in accordance with FAA Specification Item D-701 as included and modified hereafter.

Some storm drain pipe will be installed in areas of limited-time night construction as shown on the phasing sheets in the plans. The Contractor is responsible for determining the difficulties associated with installation of pipe under these conditions. He shall plan his construction approach accordingly and include additional costs associated with construction in these areas in his unit prices.

80-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

80-3 RELATED SECTIONS

   a. Section 23 – Removals
   b. Section 30 – Temporary Air and Water Pollution, Soil Erosion and Siltation Control (FAA P-156)
   c. Section 41 – Earthwork (FAA P-152)
   d. Section 43 – Controlled Low-Strength Material (FAA P-153)
   e. Section 83 – Manholes, Catch Basins, Inlets and Miscellaneous Utility System Structures (FAA D-751, -752, -754)
   f. Section 90 – Structural Concrete (FAA P-610)
   g. Other Sections, Tests, Specifications, and Standards referenced herein.

80-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 – Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM D-701 PIPE FOR STORM DRAINS AND CULVERTS

701-1 DESCRIPTION. This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.
701-2 MATERIALS

701-2.1 GENERAL. Materials shall meet the requirements shown on the plans and specified below.

701-2.2 PIPE. The pipe shall be of the type and size called for on the plans and shall be in accordance with the following appropriate requirements.

Unless otherwise noted on the plans, all Reinforced Concrete Pipe shall be ASTM C 76, Class V rated. All PVC pipe shall be rated Schedule 80, unless otherwise noted.

- ASTM A 761 Corrugated Structural Steel Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
- ASTM C 76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

701-2.3 CONCRETE. Concrete for pipe cradles shall have a minimum compressive strength of 3,000 psi at 28 days and conform to the requirements of Section 90, Structural Concrete.

Concrete for pre-cast reinforced concrete boxes shall conform to the requirements of Section 90, Structural Concrete, and shall have a minimum compressive strength of 5,000 psi at 28 days.

701-2.4 RUBBER GASKETS. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D1056, for the “RE” closed cell grades. Rubber gaskets for steel reinforced thermoplastic ribbed pipe shall conform to the requirements of ASTM F477.

701-2.5 JOINT MORTAR/GROUT. Pipe joint mortar/grout shall consist of one part portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

701-2.6 JOINT FILLERS. Poured filler for joints shall conform to the requirements of ASTM D 6690.

701-2.7 PLASTIC GASKETS. Plastic gaskets shall conform to the requirements of AASHTO M 198 (Type B).

701-2.8 CONTROLLED LOW STRENGTH MATERIAL (CLSM). Controlled low strength material shall conform to the requirements of Section 43 of these Specifications, Controlled Low-Strength Material (FAA Item P-153). When CLSM is used, all joints shall have gaskets.
701-3 CONSTRUCTION METHODS

701-3.1 EXCAVATION

a. General. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 6 inches on each side. The trench walls shall be approximately vertical.

The Contractor shall comply with all current Federal, state and local rules and regulations governing the safety of men and materials during the excavation, installation and backfilling operations. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. The width of the trench shall be sufficient to permit satisfactorily jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths shown on the plans trench detail. The trench bottom shall be shaped to fully and uniformly support the bottom quadrant of the pipe.

Trenches shall be excavated not more than 500 feet in advance of pipe laying unless otherwise permitted in writing by Engineer. Trenches shall be adequately shored and braced so that the earth will not slide or settle and so that all existing improvements of any kind will be fully protected from damage. Any damage resulting from lack of adequate shoring and bracing shall be responsibility of Contractor. Contractor shall complete all necessary repairs or reconstruction due to inadequate shoring or bracing at its own expense and shall bear all other expenses resulting from such damage.

Should the excavation for the pipeline be carried below grade without permission, it shall be refilled to proper grade at Contractor’s expense for all labor and material with clean sand and gravel tamped in place to 90 percent minimum compaction, as determined by ASTM D1557, and the Contractor shall bear all expenses resulting from such damage.

The excavation for pipes that are placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

b. Excavation in Good Soil. The trench shall have a flat or semi-circular bottom conforming to the grade to which the pipe is to be laid. The bottom of trench for all pipe shall be graded and prepared to provide firm and uniform bearing throughout the entire length of each joint of pipe.

Corrugated metal and polyvinyl chloride pipe shall not be laid on earth mounds. It shall be laid so that pipe barrel will bear evenly on the
bottom of the trench. Trenches shall be of such size that the process of making joints and inspections can be carried on satisfactorily.

Reinforced Concrete Pipe shall be laid on prepared and shaped subgrade to provide uniform bearing evenly on the bottom of the trench. Trenches shall be of such size that the process of making joints and inspections can be carried on satisfactorily.

c. **Excavation in Rock.** Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 8 inches or one-half inch for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The width of the excavation shall be at least 1 foot greater than the horizontal outside diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 inches in uncompacted depth to 90% relative density, per ASTM D1557, to form a uniform but yielding foundation.

d. **Excavation in Poor Soil.** Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be graded and compacted to 90% relative density, per ASTM D1557, to provide a firm and uniform trench bottom.

e. **Excavated Materials.** All material excavated from the trench shall be placed to prevent any obstruction to aircraft or vehicle traffic. Materials shall not be stockpiled in runway or taxiway safety areas and shall not be allowed to interrupt natural drainage patterns. Silt fences or other methods shall be employed, per Section 30, Temporary Air and Water Pollution, Soil Erosion and Siltation Control. Excess material, and material that is not approved by Engineer for use as backfill, shall be disposed of legally off the airport site. Cost for hauling and disposal shall be considered incidental to the pipe installation and no separate payment will be made unless otherwise permitted by the Engineer.

f. **Trenching through Existing Pavement.** Where pavement is encountered, including but not limited to asphaltic concrete or Portland cement concrete, removal shall be undertaken per Section 23, Removals. Pavement removal shall be measured for payment under Section 23. Reconstruction of pavement will be paid under the appropriate sections, unless otherwise provided.

701-3.2 **BEDDING.** Pipe bedding shall conform to the class specified on the plans. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. When no bedding class
is specified or detailed on the plans, the requirements for Class B bedding shall apply.

a. **Rigid Pipe Bedding.**

(1) **Class A.** Class A bedding used for concrete and CLSM encased pipe or as shown on the plans shall consist of a protective layer on the upper portion of the pipe and a bedding material conforming to the plan details. The layer of bedding material shall be shaped to fit the pipe for at least 10 percent of the pipe's vertical diameter and shall have recesses shaped to receive the bell of bell and spigot pipe. The bedding material shall be sand or selected sandy soil, all of which passes a 3/8 inch sieve and not more than 10 percent of which passes a No. 200 sieve.

(2) **Class B.** Class B bedding shall consist of a bed of granular material having a thickness of at least 6 inches below the bottom of the pipe and extending up around the pipe for a depth of not less than 30 percent of the pipe's vertical outside diameter. The layer of bedding material shall be shaped to fit the pipe for at least 10 percent of the pipe's vertical diameter and shall have recesses shaped to receive the bell of bell and spigot pipe. The bedding material shall be sand or selected sandy soil, all of which passes a 3/8 inch sieve and not more than 10 percent of which passes a No. 200 sieve.

(3) **Class C.** Class C bedding shall consist of bedding the pipe in its natural foundation to a depth of not less than 10 percent of the pipe's vertical outside diameter. The bed shall be shaped to fit the pipe and shall have recesses shaped to receive the bell of bell and spigot pipe.

b. **PVC and Polyethylene Pipe.** For PVC and polyethylene pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of ¾ inches. For pipes installed under paved areas, no more than 12 percent of the material shall pass the No. 200 sieve. For all other areas, no more than 50 percent of the material shall pass the No. 200 sieve. The bedding shall have a thickness of at least 6 inches below the bottom of the pipe and shall extend up around the pipe for a depth of not less than 50 percent of the pipe's vertical outside diameter.

701-3.3 **LAYING PIPE.** The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.
Elliptical and elliptically reinforced pipes shall be placed with the manufacturer's top of pipe mark within five degrees of a vertical plane through the longitudinal axis of the pipe.

In limited areas, such as night construction areas, it may not be feasible to proceed with pipe laying from the lowest point. In these areas, if approved by the Engineer, the Contractor may proceed otherwise, but must provide, to the satisfaction of the Engineer, methods of stabilizing pipe sections to ensure that no separation of joints occurs.

701-3.4 JOINING PIPE. Joints shall be made with (1) Portland cement mortar, (2) Portland cement grout, (3) rubber gaskets, (4) plastic gaskets, or (5) coupling bands.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints in order to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

a. Concrete Pipe. Concrete pipe shall be tongue and groove. The method of joining pipe sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even. Joints shall be thoroughly wetted before mortar or grout is applied.

b. PVC, Polyethylene and Polypropylene Pipe. Joints for PVC, Polyethylene and Polypropylene pipe shall conform to the requirements of ASTM D 3212 when water tight joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M 304 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M 252 or M 294M. Fittings for polypropylene pipe shall conform to ASTM F2881, ASTM F2736, or ASTM F2764.

701-3.5 BACKFILLING. Pipes shall be inspected before any encasement or backfill is placed. Any pipes found to be out of alignment, unduly settled, or damaged shall be removed and relaid or replaced at the Contractor's expense. All pipes shall be properly installed and observed by the Engineer prior to placement of backfill. Loose soil, formwork and debris shall be removed prior to backfilling.

CLSM encasement shall be placed as shown in the plans and in accordance with Section 43, Controlled Low Strength Material.

Material for backfill shall be fine, readily compatible soil, granular material selected from the excavation or imported from an approved location. It shall not contain stones that would be retained on a 2-inch sieve, chunks of highly plastic clay, debris, or other objectionable material. No less than 95 percent of a granular backfill material shall pass through a 1/2 inch sieve, and no less than 95 percent of it shall be retained on a No. 4 sieve. Backfill shall be approved in advance by the Engineer.
When the top of the pipe is even with or below the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches on both sides of the pipe and shall be brought up one foot above the top of the pipe or to natural ground level, whichever is greater. Care shall be exercised to thoroughly compact the backfill material under the haunches of the pipe. Material shall be brought up evenly on both sides of the pipe.

When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches and shall be brought up evenly on both sides of the pipe to 1 foot above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the pipe’s diameter or 12 feet, whichever is less.

For PVC and polyethylene pipe, the backfill shall be placed in two stages; first to the top of the pipe and then at least 12 inches over the top of the pipe. The backfill material shall meet the requirements of paragraph 701-3.2c.

All backfill shall be compacted to the densities required under Section 41, Earthwork, FAA Item P-152.

It shall be the Contractor’s responsibility to protect installed pipes and culverts from damage due to construction equipment operations. The Contractor shall be responsible for installation of any extra strutting or backfill required to protect pipes from the construction equipment.

**701-3.6  CONNECTION TO EXISTING STRUCTURES.** Unless otherwise detailed, new pipes to be connected to existing catch basins, manholes, or other structures shall be connected in accordance with per Standard Plans for Public Works Construction plan No. 208-1.

**701-3.7  CONCRETE COLLAR.** Construction of concrete collars on existing pipe to remain shall be completed as shown on the plans, or as directed by the Engineer.

The Contractor shall confirm the pipe locations for placement of concrete collars, use care to not damage existing pipe to remain during demolition, and installation of concrete collars. Removal of existing pipe shall be in accordance with Section 23 – Removals.

**701-3.8  MAINTENANCE OF EXISTING SYSTEM.** When work on existing pipes or structures occurs during months when rainfall is possible, the Contractor shall have means and methods to provide temporary control of system flows. No work shall be undertaken on functioning, existing pipes or structures if rain is imminent. Costs to provide temporary accommodation of flows shall be considered incidental to the drainage system work and no separate payment will be made.

Plugging and capping of existing storm drain pipe to remain shall be in accordance with Section 23, Removals.
**701-4 METHOD OF MEASUREMENT.** See 80-6.

**701-5 BASIS OF PAYMENT.** See 80-6.

**701-6 MATERIAL REQUIREMENTS**

- AASHTO M 198 Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
- AASHTO M 252 Corrugated Polyethylene Drainage Tubing
- AASHTO M 294 Corrugated Polyethylene Pipe, 300 to 1200 mm Diameter
- AASHTO M 304 Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
- ASTM A 798 Installing Factory-Made Corrugated Steel Pipe for Sewers
- ASTM C 14 Concrete Sewer, Storm Drain, and Culvert Pipe
- ASTM C 76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- ASTM C 94 Ready Mixed Concrete
- ASTM C 144 Aggregate for Masonry Mortar
- ASTM C 150 Portland Cement
- ASTM C 443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- ASTM D 1056 Flexible Cellular Materials - Sponge or Expanded Rubber
- ASTM D 3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- ASTM D 3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- ASTM D 6690 Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements
- ASTM F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- ASTM F 794 Poly (Vinyl Chloride) Ribbed Drain Pipe & Fittings Based on Controlled Inside Diameter

PR-14 – Quality Control Program

**END OF ITEM D-701**
80-5 **SUBMITTALS**. Submittals required for this item include, but are not limited to:

a. Pipe

b. Pipe fittings, gaskets

c. Joint fillers

d. CLSM, concrete

e. Backfill material

80-6 **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

1. “18-Inch Class V RCP” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

2. “30-Inch Class V RCP” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

3. “2-Inch Schedule 40 PVC Drain” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

4. “Concrete Collar” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

5. “Temporary Drainage Facilities (Temporary Taxiway)” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

6. “Temporary Drainage Facilities (Temporary Service Road)” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 80
SECTION 83 – MANHOLES, CATCH BASINS, INLETS AND MISCELLANEOUS UTILITY SYSTEM STRUCTURES (FAA D-751, FAA D-752, AND D-754)

83-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of catch basins, underground infiltration system, flow splitters, hydrodynamic separators, catch basin drop inlet inserts, and other miscellaneous utility or storm drain systems work. Work shall be in accordance with following FAA Specifications as included and modified hereafter. In addition, for topics relevant to the construction of drainage and utility structures which are not addressed in this section, Standard Specifications for Public Works Constructions (Greenbook) Section 306 (Underground Conduit Construction) shall be applicable unless otherwise stipulated.

a. Item D-751, Manholes, Catch Basins, Inlets and Miscellaneous Utility System Work;
b. Item D-752, Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures;
c. Item D-754, Concrete Gutters, Ditches, and Flumes

Some drainage and utility system structures and work installation may be in areas of limited-time and/or night construction as shown on the phasing sheets in the plans. The Contractor is responsible for determining the difficulties associated with this work under these conditions, shall plan his construction approach accordingly, and shall make the necessary allowances for associated additional costs in his bid items.

83-2 DEFECTIVE WORK Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

83-3 RELATED SECTIONS

a. Section 41 – Earthwork (FAA P-152)
b. Section 43 – Controlled Low-Strength Material (CLSM) (FAA P-153)
c. Section 57 – Processed Miscellaneous Base
d. Section 80 – Pipe for Storm Drain and Culverts (FAA D-701)
e. Section 90 – Structural Concrete (FAA P-610)
f. Other Sections, Tests, Specifications, and Standards referenced herein.

83-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.
ITEM D-751 MANHOLES, CATCH BASINS, INLETS AND INSPECTION HOLES

751-1 DESCRIPTION. This item shall consist of construction of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the Engineer.

751-2 MATERIALS

751-2.1 BRICK. Section not used.

751-2.2 MORTAR / GROUT. Mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

Grout shall have a compressive strength of 2,000 psi at 28 days unless otherwise indicated. The grout shall be installed in one continuous operation at a time as allowed by the Engineer. Care shall be taken to prevent grout from leaking out of the ends of the casing pipe during the curing period.

751-2.3 CONCRETE. Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Section 90, Structural Concrete, FAA Item P-610.

751-2.4 PRECAST CONCRETE PIPE MANHOLE RINGS. Precast concrete pipe manhole rings shall conform to the requirements of ASTM C 478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches nor more than 48 inches. There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole.

751-2.5 FRAMES, COVERS, AND GRATES. The castings shall conform to one of the following requirements:

a. ASTM A 48, Gray iron castings, Class 30B and 35B
b. ASTM A 47, Malleable iron castings
c. ASTM A 27, Steel castings
d. ASTM A 283, Grade D, Structural steel for grates and frames
e. ASTM A 536, Ductile iron castings
f. ASTM A 897, Austempered ductile iron castings

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified in Section 83-12.
Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure. All covers shall have spring-assisted opening mechanisms and shall have the ability to be locked against unauthorized access.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A 123.

All Manholes Frame, Covers, and Grates shall be shop inspected. Refer to PR-9 for additional requirements.

751-2.6 STEPS. The steps or ladder bars shall be galvanized steel. The steps shall be the size, length, and shape shown on the plans.

751-2.7 PRECAST INLET STRUCTURES. Manufactured in accordance with and conforming to ASTM C1433.

751-2.8 REINFORCING STEEL. Reinforcing steel shall meet the requirements set forth in Item Section 90, Structural Concrete (FAA Item P-610).

751-2.9 DRAIN PIPE. Drain pipe shall be as shown in the plans, and in accordance with Section 80, Pipe for Storm Drains and Culvers.

751-2.10 FILTER FABRIC. Filter fabric shall be in accordance with Section 84, Geotextiles.

751-3 CONSTRUCTION METHODS

751-3.1 UNCLASSIFIED EXCAVATION

a. The Contractor shall complete all excavation for structures and structure footings to the lines and grades or elevations, shown on the plans or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. All soft and unsuitable material shall be removed and replaced with suitable approved material. A layer of Processed Miscellaneous Base, conforming to Section 57, Processed Miscellaneous Base, shall be placed and compacted to the thickness indicated on the plans, or to a minimum of 8 inches, to form a subbase for the structure. Compaction shall be to 90% of D1557. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only; and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

b. Boulders, logs, or any other objectionable material encountered in the excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated
rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

c. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

d. Unless otherwise provided, bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be considered incidental and no separate payment will be made.

e. After each excavation is completed, the Contractor shall notify the Engineer to that effect. Concrete or reinforcing steel shall only be placed after the Engineer has approved the depth of the excavation and the character of the foundation material.

751-3.2 BRICK STRUCTURES. Section not used.

751-3.3 CONCRETE STRUCTURES. Concrete structures shall be built on prepared foundations, conforming to the dimensions and form indicated on the plans. The construction shall conform to the requirements specified in Section 90, Structural Concrete (P-610). Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is poured.

All invert channels shall be constructed and shaped accurately so as to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped downward toward the outlet.

751-3.4 PRECAST CONCRETE STRUCTURES. Precast concrete structures shall conform to ASTM C478. Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations shown on the plans. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal steps that are embedded or built into the side walls shall be aligned and placed at vertical intervals of 12 inches (300 mm). When a metal ladder replaces the steps, it shall be securely fastened into position.
**751-3.5 INLET AND OUTLET PIPES.** Inlet and outlet pipes shall extend through the walls of the structures for a sufficient distance beyond the outside surface to allow for connections but shall be cut off flush with the wall on the inside surface, unless otherwise directed. Mortar shall be placed around these pipes so as to form a tight, neat connection.

**751-3.6 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES, AND FITTINGS.** All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the Engineer, and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are to be placed upon previously constructed masonry, the bearing surface or masonry shall be brought true to line and grade and shall present an even bearing surface in order that the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed and approved by the Engineer. All units shall set firm and secure.

After the frames or fittings have been set in final position and the concrete or mortar has been allowed to harden for 7 days, then the grates or covers shall be placed and fastened down.

In areas of night construction, steel plating or other methods approved by the Engineer shall be employed to cover formed structures until the curing period has elapsed. Methods shall insure adequate support, without damaging the structure or the aircraft, for loads described Section 83-12, below, and shall be approved by the Engineer in advance. No additional payment will be made for steel plating or other methods of protecting formed structures during the curing period in such areas.

**751-3.7 INSTALLATION OF STEPS.** The steps shall be installed as indicated on the plans or as directed by the Engineer. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is poured. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least 7 days. After this period has elapsed, the steps shall be cleaned and painted, unless they have been galvanized.

In lieu of steps, prefabricated ladders may be installed. In the case of concrete structures, the ladder shall be held in place by grouting the supports in drilled holes.

**751-3.8 BACKFILLING**

a. After a structure has been completed, the area around it shall be filled with approved material, in horizontal layers not to exceed 8 inches in loose depth, and compacted to the density of at least 90 percent of the maximum density for cohesive soils and 95 percent of the maximum density for cohesionless soils.
density for noncohesive soils. The maximum density shall be determined in accordance with ASTM D 1557. The field density shall be determined in accordance with ASTM D 1556. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Engineer.

b. Backfill shall not be placed against any structure until permission is given by the Engineer. In the case of concrete, such permission shall not be given until the concrete has been in place 7 days, or until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

c. The Contractor shall assess the consequences of the cure-time for structures when developing his construction phasing methods, especially in areas of night construction where temporary plating may be required.

d. Fill or CLSM placed around concrete culverts shall be deposited on both sides at the same time and to approximately the same elevation. Care shall be taken to prevent any wedging action against the structure, and all slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent wedge action.

e. Backfill will not be measured for direct payment. Performance of this work shall be considered on obligation of the Contractor covered under the contract unit price for the structure involved.

751-3.9 CLEANING AND RESTORATION OF SITE. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. Excess material should be hauled off Airport property at the Contractor's expense. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

751-4 METHOD OF MEASUREMENT. See Section 83-21.

751-5 BASIS OF PAYMENT. See Section 83-21.

751-6 MATERIAL REQUIREMENT

ASTM A 27 Steel Castings, Carbon, for General Application
ASTM A 47 Ferritic Malleable Iron Castings
ASTM A 48  Gray Iron Castings
ASTM A 283  Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
ASTM A 536  Ductile Iron Castings
ASTM A 897  Austempered Ductile Iron Castings
ASTM C 32  Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 144  Aggregate for Masonry Mortar
ASTM C 150  Portland Cement
ASTM C 478  Precast Reinforced Concrete Manhole Sections
ASTM D 1556  Density of Soil in Place by the Sand-Cone Method
ASTM D 1557  Test for Laboratory Compaction Characteristics of Soil Using Modified Effort
AASHTO M 36  Zinc Coated (Galvanized) Corrugated Iron or Steel Culverts and Underdrains

END OF ITEM D-751
ITEM D-752 CONCRETE CULVERTS, HEADWALLS, AND MISCELLANEOUS DRAINAGE STRUCTURES

752-1 DESCRIPTION. This item shall consist of plain or reinforced concrete culverts, headwalls, underground infiltration system, flow splitters, hydrodynamic separators, and miscellaneous drainage structures constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the Engineer.

752-2 MATERIALS. See Section 751-2.

752-3 CONSTRUCTION METHODS

752-3.1 UNCLASSIFIED EXCAVATION. See Section 751-3.1.

752-3.2 BACKFILLING

a. After a structure has been completed, backfilling with approved material shall be accomplished by applying the fill in horizontal layers not to exceed 8 inches in loose depth, and compacted. The field density of the compacted material shall be at least 90 percent of the maximum density for cohesive soils and 95 percent of the maximum density for noncohesive soils. The maximum density shall be determined in accordance with ASTM D 1557. The field density shall be determined in accordance with ASTM D 1556.

b. No backfilling shall be placed against any structure until permission is given by the Engineer. In the case of concrete, such permission shall not be given until the concrete has been in place 7 days, or until tests made by the laboratory under the supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

The Contractor shall assess the consequences of the cure-time for structures when developing his construction phasing methods, especially in areas of night construction where temporary plating may be required.

c. Fill or CLSM placed around concrete culverts shall be deposited on both sides at the same time and to approximately the same elevation. Care shall be taken to prevent any wedging action against the structure, and all slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent wedge action.

d. Backfill will not be measured for direct payment. Performance of this work under the contract is not payable directly but shall be considered incidental and no separate payment will be made.
752-3.3  **CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the Engineer. Excess material shall be hauled off Airport property at Contractors expense. The Contractor shall restore all disturbed areas to their original condition. After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

752-4  **METHOD OF MEASUREMENT.** See Section 83-21.

752-5  **BASIS OF PAYMENT.** See Section 83-21.

752-6  **TESTING REQUIREMENTS**  
ASTM D 1556  Density of Soil in Place by the Sand-Cone Method  
ASTM D 1557  Test for Laboratory Compaction Characteristics of Soil Using Modified Effort

**END OF ITEM D-752**
ITEM D-754 CONCRETE GUTTERS, DITCHES, AND FLUMES

754-1 DESCRIPTION. This item shall consist of Portland cement concrete gutters, ditches, and flumes constructed in accordance with these specifications at the specified locations in accordance with the dimensions, lines, and grades as shown on the plans.

754-2 MATERIALS

754-2.1 CONCRETE. Concrete, plain and reinforced concrete shall meet the requirements of Section 90, Structural Concrete, FAA Item P-610.

754-2.2 JOINTS. Joint filler materials and premolded joint material shall conform to Section 90, Structural Concrete, FAA Item P-610.

754-2.3 REINFORCING STEEL. Reinforcing steel shall meet the requirements set forth in Item Section 90, Structural Concrete (FAA Item P-610).

754-3 CONSTRUCTION METHODS

754-3.1 PREPARING SUBGRADE. Excavation shall be made to the required width and depth, and the subgrade upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. A layer of approved granular material, compacted to the thickness indicated on the plans, shall be placed to form a subbase. The underlying course shall be checked and accepted by the Engineer before placing and spreading operations are started.

754-3.2 PLACING. The forms for and the mixing, placing, finishing, and curing of concrete shall conform to the requirements of Section 90, Structural Concrete, FAA Item P-610 and shall be in accordance with the following requirements.

The concrete shall be tamped and spaded until it is consolidated and mortar entirely covers and forms the top surface. The surface of the concrete shall be floated smooth and the edges rounded to the radii shown on the plans. Before the concrete is given the final finishing, the surface shall be tested with a 10-foot straightedge, and any irregularities of more than 1/4 inch in 10 feet shall be eliminated.

The concrete shall be placed with dummy-grooved joints not to exceed 25 feet apart, except where shorter lengths are necessary for closures, but no section shall be less than 4 feet long.

Expansion joints of the type called for in the plans shall be constructed to replace a dummy groove at spacings of approximately 100 feet. When the gutter is placed next to concrete pavement, expansion joints in the gutter shall be located opposite expansion joints in the pavement. When a gutter abuts a pavement or
other structure, an expansion joint shall be placed between the gutter and the other structure.

Forms shall not be removed within 24 hours after the concrete has been placed. Minor defects shall be repaired with mortar containing 1 part cement and 2 parts fine aggregate.

The operations of depositing, compacting, and finishing the item shall be conducted so as to build a satisfactory structure. If any section of concrete is found to be porous, other than minor defects that may be plastered, or is otherwise defective, it shall be removed and replaced by the Contractor without additional compensation.

754-3.3 BACKFILLING. After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the plans and compacted by mechanical equipment to at least 90% of the maximum density as determined by ASTM D 1557. The in-place density shall be determined in accordance with ASTM D 1556.

754-3.4 CLEANING AND RESTORATION OF SITE. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear and in good condition.

754-4 METHOD OF MEASUREMENT. See 83-21.

754-5 BASIS OF PAYMENT. See 83-21.

754-6 TESTING REQUIREMENTS

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<thead>
<tr>
<th>ASTM D 1556</th>
<th>Test for Density of Soil In Place by the Sand-Cone Method</th>
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<tbody>
<tr>
<td>ASTM D 1557</td>
<td>Test for Laboratory Compaction Characteristics of Soil</td>
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<td></td>
<td>Using Modified Effort</td>
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END OF ITEM D-754

83-5 CATCH BASIN DROP INLET INSERT. Catch basin drop inlet insert as shown on the plans and details shall be installed per manufacturer’s plans and specifications. The Contractor shall measure and field verify catch basin dimensions prior to procuring the insert.

a. Catch basin inserts shall be Triton, model and size as indicated on the drawings, manufactured by Contech Stormwater Solutions, Inc., 9025 Centre Pointe Drive, Suite 400, West Chester, OH 45069, phone 1-866-551-8325, or approved equal.
b. Catch basin inserts shall be designed for use in storm drains that experience oil and grease pollution accompanied by sediment and debris. They shall be designed so that trash and sediment accumulate in an outer housing, and oil and grease and fine particulates are trapped in a media cartridge. The units are constructed from high density polyethylene plastic with UV inhibitors.

83-6 JUNCTION STRUCTURE. Junction Structure shall be constructed as shown on plans and in accordance with these specifications.

83-7 ADJUST MISCELLANEOUS STRUCTURES TO GRADE. Manholes, inlets, handholes, catch basins, junction structures, groundwater monitoring wells and other structures and utilities identified on the plans to be adjusted to grade shall be done in accordance with the details and standard specification references shown on the plans, or with manufactured grade adjustment rings fabricated for the particular structures affected. Grade tolerances will be the same as the grade tolerances for the surface into which the structure is situated (AC pavement, PCC pavement, infield grading, etc.).

Where no specific details are called out, the Contractor’s method of adjusting the grade of the structure shall be submitted to, and approved by, the Engineer prior to proceeding with the work. All adjustments shall be capable of supporting the aircraft noted in Section 83-12.

83-7.1 Special Groundwater Monitoring Well Requirements:

a. Prior to adjusting existing groundwater monitoring wells to grade, the Contractor shall notify the Engineer and LAWA Environmental (local rep: Matt Hillman) at least two weeks prior to intent to adjust monitoring well.

b. Throughout the duration of construction, the Contractor shall provide third-party access to monitoring wells by Jacob & Hefner Associates. Monitoring wells generally require daily access.

83-8 MODIFY/CAP STRUCTURE BELOW GRADE. Structures identified to be capped or modified underground are to be permanently capped or modified as detailed on the plans. The Contractor shall take steps necessary to ensure that debris from the structure modification or capping construction does not impact the flow line characteristics of the remaining, modified structure. Cast-in-place concrete and reinforcement for modify/cap structures below grade shall conform to the requirements of Section 90, Structural Concrete (FAA P-610).

83-9 MODIFY RECOVERY WELL TRENCH. Modify existing recovery well trench shall be completed as shown on the drawings. Contractor shall notify engineer at least 14 days prior to any required recovery well trench modifications. ABS pipe shall be as shown on the drawings. CLSM for backfill shall be in accordance with Section 43, Controlled Low-Strength Material (FAA P-153).

83-10 CONCRETE COLLARS. Methods and materials employed in the construction of concrete collars shall conform to the requirements of the Caltrans Standard Plans and Standard Details referenced and as shown on the plans.
83-11 LOAD RATINGS. All structures, frames, grates and lids within Runway Safety Areas and Taxiway Safety Areas shall be capable of supporting the minimum loads shown on the plans. Certificates of load rating for pre-cast concrete structures, and for all castings, shall be provided by the manufacturer.

Should the Contractor propose a method of construction which differs from the detailing shown on the plans, he shall submit structural calculations from a Civil Engineer, registered in the State of California, verifying conformance with loading requirements prior to fabrication.

Manufactured grade adjustment rings shall have a certification from the manufacturer showing that the required loading requirements are satisfied. Cast-in-place extensions shall include calculations from a California-registered Professional Civil Engineer showing that the support ability of the structural extension is adequate.

Utility systems on lines where manholes, handholes and other structures are modified or adjusted to grade shall be tested after the completion of the work. No modification or adjustment will be accepted for payment until such testing is completed and approved by the Engineer.

83-12 UTILITY COORDINATION. The Contractor shall be solely responsible for all coordination with affected utility or owner agencies where access to structures must be monitored, or where work must be tested by the agency upon completion of modifications. This shall include FAA, fuel companies, telephone and other utility companies.

No modifications to the schedule will be allowed for delays due to the failure on the part of the Contractor to coordinate in a timely manner with agencies. No modification or adjustment will be accepted for payment until required testing is completed and approved by the Engineer.

83-13 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Pipe
b. Concrete
c. Reinforcing Steel
d. Curing Compound
e. Frames, Covers, Grates
f. Grade adjustment rings
g. Steps
h. Manholes
i. Catch Basins
j. Catch Basin Drop Inlet Inserts. Provide product data and performance for each insert with the existing catch basin dimensions.
k. Drain Rock

l. Underground Infiltration System, submit drain rock, filter fabric, perforated corrugated metal pipe, couplings, access risers, ladders, frames and covers.
   
   A. Product Data: Provide manufacturer’s product data for all materials in this specification.

   B. Shop Drawings: Show profiles, accessories, location, and dimensions.

   C. Contract Closeout: Vault access door manufacturer shall provide the manufacturer’s Warranty prior to the contract closeout.

83-14 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. Catch Basin Type A
2. Manhole Type B
3. Catch Basin Drop Inlet Insert
4. Adjust Existing Catch Basin to Finished Grade
5. Adjust Existing Groundwater Monitoring Well to Finished Grade

END OF SECTION 83
SECTION 84 – GEOTEXTILES

84-1 GENERAL

This item covers the furnishing of all materials, equipment, labor and supervision necessary to install geotextile fabrics of the types indicated and geogrid, at the locations indicated on the plans or as directed by the Engineer.

84-1.1 In addition to the bid item for subgrade improvement – small and large subgrade improvement - the use of geotextiles to stabilize isolated areas of unstable subgrade under pavement construction may become necessary on the project. The specific locations, types and quantities will, by necessity, be field-determined. In anticipation of these contingency needs for geotextiles, the Contractor will be required to maintain a minimum of 5,000 sy of geogrid for such purposes.

84-1.2 Should these stockpiled materials not be incorporated into the work, the Contractor shall be compensated a reasonable restocking fee.

84-2 MATERIALS

84-2.1 Filter Fabric

Filter Fabric shall conform to Section 88-1.02B of the 2010 State of California Standard Specifications with the following additional requirements:

a. The 85 percent size of the underlying material, divided by the nearest opening size of Apparent Opening Size (AOS) sieve (nearest U.S. Standard Sieve) of the fabric shall be equal to or greater than one.

b. Open area shall not to exceed 36 percent.

To reduce the chance of clogging, no cloth should be used with an open area less than 4 percent, or an AOS with openings smaller than the openings of a U.S. Standard Sieve Sized 150 micrometers No. 100.

When appropriate for the soil conditions, filter fabric shall be Mirafi 140NC, or approved equal.

84-2.2 Subgrade Stabilization Geotextile

Work shall conform to all requirements of this item, inclusive, Section 88 - Geosynthetics from the CALTRANS Standard Specifications, except that any revisions to the CALTRANS Standard Specifications written in this specification section shall supersede the CALTRANS Standard Specifications.

The Contractor shall furnish and place both non-woven construction geotextile for separation and geogrid in accordance with the details shown in the Plans. Material shall meet the requirements of Class A2 (Geotextile) and B2 (Geogrid) materials respectively of Section 88-1.02O - Subgrade Enhancement Geotextile of the CALTRANS Standard Specifications.
References and definitions:

CALTRANS 2010 Standard Specifications, current Amendments and current General Special Provisions, including the APWA General Special Provisions. These are defined as and referred to collectively as the CALTRANS Standard Specifications.


84-3 CONSTRUCTION METHODS

Upon exposure of unstable subgrade materials, and when it is determined by the Engineer to be necessary, subgrade stabilization fabric shall be placed at the locations directed by the Engineer. The Contractor will place the geotextile in accordance with the manufacturer's recommendations, then backfill with an adequate depth of sound aggregate or PMB, and compact as directed by the Engineer, to provide a stable construction platform so that pavement construction can continue. The Contractor shall conform to the geotextile manufacturer's recommendations regarding overlap, pinning, backfill and other construction methods.

84-4 METHOD OF MEASUREMENT and basis of payment

Payment for filter fabric will be considered incidental to the item of work for which it is installed and no separate measurement or payment for Filter Fabric will be made.

END OF SECTION 84
SECTION 89 – JET BLAST DEFLECTOR

89-1 GENERAL. The Contractor shall furnish all materials, equipment, and labor required by the plans and specifications for the installation of new fixed, portable and temporary Jet Blast Deflector (JBD) at the locations indicated on the plans or as directed by the Engineer.

The dismantling and removal of existing jet blast deflectors and fence shall be completed in accordance with Section 23 – Removals. Placement of portable and temporary jet blast deflectors shall be in accordance with Section 27 – Construction Barricades, Fencing, Markers and Signs.

Installation of all jet blast deflector components shall be as described on the plans and as described in this specification.

89-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor's expense.

89-3 RELATED SECTIONS.

Section 23 – Removals
Section 27 – Construction Barricades, Fencing, Markers and Signs
Section 41 – Earthwork
Section 90 – Structural Portland Cement Concrete (FAA P-610)
Section 110 – Airfield Electrical Work
Other Sections, Tests, Specifications, and Standards referenced herein.

89-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

89-5 SUMMARY.

89-5.1 NEW JET BLAST DEFLECTOR. This Section includes the fabrication and erection for a new fixed and portable JBD units.

The Contractor shall furnish all labor, materials, and equipment to fabricate and erect JBD, as shown on the plans, including foundation construction, as well as all related electrical work including any required grounding, lightning protection or lighting.
89-6 MATERIALS

89-6.1 APPROVED JBD MANUFACTURER:

Blast Deflectors, Inc.
8620 Technology Way
Reno, NV 89521
(775) 856-1928
dbergin@bdi.aero

89-6.2 ALTERNATE MANUFACTURERS: See Quality Assurance paragraph of this Section for proposal of alternate manufacturers.

89-6.3 PORTABLE JET BLAST DEFLECTOR

a. The 14’ high portable jet blast deflector shall be a curved, corrugated non-perforated type, mounted on pre-cast concrete bases as shown on the drawings.

b. Corrugated surfaces shall run in the horizontal direction. Deflecting surfaces shall be rigidly supported by bolted structural steel frames spaced at 6'-0” maximum centers. The JBD shall be a LYNNCO Type G14NB-6P or an approved equal.

89-6.4 MATERIAL FABRICATION: Approved fabricator shall manufacture new JBD in accordance with the following:

a. Form metal fabrications from materials of size, thickness, and shapes as required. Work to dimensions indicated on approved shop drawings, using proven details of fabrication and support. Use type of materials indicted or specified for various components of each metal fabrication.

b. Form exposed work with accurate angles and surfaces and straight sharp edges.

c. Shear and punch metals clearly and accurately. Remove burrs.

d. Remove sharp or rough areas on exposed surfaces.

89-6.5 FOUNDATIONS: JBD and JBF foundations shall be constructed of the materials shown on the drawings and as follows:

a. Excavation/Subgrade: Materials used in the excavation and preparation of subgrade for foundation construction shall be as shown on the drawings and in accordance with Section 41 – Earthwork of these Specifications.

b. Concrete and Reinforcing Steel. Materials used in the preparation of concrete and reinforcing steel for foundation construction shall be as shown on the drawings and in accordance with Section 90 – Structural Portland Cement Concrete (FAA P-610) of these Specifications.

89-6.6 STRUCTURE FRAMES: Frames shall be fabricated from ASTM A36 structural steel shapes which shall be cut and punched, as required. All field connections shall be bolted. After fabrication, all individual structural steel parts shall be hot-dip galvanized to a minimum of 2 oz/ft2 per ASTM A123.
89-6.7 METAL STRUCTURE FACE SHEETS: Face sheets shall be galvanized corrugated steel formed from minimum 16-gauge ASTM A924 sheet steel with ASTM A653 2oz/ft² hot-dip galvanized coating. They shall have a minimum section modulus of .1961 in³/ft. Sheets shall be attached to frames with 3/8” diameter bolts using half oval washers.

89-6.8 FASTENERS: All field connections for new and temporary JBD shall be bolted with locking fasteners. Fasteners shall have adequate locking properties to prevent them from working loose during continued normal operation of the facility. All fasteners shall be new, and as follows:

   a. Bolts: ASTM A449 or SAE J429
   b. Flat Washers: Grade 18-8 stainless
   c. Nuts: IFI-100/107 (all metal self-locking Stover type)
   d. All nuts, bolts and washers are zinc plated per ASTM F1941 or A153/F2329
   e. Half oval washers are A36 steel hot-dip galvanized per ASTM A123 to 2oz/ft² after fabrication. Minimum bearing area on corrugated sheets shall be 0.92 in²

89-6.9 ANCHOR BOLTS: Anchor bolts for new, temporary and/or reinstallation of existing JBD shall be zinc-plated expansion type, LYNanco Spec AB-34M “Epoxy Locked” anchors. Where expansion type anchors cannot be used due to concrete conditions when installing temporary JBD on existing concrete, (i.e.: edge distance or surface condition), Hilti HDI epoxy anchors may be substituted for the LYNanco anchors with prior approval from the Engineer.

89-6.10 GALVANIZED REPAIR PAINT: Galvanized repair paint shall be high zinc dust content paint for re-galvanizing damaged areas in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

89-6.11 GROUNDING: Materials used for grounding shall be as shown on the drawings and as follows:

   a. Grounding Conductors: Grounding conductors shall be stranded copper cable sized as shown on the drawings.
   b. Connector Products:
      1. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
      2. Bolted Connectors: All grounding connections to structural steel members shall use connectors shown on the drawings.
      3. Welded Connections: All grounding connections to grounding rods shall be exothermic-welded type, in kit form, and selected per manufacturer's written instructions.
   c. Grounding Rods: Grounding rods shall be copper-clad steel sized as shown on the drawings.
89-7 CONSTRUCTION METHODS

89-7.1 SITE CONDITION: The JBD manufacturer shall inspect the site prior to beginning work and notify LAWA of any defects, which must be corrected before installation of the new and temporary JBD can be completed. Do not proceed with installation until unsatisfactory conditions have been corrected.

89-7.2 MATERIAL STORAGE AND HANDLING: Store materials in approved areas. Protect all components from damage. Keep corrugated sheets and steel members off ground by using pallets, platforms or other supports. Store all fasteners in a protected area. Do not store materials in a manner that might cause distortion, deterioration or damage. Repair or replace damaged materials.

89-7.3 FOUNDATION CONSTRUCTION:

a. Excavation/Sub-grade: The excavation and preparation of subgrade for foundation construction shall be as shown on the drawings and in accordance with Section 41 – Earthwork of these Specifications. Subgrade shall be compacted, firm and unyielding prior to placement of concrete foundations.

b. Concrete and Reinforcing Steel: The preparation and placement of concrete and steel reinforcement for foundation construction shall be as shown on the drawings and in accordance with Section 90 – Structural Portland Cement Concrete (FAA P-610) of these Specifications.

89-7.4 ERECTION:

a. An authorized representative of the JBD manufacturer shall observe and supervise all new and temporary JBD erection, including setting of the anchor bolts for the performance warranty to be valid.

b. Set steel frames accurately in locations indicated on approved shop drawings in accordance with AISC specifications.

c. Provide temporary guys and braces as required to temporarily support structures during erection.

d. Do not use thermal cutting or welding during erection.

e. Install concrete anchors in accordance with manufacturer’s written instructions. Anchors shall be installed by or under the supervision of the JBD manufacturer, in order to warranty the integrity of the anchorage system.

f. Tighten all fasteners to torques specified by the JBD manufacturer.

g. Touch up any damaged galvanized surfaces with galvanizing repair paint. Follow paint manufacturer’s instructions for application.

89-7.5 GROUNDING:

a. Grounding for the JBD shall be installed in the locations and at the intervals shown on the drawings.
89-8 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Qualification data for the JBD manufacturer(s) specified in the “Quality Assurance” article to demonstrate their capabilities and experience.

b. For alternate manufacture’s, in addition to those items listed in this Section, include test results, analysis, drawings, and a list of five similar completed projects with project name, address, and names of owners, reference contact and other pertinent information. (Note: Alternate manufacturers must be approved prior to submitting a bid.)

c. Jet Blast Deflector installation drawings detailing erection of the jet blast deflector, including plans, elevations and sections. Show foundation, anchorage and accessory items.

d. Temporary Jet Blast Deflector installation drawings detailing erection of the existing jet blast deflector components, including plans, elevations and sections. Show anchorage and accessory items.

e. Provide manufacturer’s data for each epoxy and expansion type anchor, including installation instructions.

f. Provide product data for all materials used to construct the JBD grounding systems shown on the drawings.

g. Provide product data for obstruction lighting in accordance with Section 110 – Airfield Electrical Work.

h. Warranty at Project Closeout: Provide a written copy of the manufacturer’s warranty certifying the workmanship, materials, installation and performance of the JBD systems for a period of (2) two years.

89-9 INSPECTION. The JBD manufacturer or designated representative and a representative from LAWA shall visually inspect the completed facility to assure that all work has been completed in an acceptable manner. Special care should be given to inspecting for loose components or missing fasteners throughout the structure.

89-10 ACCEPTANCE LETTER. At successful completion of the inspection, an acceptance letter shall be signed by LAWA, or designated representative. This inspection must be performed to validate the warranty of the JBD structure.

89-11 PAINT. After installation and galvanized paint touch-up, paint entire structure face sheets (both front and back sides) with alternating white/international orange paint as shown on the drawings.

89-12 QUALITY ASSURANCE

89-12.1 MANUFACTURER’S QUALIFICATIONS. JBD Manufacturer Qualifications: The JBD manufacturer shall have completed a minimum of five (5) JBDs of similar design, which shall
have demonstrated that they allowed successful taxi-breakaway power operation with jet aircraft without harmful exhaust wake velocities behind the structure. At least one of the JBDs shall have been in satisfactory operation for at least five (5) years of actual field service.

**89-12.2 ALTERNATE MANUFACTURER APPROVAL.** To be approved as an alternate JBD manufacturer, the following information for the proposed JBD manufacturer shall be submitted to and approved by LAWA, as specified in the General Conditions and Project Requirements:

a. Results of full-scale field proof tests in which the proposed alternate manufacturer’s standard JBD was subjected to the specified aircraft and power loadings.

b. Results of smoke-pot tests behind the deflector, demonstrating that smoke and gases are deflected in an upward direction, with no evidence of smoke dispersal behind the deflector.

c. Evidence of satisfactory operation for at least five (5) years in actual field service for continuous use with similar aircraft and jet engines.

d. Detailed design analysis, showing loads and stresses in structural members, deflecting surfaces and any bolted joints, using the worst-case aircraft velocity profiles as the calculated pressure for load calculations. Structural calculations shall comply with current IBC standards and shall be submitted by manufacturer during shop drawing review and shall be approved by Engineer prior to installation.

e. Design drawings of the proposed alternate fence with sections showing all deflecting surfaces and structural members. The proposed alternate design may not use concrete or perforated metal or expanded metal deflecting surfaces. Field welds at joints subjected to tension or vibration shall not be used. The proposed alternate must meet all design and material specifications listed in Parts 1&2.

f. Certification that the alternate JBD manufacturer is ISO 9001:2008 registered.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

“14-Foot High Portable Jet Blast Deflector Unit” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

**END OF SECTION 89**
SECTION 90 – STRUCTURAL CONCRETE (FAA P-610)

90-1 GENERAL. The Contractor shall perform all work required by the plans requiring structural concrete for fuel pit structures and miscellaneous other uses, in accordance with Standard Specifications, except as specified otherwise in FAA Specification Item P-610, as included and modified hereafter, and as shown on the Plans.

The Contractor shall be responsible for all testing under this Section including Preparation and Cure Cylinders, Compressive Strength Testing, etc. All Contractor performed tests shall be witnessed by the Engineer.

90-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

90-3 RELATED SECTIONS.

Section 71 – Concrete Repair
Section 73 – Joint Sealing Filler (FAA P-605)
Section 110 – Airfield Electrical Work
Section 115 – Underground Conduit for Airports (FAA L-110)
Other Sections, Tests, Specifications, and Standards referenced herein.

90-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-610 STRUCTURAL PORTLAND CEMENT CONCRETE

610-1 DESCRIPTION

This item shall consist of plain or reinforced structural portland cement concrete, prepared and constructed in accordance with these specifications, at the locations and of the form and dimensions shown on the plans. This specification shall be used for all structural and miscellaneous concrete, including sign bases.

610-2 MATERIALS

610-2.1 GENERAL. Only approved materials, conforming to the requirements of these specifications, shall be used in the work. They may be subjected to inspection and tests at any time during the progress of their preparation or use. The source of supply of each of the materials shall be
approved by the Engineer before delivery or use is started. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to insure the preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

In no case shall the use of pit-run or naturally mixed aggregates be permitted. Naturally mixed aggregate shall be screened and washed, and all fine and coarse aggregates shall be stored separately and kept clean. The mixing of different kinds of aggregates from different sources in one storage pile or alternating batches of different aggregates will not be permitted.

a. Reactivity. Fine and Coarse aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and C1567. Aggregate and mix proportion reactivity tests shall be performed for each project.

(1) Coarse and fine aggregate shall be tested separately in accordance with ASTM C1260. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.10% at 28 days (30 days from casting).

(2) Combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) CRD C662. If lithium nitrate admixture is used, it shall be nominal 30% ±0.5% weight lithium nitrate in water.

(3) If the expansion of the proposed combined materials test specimens, tested in accordance with ASTM C1567, modified for combined aggregates, or COE CRD C662, does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion of the proposed combined materials test specimens is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

610-2.2 COARSE AGGREGATE. The coarse aggregate for concrete shall meet the requirements of ASTM C 33. Crushed stone aggregate shall have a durability factor, as determined by ASTM C 666, greater than or equal to 95. The Engineer may consider and reserve final approval of other State classification procedures addressing aggregate durability.
Coarse aggregate shall be well graded from coarse to fine and shall meet one of the gradations shown in Table 1, using ASTM C 136.

\textbf{a. Aggregate susceptibility to durability (D) cracking.} Coarse aggregate may be accepted from sources that have a 20 year service history for the same gradation to be supplied with no durability issues.

610-2.3 610-2.3 FINE AGGREGATE. The fine aggregate for concrete shall meet the requirements of ASTM C 33.

The fine aggregate shall be well graded from fine to coarse and shall meet the requirements of Table 2 when tested in accordance with ASTM C 136:

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
Sieve Designation (square openings) & Percentage by Weight Passing Sieves \\
\hline
 & 2” & 1-1/2” & 1” & 3/4” & 1/2” & 3/8” & No. 4 \\
\hline
No. 4 to 3/4 in. & & 100 & 90-100 & 20-55 & 0-10 & \\
No. 4 to 1 in. & 100 & 90-100 & 25-60 & 0-10 & \\
No. 4 to 1-1/2 in. & 100 & 95-100 & 35-70 & 10-30 & 0-5 & \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
Sieve Designation (square openings) & Percentage by Weight Passing Sieves \\
\hline
3/8 inch & 100 \\
No. 4 & 95-100 \\
No. 16 & 45-80 \\
No. 30 & 25-55 \\
No. 50 & 10-30 \\
No. 100 & 2-10 \\
\hline
\end{tabular}
\end{table}

Blending will be permitted, if necessary, in order to meet the gradation requirements for fine aggregate. Fine aggregate deficient in the percentage of material passing the No. 50 mesh sieve may be accepted, provided that such deficiency does not exceed 5% and is remedied by the addition of pozzolanic or cementitious materials other than portland cement, as specified in 610-2.6,
Admixtures, in sufficient quantity to produce the required workability as approved by the Engineer.

610-2.4 CEMENT. Cement shall conform to the requirements of ASTM C150, Type II, low alkali.

If cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

The Contractor shall furnish vendors' certified test reports for each carload, or equivalent, of cement shipped to the project. The report shall be delivered to the Engineer before permission to use the cement is granted. All such test reports shall be subject to verification by testing sample materials received for use on the project.

610-2.5 WATER. The water used in concrete shall be fresh, clean and potable; free from injurious amounts of oils, acids, alkalies, salts, organic materials or other substances deleterious to concrete.

610-2.6 ADMIXTURES. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

a. Air-entraining Admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air entrainment agent and any water reducer admixture shall be compatible.

b. Water-reducing Admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

c. Other Chemical Admixtures. The use of set retarding, and set accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

d. Lithium Nitrate. The lithium admixture shall be a nominal 30% aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon (1.2 kg/L), and shall have the approximate chemical form as shown below:
Constituent Limit (Percent by Mass)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Limit (Percent by Mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LiNO₃ (Lithium Nitrate)</td>
<td>30 ±0.5</td>
</tr>
<tr>
<td>SO₄ (Sulfate Ion)</td>
<td>0.1 (max)</td>
</tr>
<tr>
<td>Cl (Chloride Ion)</td>
<td>0.2 (max)</td>
</tr>
<tr>
<td>Na (Sodium Ion)</td>
<td>0.1 (max)</td>
</tr>
<tr>
<td>K (Potassium Ion)</td>
<td>0.1 (max)</td>
</tr>
</tbody>
</table>

Provide a trained representative to supervise the lithium nitrate admixture dispensing and mixing operations.

610-2.7 PREMOLDED JOINT MATERIAL. Pre-molded joint material for expansion joints shall meet the requirements of ASTM D1751 or ASTM D1752.

610-2.8 JOINT FILLER. The filler for joints shall meet the requirements of Section 73 (FAA Item P-605), unless otherwise specified in the proposal.

610-2.9 STEEL REINFORCEMENT. Reinforcing shall be Grade 60 per ASTM A615, and shall conform to the following requirements, as appropriate to the details shown on the Plans:

- Welded Deformed Steel Fabric: ASTM A1064
- Bar Mats: ASTM A184 or A704

610-2.10 COVER MATERIALS FOR CURING. Curing materials shall conform to the following specifications:

| White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B | ASTM C 309 |

610-3 CONSTRUCTION METHODS

610-3.1 GENERAL. The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified herein. All machinery and equipment owned or controlled by the Contractor, which he proposes to use on the work, shall be of sufficient size to meet the requirements of the work, and shall be such as to produce satisfactory work; all work shall be subject to the inspection and approval of the Engineer.

610-3.2 CONCRETE COMPOSITION. Concrete shall develop a compressive strength of 4,000 psi in 28 days for structures under full strength PCC and asphalt pavements, 1,200 psi in 7 days for the pavement section over the fuel lines, and 3,000 psi in 28 days for all other areas, unless otherwise stated in the Plans or Specifications, as determined by test cylinders made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The 4,000 psi concrete shall contain not less than 470 pounds of cement per cubic
yard. The concrete shall contain 5% of entrained air, plus or minus 1%, as determined by ASTM C 231 and shall have a slump of not more than 4 inches as determined by ASTM C 143.

610-3.3 ACCEPTANCE SAMPLING AND TESTING. Concrete for each structure will be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The concrete shall be sampled in accordance with ASTM C 172. Concrete cylindrical test specimens shall be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The Contractor shall cure and store the test specimens under such conditions as directed. The Contractor will make the actual tests on the specimens. Contractor shall sample at the rate of 100 cubic yards/lot or a day’s production, whichever is less.

610-3.4 QUALIFICATIONS FOR CONCRETE TESTING SERVICE. Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM C1077 or ASTM E329.

610-3.5 PROPORTIONING AND MEASURING DEVICES. When package cement is used, the quantity for each batch shall be equal to one or more whole sacks of cement. The aggregates shall be measured separately by weight. If aggregates are delivered to the mixer in batch trucks, the exact amount for each mixer charge shall be contained in each batch compartment. Weighing boxes or hoppers shall be approved by the Engineer and shall provide means of regulating the flow of aggregates into the batch box so that the required and exact weight of aggregates can be readily obtained.

610-3.6 CONSISTENCY. The consistency of the concrete shall be checked by the slump test specified in ASTM C 143.

610-3.7 MIXING. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C 94.

610-3.8 MIXING CONDITIONS. The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F (4°C) without permission of the Engineer. If permission is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F (10°C) nor more than 100°F (38°C). The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his/her expense.

Retempering of concrete by adding water or any other material shall not be permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.
610-3.9 FORMS. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as designed on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The Contractor shall bear responsibility for their adequacy. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface. The forms shall not be removed until at least 30 hours after concrete placement for vertical faces, walls, slender columns, and similar structures. Forms supported by falsework under slabs, beams, girders, arches, and similar construction shall not be removed until tests indicate the concrete has developed at least 60% of the design strength. No backfill shall be permitted against newly placed concrete for a minimum of 7 days, or until 75% of design strength is achieved.

610-3.10 PLACING REINFORCEMENT. All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concreting. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

610-3.11 EMBEDDED ITEMS. Before placing concrete, any items that are to be embedded shall be firmly and securely fastened in place as indicated. All such items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The embedding of wood shall be avoided. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

610-3.12 PLACING CONCRETE. All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the Engineer. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet (1.5 m). Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.
610-3.13  VIBRATION.  Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309, Guide for Consolidation of Concrete. Where bars meeting ASTM A775 or A934 are used, the vibrators shall be equipped with rubber or non-metallic vibrator heads. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches (100 mm) in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches (100 mm) or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 cycles per minute when submerged. Do not use vibrators to transport the concrete in the forms. Penetrate the previously placed lift with the vibrator when more than one lift is required. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete. Vibrators shall be manipulated to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie or other approved method and shall not be disturbed after placement.

610-3.14  CONSTRUCTION JOINTS.  If the placement of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, such provisions shall be made for grooves, steps, reinforcing bars or other devices as may be specified. The work shall be arranged so that a section begun on any day shall be finished during daylight of the same day. Before depositing new concrete on or against concrete that has hardened, the surface of the hardened concrete shall be cleaned by a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.

610-3.15  EXPANSION JOINTS.  Expansion joints shall be constructed at such points and of such dimensions as may be indicated on the drawings. The premolded filler shall be cut to the same shape as that of the surfaces being joined. The filler shall be fixed firmly against the surface of the concrete already in place in such manner that it will not be displaced when concrete is deposited against it.

610-3.16  DEFECTIVE WORK.  Any defective work discovered after the forms have been removed, which in the opinion of the Engineer cannot be repaired satisfactorily, shall be immediately removed and replaced at the expense of the Contractor. Defective work shall include deficient dimensions, or bulged, uneven, or honeycomb on the surface of the concrete.

610-3.17  SURFACE FINISH.  All exposed concrete surfaces shall be true, smooth, and free from open or rough spaces, depressions, or projections. The concrete in horizontal plane surfaces shall be brought flush with the finished top surface at the proper elevation and shall be struck-off with a straightedge and
floated. Mortar finishing shall not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

When directed, the surface finish of exposed concrete shall be a rubbed finish. If forms can be removed while the concrete is still green, the surface shall be pointed and wetted and then rubbed with a wooden float until all irregularities are removed. If the concrete has hardened before being rubbed, a carborundum stone shall be used to finish the surface. When approved, the finishing can be done with a finishing machine.

610-3.18 CURING AND PROTECTION. All concrete shall be properly cured and protected by the Contractor. The concrete shall be protected from the weather, flowing water, and from defacement of any nature during the project. The concrete shall be cured by covering with an approved material as soon as it has sufficiently hardened. Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for at least three (3) days following concrete placement. All curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to air currents. Wooden forms shall be kept wet at all times until removed to prevent opening of joints and drying out of the concrete. Traffic shall not be allowed on concrete surfaces for seven (7) days after the concrete has been placed.

610-3.19 DRAINS OR DUCTS. Drainage pipes, conduits, and ducts that are to be encased in concrete shall be installed by the Contractor before the concrete is placed. The pipe shall be held rigidly so that it will not be displaced or moved during the placing of the concrete.

610-3.20 COLD WEATHER PROTECTION. When concrete is placed at temperatures below 40°F (4°C), the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. The aggregates, or water, or both, shall be heated in order to place the concrete at temperatures between 50°F and 100°F (10°C and 38°C).

Calcium chloride may be incorporated in the mixing water when directed by the Engineer. Not more than 2 pounds of Type 1 nor more than 1.6 pounds of Type 2 shall be added per bag of cement. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the mix at not less than 50°F (10°C) until at least 60% of the designed strength has been attained.

610-3.21 HOT WEATHER PLACING. Concrete shall be properly placed and finished with procedures previously submitted. The concrete-placing temperature shall not exceed 90°F when measured in accordance with ASTM C1064. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph 610-2.6 may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel
temperatures are greater than 120°F (50°C). Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature. Submit the proposed materials and methods for review and approval by the Engineer, if concrete is to be placed under hot weather conditions.

610-3.22 FILLING JOINTS. All joints that require filling shall be thoroughly cleaned, and any excess mortar or concrete shall be cut out with proper tools. Joint filling shall not be started until after final curing and shall be done only when the concrete is completely dry. The cleaning and filling shall be carefully done with proper equipment and in a manner to obtain a neat looking joint free from excess filler.

610-4 METHOD OF MEASUREMENT See Section 90-6.

610-5 BASIS OF PAYMENT See Section 90-6.

610-6 TESTING REQUIREMENTS

ASTM C 31 Making and Curing Test Specimens in the Field
ASTM C 39 Compressive Strength of Cylindrical Concrete Specimens
ASTM C 136 Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138 Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143 Slump of Hydraulic Cement Concrete
ASTM C 231 Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 666 Resistance of Concrete to Rapid Freezing and Thawing
ASTM C1017 Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064 Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1260 Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567 Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated MortarBarMethod)
ASTM E329 Agencies Engaged in Construction Inspection, Testing, or Special Inspection
U.S. Army
Corps of Engineers (USACE)  Concrete Research Division (CRD) C662 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

610-7  MATERIAL REQUIREMENTS

ASTM A 184  Specification for Fabricated Deformed Steel Bar or Rod Mats for Concrete Reinforcement

ASTM A 185  Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 615  Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 704  Welded Steel Plain Bars or Rod Mats for Concrete Reinforcement

ASTM A706  Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A775  Epoxy-Coated Steel Reinforcing Bars

ASTM A934  Epoxy-Coated Prefabricated Steel Reinforcing Bars

ASTM A1064  Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C 33  Concrete Aggregates

ASTM C 94  Ready-Mixed Concrete

ASTM C 150  Portland Cement

ASTM C 171  Sheet Materials for Curing Concrete

ASTM C 172  Sampling Freshly Mixed Concrete

ASTM C 260  Air-Entraining Admixtures for Concrete

ASTM C 309  Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 494  Chemical Admixtures for Concrete

ASTM C 595  Blended Hydraulic Cements

ASTM C 618  Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM D 1751 Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ACI 305R Hot Weather Concreting

ACI 306R Cold Weather Concreting

ACI 309R Guide for Consolidation of Concrete

END OF ITEM P-610

90-5 SUBMITTALS. Submittals required for this item include, but are not limited to:

b. Aggregate

c. Cement

d. Admixtures

e. Reinforcing Steel

90-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT. Except for the specific bid items indicated below, structural concrete will not be measured separately for payment but shall be included in the prices bid for the particular items which reference it.

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. Variable Depth Structural Concrete (P-610)

END OF SECTION 90
SECTION 91 - MARKING (FAA P-620)

91-1 GENERAL

The Contractor shall perform all work required by the plans for the application of pavement marking paint to taxiways, runways, roads, infield areas and other pavement as shown on the plans and in accordance with FAA Specification Item P-620, as included and modified hereafter, and in accordance with the Innovative Pavement Research Foundation Airfield Marking Handbook, included as Appendix M. The section also covers reflective media (glass beads).

For temporary road and taxiway signs or weighted barricades see Section 27 – Construction Barricades, Fencing, Markers and Signs.

For marking removals see Section 23 – Removals.

91-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

91-3 RELATED SECTIONS

Section 23 - Removals

Section 27 - Construction Barricades, Fencing, Markers and Signs

Other Sections, Tests, Specifications, and Standards referenced herein.

91-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1 Scope of Work, PR-2 Work Sequence Phasing, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-620  RUNWAY AND TAXIWAY PAINTING

620-1 DESCRIPTION

This item shall consist of the painting of numbers, markings, surface painted signs, and stripes on the surface of runways, taxiways, infield areas and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

620-2 MATERIALS

620-2.1 MATERIALS ACCEPTANCE. The Contractor shall furnish manufacturer’s certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the
specification requirements. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers 55 gallons or smaller for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer.

All emptied containers shall be returned to the paint storage area and shall not be removed from the airport or destroyed until authorized by the Engineer. The Contractor shall periodically provide the Engineer with a report showing the correlation between the total number of square feet painted and the empty containers.

620-2.2 PAINT. Paint shall be waterborne paint manufactured by Sherwin-Williams, unless otherwise noted or approval equal, and in accordance with the requirements of paragraph 620-2.2a. Paint shall be furnished in the following colors, in accordance with Federal Standard No. 595:

a. White – 37925
b. Red – 31136
c. Yellow – 33655
d. Black – 37038
e. Green – 34108

(1) Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952E, Type II for all markings with the exception of the shoulder markings. Shoulder markings on the asphalt surfaces shall be painted using TT-P-1952E, Type III. The nonvolatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm⁻¹ with intensities equal to those produced by an acrylic resin known to be 100% cross linking.

(2) Epoxy. Section not used.

(3) Methacrylate. Section not used.

(4) Solvent Base. Section not used.

(5) Preformed Thermoplastic Airport Pavement Markings. Section not used.

620-2.3 REFLECTIVE MEDIA. Glass beads shall meet the requirements for Federal Specification TT-B-1325D, Type I, gradation A and Federal
Specification. TT-B-1325D, Type III, gradation A depending on color, see table below. Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment. Glass beads shall only be applied to the second coat of permanent markings, see table below.

<table>
<thead>
<tr>
<th>Paint Color</th>
<th>Glass Beads, Type I, Gradation A</th>
<th>Glass Beads, Type III</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Not Used</td>
<td>See Table 3</td>
</tr>
<tr>
<td>Yellow</td>
<td>Not Used</td>
<td>See Table 3</td>
</tr>
<tr>
<td>Red</td>
<td>See Table 3</td>
<td>Not used.</td>
</tr>
<tr>
<td>Green</td>
<td>Not Used</td>
<td>Not used.</td>
</tr>
<tr>
<td>Black</td>
<td>Not Used</td>
<td>Not used.</td>
</tr>
</tbody>
</table>

620-3 CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. The painting shall be performed only when the surface is dry and when the surface temperature is at least 45°F (7°C) and rising and the pavement surface temperature is at least 5°F (2.7°C) above the dew point. Markings shall not be applied when the pavement temperature is greater than 130°F (55°C). Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns.

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking truck, a bead dispensing machine apparatus attached to the marking truck to dispense, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless-type marking truck suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray.

If black-bordering is applied along with another color that is reflectorized, care must be taken to keep the beads out of the black paint.

In addition to the equipment listed in Section 23 and elsewhere, the Contractor shall have the following minimum marking equipment on site at all times while marking and removal operations are occurring.
### TABLE 1. Minimum Marking Equipment

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>ITEM NAME</th>
<th>Minimum Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Truck Mounted Airport Marking System</td>
<td>• Capable of applying markings 6 to 36 inches wide in a single pass, and be capable of applying two colors simultaneously.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• On truck paint storage tanks with a minimum capacity of 100 gallons for each color.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Uniform flow of beads are automatically triggered when the paint guns are activated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pressurized bead guns</td>
</tr>
<tr>
<td>1</td>
<td>Walk Behind Marking System</td>
<td>• With mechanical bead dispenser</td>
</tr>
</tbody>
</table>

### 620-3.3 PREPARATION OF SURFACE AND CLEANING

Surface preparation is the cleaning and removal of all items that would reduce the bond between newly applied material and the surface.

Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material that would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by waterblasting, shotblasting, grinding, or by other methods as required to remove all dirt, laitance, and loose materials without damage to the pavement surface. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer. After the cleaning operations sweeping, blowing or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit and other debris left from the cleaning process.

Paint shall not be applied to Portland cement concrete pavement until the areas to be painted are clean of curing material. High-pressure water shall be used to remove curing materials.

At least 24 hours prior to remarking existing marking, the existing markings must be removed such that at least 75% of the existing markings are removed with low pressure water blaster (3,500-10,000 psi). After water blasting, the surface shall be cleaned of any residue or debris either with sweeping or blowing with compressed air, or both. Surface shall be allowed to dry prior to the application of any new markings.

Prior to the initial application of markings, the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer’s requirements, that the application equipment is appropriate for the type of marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufacturer’s surface preparation and application requirements must be submitted and approved by the Engineer prior to the initial application of markings.
620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out by survey in advance of the paint application. Contractor shall provide all stencils as required for roadway and airfield markings.

The locations of markings to receive glass beads shall be shown on the plans, listed herein, or designated by the Engineer. The following locations, at a minimum, shall receive glass beads:

a. All holding position markings used on runways, taxiways, and holding bays, and used to indicate instrument landing system or critical areas.
b. Runway threshold markings
c. Runway threshold bars
d. Runway aiming point markings
e. Runway designation markings
f. Runway touchdown zone markings
g. Runway centerline markings
h. All taxiway centerline markings and enhanced taxiway centerline markings
i. Geographical position marking
j. Surface painted signs
k. Non-movement area boundary markings
l. Runway side stripes
m. Taxiway edge markings
n. Runway Displaced threshold markings
o. Runway Demarcation bar

620-3.5 APPLICATION – PAINT AND GLASS BEADS. Paint shall be applied in at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer. The first coat shall be fully dry and adequate time shall have elapsed between coats, per manufacturer’s recommendations before application of the second coat. The edges of the markings shall not vary from a straight line more than 1/2 inch in 50 feet and marking dimensions and spacings shall be within the following tolerances:
TABLE 2. MARKING DIMENSION AND SPACING

<table>
<thead>
<tr>
<th>Dimension and Spacing:</th>
<th>Tolerance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 inches or less</td>
<td>±1/2 inch</td>
</tr>
<tr>
<td>greater than 36 inches to 6 feet</td>
<td>± 1 inch</td>
</tr>
<tr>
<td>greater than 6 feet to 60 feet</td>
<td>± 2 inches</td>
</tr>
<tr>
<td>greater than 60 feet</td>
<td>± 3 inches</td>
</tr>
</tbody>
</table>

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate(s) shown in Table 3. The addition of thinner will not be permitted. A period of 6 hours or per paint manufacturer's recommendations shall elapse between placement of a bituminous surface course or seal coat and application of any paint.

Prior to the initial application of markings, the pavement surfaces shall be allowed to sufficiently cure and the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer's requirements, that the application equipment is appropriate for the marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the Engineer prior to the initial application of markings.

Curing times stated in Table 3 may be shortened only by written waiver from the Engineer.
### TABLE 3. APPLICATION RATES AND SURFACE CURING TIME FOR APPLICATION OF PAINT AND GLASS BEADS

<table>
<thead>
<tr>
<th>Marking Type</th>
<th>Paint Square feet per Gallon</th>
<th>Glass Beads, Type I, Gradation A Pounds per gallon of paint (^1)</th>
<th>Glass Beads, Type III Pounds per gallon of paint (^1)</th>
<th>Curing Time for AC Pavement prior to receiving Markings</th>
<th>Curing Time for PCC Pavement Prior to receiving Markings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent – Two Coats as follows:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent Markings - Coat 1</td>
<td>Type II - 230 ft(^2)/gal maximum</td>
<td>None</td>
<td>10 lb./gal. minimum</td>
<td>6 hours minimum</td>
<td>7 days or duration of cure period</td>
</tr>
<tr>
<td>Permanent Markings – Coat 2</td>
<td>Type II - 115 ft(^2)/gal. maximum (Red Paint Only)</td>
<td>5 lb./gal. minimum</td>
<td>10 lb./gal. minimum</td>
<td>30 days</td>
<td>40 days</td>
</tr>
<tr>
<td>Temporary (^2)</td>
<td>Type II - 230 ft(^2)/gal maximum</td>
<td>None</td>
<td>10 lb./gal. minimum</td>
<td>6 hours minimum</td>
<td>7 days or duration of cure period</td>
</tr>
<tr>
<td>Refresh Existing</td>
<td>Type II - 115 ft(^2)/gal. maximum (Red Paint Only)</td>
<td>5 lb./gal. minimum</td>
<td>10 lb./gal. minimum</td>
<td>30 days</td>
<td>40 days</td>
</tr>
<tr>
<td>Infield (Shoulder) Marking (Green Paint on Asphalt)</td>
<td>Type III - 115 ft(^2)/gal. maximum</td>
<td>None</td>
<td>None</td>
<td>30 days</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Notes (Table 3):**

1. Glass beads not applied to green or black paint.
2. All temporary markings shall be applied as indicated, except temporary runway markings, which shall conform to the requirements of, and paid for as, permanent markings.

Glass beads shall be distributed upon the marked areas at the locations designated immediately after application of the final coat of paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Hand spreading of beads will not be allowed. Glass beads shall be applied at the rate(s) shown in Table 3. Glass beads shall not be applied to black or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment shall be performed. After curing of marking glass beads that did not embed in paint markings shall be thoroughly vacuumed and the area cleaned before opening to aircraft traffic.
All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

620-3.6 TEST STRIP. Prior to the full application of airfield markings, the Contractor shall produce a test strip in the presence of the Engineer. The test strip shall include the application of the minimum of 5 gallons of paint and 35 lbs of glass beads. Prior to the application of the test strip, the Contractor shall calibrate their equipment. The test strip shall be installed with the same equipment, application rates, and procedures as will be used for the permanent marking. If approved, the quantity of marking will be paid for per Project Requirements – 4. Unapproved test strips will not be eligible for compensation.

620-3.7 APPLICATION - PREFORMED THERMOPLASTIC AIRPORT PAVEMENT MARKINGS. Section not used.

620-3.8 PROTECTION AND CLEANUP. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose or unadhered reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

Throughout the duration of the project the Contractor will be responsible for restoration of paint and reflective media to all surfaces where existing markings have been compromised by haul and work activities. Contractor shall document existing marking conditions prior to starting work, refer to Section 39. Contractor shall bear the entire expense for the restoration of damaged markings.

620-4 METHOD OF MEASUREMENT. See 91-11.

620-5 BASIS OF PAYMENT. See 91-11.

620-6 TESTING REQUIREMENTS

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C 371</td>
<td>Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders</td>
</tr>
<tr>
<td>ASTM D 92</td>
<td>Test Method for Flash and Fire Points by Cleveland Open Cup</td>
</tr>
<tr>
<td>ASTM D 711</td>
<td>No-Pick-Up Time of Traffic Paint</td>
</tr>
<tr>
<td>ASTM D1652</td>
<td>Epoxy Content of Epoxy Resins Coatings by Falling Abrasive</td>
</tr>
</tbody>
</table>
ASTM D 2074  Test Method for Total Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method

ASTM D 2240  Test Method for Rubber Products-Durometer Hardness

ASTM D7585  Retroreflective Pavement Markings Using Portable Hand-Operated Instruments

ASTM E1710  Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer

ASTM E2302  Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer

ASTM G154  Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

620-7  MATERIAL REQUIREMENTS

ASTM D 476  Specifications for Dry Pigmentary Titanium Dioxide Pigments Products

Code of Federal Regulations  40 CFR Part 60, Appendix A
Definition of Traverse Point Number and Location

Hazard Communications

FED SPEC TT-B-1325D  Beads (Glass Spheres) Retroreflective

AASHTO M 247  Glass Beads Used in Traffic Paints


FED STD 595  Colors used in Government Procurement

AC 150/5340-1  Standards for Airport Markings

END OF ITEM P-620

91-5  ROADWAY PAVEMENT MARKINGS. All temporary and permanent roadway pavement markings shall conform to the plans and the requirements of FAA Specification P-620 included herein.
91-6 SURFACE PAINTED SIGNS. Surface painted signs shall be double-coat painted and conform to the requirements of FAA Specification P-620 included herein, and will be measured separately from other markings for payment.

91-7 TEMPORARY PAVEMENT MARKINGS AND REMOVALS. All temporary pavement markings required to accommodate aircraft and vehicle traffic, including taxiway and roadway markings, will be measured for payment as “Temporary Markings”, except for temporary runway markings, which shall conform to the requirements of, and paid for as, “Permanent Markings”.

In order to accommodate the various phasing requirements of the Plans, or for other airfield operations needs as may be directed by the Engineer, the Contractor will be required to remove pavement markings at various locations as the construction proceeds, and place new marking, either permanent or temporary. Removal of temporary or permanent markings, as directed by the Engineer, shall be measured for payment under Section 23 – Removals.

91-8 INFIELD MARKING. Airfield Infield painting shall consist of green paint applied in accordance with FAA Specification P-620 included herein to areas shown on the plans or designated by the Engineer.

91-9 RETROREFLECTIVE TAXIWAY MARKERS

Retroreflective markers shall be Type II, Elevated Marker for Edge Marking, 24” in height, a tube color of blue, with one blue band. Markers shall be able to be mounted on pavement or on soil.

In the event that existing taxiway edge light circuitry is to be interrupted due to construction activities, taxiway retroreflective markers shall be installed next to and on the inside of existing edge lights. Markers shall be installed prior to interruption of circuitry. The Contractor shall maintain runway circuitry at all times. Markers shall also be installed where existing edge lights are to be removed and before new edge lights are installed.

The Contractor shall be responsible for installing, maintaining, and relocating taxiway retroreflective markers as necessary.

Taxiway retroreflective markers shall be removed when interrupted circuitry and/or new edge lights are tested and approved by the Engineer. Pavement shall be cleaned of any adhesive remnants or repaired as necessary after removal.

91-10 SUBMITTALS. Submittals required for this item include, but are not limited to:

a. Paint
b. Glass Beads
c. Marking equipment
d. Method of paint removal
e. Retroreflective Taxiway Markers
91-11 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

1. “Airfield Markings - Permanent” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

2. “Airfield Markings - Temporary” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

3. “Airfield Markings - Refresh Existing” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

4. “Surface Painted Signs” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

5. “Infield Painting (Green)” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

6. “Retroreflective Taxiway Marker” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

END OF SECTION 91
SECTION 93 – SEEDING AND TOPSOILING (FAA T-901 AND T-905)

93-1 GENERAL

The Contractor shall perform all work in accordance with the Standard Specifications, except as specified otherwise in the FAA Specifications, Item T-901, Seeding, and Item T-905, Topsoiling, as included and modified herein, and as shown on the plans. Seeding shall be applied using the wet method (Hydroseeding) as described herein. Dry method application will not be allowed.

ITEM T-901 – SEEDING

901-1 DESCRIPTION

901-1.1 This item shall consist of soil preparation, seeding, and fertilizing the areas shown on the Plans or as directed by the Engineer in accordance with these specifications.

901-2 MATERIALS

901-2.1 SEED. The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seed shall be spread in a slurry composed of commercial Seed, Fertilizer, Wood Fiber/Mulch, and a Binder/Tackifier.

Fiber/Mulch shall comply with Section 212-1.2.4 of the Standard Specifications for Type 1 Organic Mulch. Binder/Tackifier shall be a commercially prepared material specifically manufactured as an emulsifying agent for hydroseeding installation. Slurry components shall be combined and applied at the following rates:
Seeding shall be performed at least 30 days prior to completion of all work. Contractor shall provide temporary water at least 4 times per day for these 30 days, then 14 days after, unless otherwise approved by the Engineer.

901-2.2 FERTILIZER. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified herein, and shall meet the requirements of Federal Specification O-F-241 and applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

- **a.** A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
- **b.** A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
- **c.** A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be 0 percent nitrogen, 36 percent phosphoric acid, and 19 percent water soluble potash commercial fertilizer and shall be spread at the rate of 326 pounds per acre.

901-2.3 SOIL FOR REPAIRS. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed,
compacting, and establishing turf, and shall be approved by the Engineer before being placed.

901-2.4 IRRIGATION SYSTEM. The Contractor shall develop and submit an irrigation plan for review and approval. The irrigation system shall be designed to provide adequate pressure and coverage to irrigate the hydroseeded area. The proposed irrigation system shall allow for a manifold connection to the contractor’s water truck. The connection points are required to be located outside of the runway and taxiway safety areas to avoid airfield impacts. All irrigation piping shall be secured to the ground, shall be constructed of non-metallic materials, and shall not exceed 3 inches in height. Metallic irrigation fixtures will not be permitted. After the grass has establish a good stand of grass of uniform color and density to the satisfaction of the Engineer then the irrigation system shall be removed by the Contractor.

901-3 CONSTRUCTION METHODS

901-3.1 ADVANCE PREPARATION AND CLEANUP. After grading of areas has been completed and before applying fertilizer, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches in any diameter, sticks, stumps, and other debris which might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 4 inches as a result of grading operations and, if immediately prior to seeding, the top 3 inches of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

However, when the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 4 inches. Clods shall be broken and the top 3 inches of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

901-3.2 DRY APPLICATION METHOD. Section not used.

901-3.3 WET APPLICATION METHOD

a. General. The Contractor shall apply seed and fertilizer by spraying them on the previously prepared seedbed in the form of an aqueous mixture of the materials described above, and by using the methods and
equipment described herein. The rates of application shall be as specified in the special provisions.

b. **Spraying Equipment.** The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons per minute at a pressure of 100 pounds per square inch. The pump shall be mounted in a line which will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 inch solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet. One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet in length shall be provided to which the nozzles may be connected.

c. **Mixtures.** Seed, fertilizer, mulch and binder shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds of these combined solids shall be added to and mixed with each 100 gallons of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least 2 weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for
chemical and saline content. The Contractor shall not use any water from any source which is disapproved by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within 2 hours from the time they were mixed or they shall be wasted and disposed of at locations acceptable to the Engineer.

d. Spraying. Mixtures of seed, fertilizer, mulch and binder shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray which shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to insure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area. Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces which are to be mulched as indicated by the Plans or designated by the Engineer, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

901-3.4 MAINTENANCE OF SEEDED AREAS. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Engineer. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water via contractor installed irrigation and otherwise maintain seeded areas in a satisfactory condition and as directed until final inspection and acceptance of the work. The Contractor shall water the seeding mix twice every night from the irrigation system at night for a period of time beginning when the seed is placed to a period of time that shall end 1 week after the grass is ½” tall as measured from the root level.

When the wet application method outlined above is used it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Engineer. A grass stand shall be considered adequate when bare spots are one square foot (0.01 sq m) or less, randomly dispersed, and do not exceed 3% of the area seeded. If at the time when the contract has been otherwise completed it is not possible to make an adequate determination of the color, density, and uniformity of such stand of grass, payment for the unaccepted
portions of the areas seeded will be withheld until such time as these requirements have been met.

901-4  METHOD OF MEASUREMENT. See Section 93-2.

901-5  BASIS OF PAYMENT. See Section 93-2.

901-6  MATERIAL REQUIREMENTS

ASTM D 977  Emulsified Asphalt
Fed. Spec. JJJ-S-181B  Agricultural Seeds

END OF ITEM T-901

ITEM T-905 – TOPSOILING

905-1  DESCRIPTION

905-1.1  This item shall consist of preparing the ground surface for topsoil application, loading, and hauling of topsoil from designated stockpiles or areas stripped on site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Engineer.

905-2  MATERIALS

905-2.1  TOPSOIL. Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 in or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the association of official agricultural chemists in effect on the date of invitation of bids. The organic content shall be not less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200 mesh (0.075 mm) sieve as determined by the wash test in accordance with ASTM C 117.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.
905-3 CONSTRUCTION METHODS

905-3.1 GENERAL. Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Engineer before the various operations are started.

905-3.2 PREPARING THE GROUND SURFACE. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Engineer, to a minimum depth of 2 in (50 mm) to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 in (50 mm) in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Areas which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be topsoiled, shall be smooth-graded and the surface left at the prescribed grades in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

905-3.4 PLACING TOPSOIL. The topsoil shall be evenly spread on the prepared areas to a uniform depth of 3 inches after compaction, unless otherwise shown on the plans. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that seeding operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks 2 inches (50 mm) or more in diameter, roots, litter, or any foreign matter shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Engineer. The compacted topsoil surface shall conform to the required lines, grades, and cross sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

Any salvaged and stockpiled stripping materials not placed as topsoil shall be removed and disposed of by the Contractor off airport property. Removal and disposal of stockpiled stripping materials shall be included in the payment for Clearing, Grubbing and Stripping and no separate measurement or payment will be made.

905-4 METHOD OF MEASUREMENT. See Section 93-2.
905-5 BASIS OF PAYMENT. See Section 93-2.

905-6 TESTING MATERIALS

ASTM C 117 Materials Finer Than 75 \( \mu \text{M} \) (NO. 200) Sieve In Mineral Aggregates by Washing

END OF ITEM T-905

93-2 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

1. “Topsoil Placement” shall be measured and paid for as described in Project Requirements – 4 of these specifications.

2. “Hydroseeding” shall be measured and paid for as described in Project Requirements – 4 of these specifications

END OF SECTION 93
SECTION 94 – TRAFFIC SIGNING

94-1 DESCRIPTION

94-1.1 The item of work to be performed under this section shall consist of furnishing, modifying and installing information, regulatory, and warning signs as shown on the contract drawings and in accordance with these specifications, or as directed by the Engineer. This section also includes removal and relocation of existing signs.

All work shall conform to the requirements of Section 56, Signs, of the 2010 Caltrans Standard Specifications, with the additions and modifications herein.

94-1.2 REFERENCES


d. FS L-P 380: Plastic Molding Material Methacrylate.

e. FS L-S-300: Sheeting and Tape, Reflective: Nonexposed Lens.

94-2 GENERAL REQUIREMENTS

94-2.1 SUBMITTALS. Submit shop drawings of each sign and support prior to fabrication, including manufacturer’s name and product number.

94-2.2 MAINTENANCE OF TRAFFIC AND SAFEGUARDS. The Contractor shall be responsible for the maintenance, control and the safeguarding of pedestrian and vehicular traffic within and immediately abutting the areas where the work is being conducted. The Contractor shall provide and maintain on a 24-hour basis if required, all necessary safeguards such as flagging personnel, warning signs, barricades and warning lights. Whenever, in the opinion of the Engineer, the Contractor has not provided sufficient or proper safety precautions and safeguards, he/she shall do so immediately and to whatever extent the Engineer deems advisable.

Special care shall be exercised to prevent vehicles and pedestrians from falling into open excavations or being otherwise harmed as a result of the work. The Contractor shall, in all cases, hold the Owner harmless for any and all damages resulting from any of his operations.

94-2.3 MAINTENANCE OF AIRPORT OPERATIONS. If any aspect of normal airport operations (including but not limited to vehicular traffic) needs to be interrupted for completion of the work, this must be coordinated with Airport Operations. A minimum of 72 hours’ notice must be given prior to any such interruption.
94-2.4 PROJECT CLEAN-UP. Concrete and paint splatters and other stains from all causes on exposed surfaces including posts, concrete, and paving shall be removed to the satisfaction of the Engineer.

94-3 MATERIALS

94-3.1 CONCRETE. All concrete shall be furnished, placed, cured and tested in accordance with the requirements of Section 90, 3,000 psi minimum compressive strength.

94-3.2 SIGN PANELS. All sheeting shall be applied in accordance with the manufacturer's recommendations. The finished sign panels shall be free from gaps, cracks, streaks, wrinkles, blisters, discoloration, buckles, and warps and shall have a smooth surface of uniform color as indicated in the Plans and these Specifications.

   d. Reflective Sheeting: Reflective per FS L-S-300 requirements with 2,200-hours minimum durability.
   e. Non-reflective Sheeting: Non-chalking, weather resistant transparent plastic having a protected adhesive backing and a smooth flat outer surface with glass spheres embedded within.
   f. Bolts, Nuts, Accessories: Stainless or galvanized steel.

94-3.3 SIGN POSTS. Sign posts shall be 4-inch by 4-inch wood posts as indicated in the plans. Sign posts shall scored as shown in the drawings, so that they are frangible.

94-3.4 SIGN COLORS AND FORMAT

   b. Provided colors of same reflectorized hue in daylight and night under artificial white illumination.

94-4 FABRICATION

94-4.1 SIGN LETTERING. Style and Spacing. Signs shall use standard MUTCD fonts and symbols.

94-4.2 WELDING, BRAZING AND SOLDERING. The work shall comply with AWS, NAAMM and CDA metal authorities for recommended procedures in welding, brazing and soldering. Use filler metals that will blend with and match the color of sheet metal being used and the required
exposed finish appearance of the metals. Continuously weld, braze, solder corners and seams, and grind smooth and flush on all exposed surfaces. Discoloration or stains between base metal and filler metal will not be acceptable for exposed portions of natural metal finish.

Clean, pretin, heat, flux and sweat solder through full contact area of surfaces to be joined in accordance with the best standards of practice in modern sheet metal shops. Remove all flux residue and foreign matter after soldering. Rinse all soldered areas with water and wipe clean.

94-5 CONSTRUCTION METHODS

94-5.1 PLACEMENT OF SIGNS. All reflectorized signs shall be turned 3 degrees away from a line perpendicular to the pavement edge of the oncoming traffic lanes. The signs shall be inspected at night by the Engineer, and if specular glare occurs from failure to install the signs at 3 degrees from perpendicular as stipulated, the Contractor shall at his own expense adjust the angle of placement to improve the legibility of the sign. All sign posts shall be plumb and signs level.

Sign panels shall be securely fastened to posts or supports as indicated on the plans. Overlay sign panel shall be securely fastened to existing sign panel with rivets spaced on 12 inch centers maximum vertically and horizontally except the edges of each overlap sign panel shall be attached with rivets spaced on 6 inch centers maximum. Rivets shall not be within 1 inch of the extruded panel joints. Fasteners shall meet ASTM A 314, Class 304, 18-8 Stainless Steel.

Damage to sign panels during erection will be repaired only as approved by the Engineer. Patching will not be permitted on any background, letter, numeral, arrow, symbol, or border. If damaged, replacement will be at the expense of the Contractor. If the sign message is not applicable at the time of erection, cover the sign with a secure, opaque material approved by the Engineer.

Use caution when excavating around existing utility lines and contact the utility company representative if any contact is made with any existing utility line. This does not relieve the Contractor from responsibility for damages incurred.

94-5.2 INSTALLATION

a. Unless indicated otherwise use clearance and locations shown in ANSI D6.1. Install posts plumb and in proper alignment.

b. Set posts as indicated in the plans. Finish concrete flush with final grades.

c. Establish proper elevation and orientation of all signs, structures, and determine proper sign post lengths as dictated by construction slopes.

d. Provide sign clearance from the ground level to the bottom of sign, as indicated on the plans or as directed by the Engineer.

e. Install posts plumb so closest edge of sign is a minimum of 2-feet from vertical projection of the curb face at the point of curve (PC) of the intersection approach curb.
f. Cover signs that require temporary covering with a porous cloth or fiber material folded over the sign edges and secured at the rear of the sign in such a manner that the sign is not damaged. Maintain covering until removal.

g. Restore all surfaces damaged during installation, including but not limited to asphalt and concrete surfaces.

94-5.3 WORKMANSHIP

a. Carefully fabricate and erect signs. Damaged signs will be rejected.

b. Make all vertical joints and cuts flat and true.

c. Elevator bolts may be used or bolt holes relocated where conflict exists with sign border, legend, or copy.

d. Layout and properly balance on the sign face all Type 1 legend and copy before fastening. Plug holes left by shifting of copy or legend with the same type screw used to fasten the legend.

e. Wash all sign faces prior to Final Inspection.

94-5.4 RELOCATION OF TRAFFIC SIGNS

a. Each sign to be relocated shall be protected from damage.

b. Sign posts may be re-used if they are in good condition and can be relocated without damaging the post. Restore and compact the post holes to existing conditions. The Contractor may provide new posts if desired. New posts shall meet the requirements for new signing.

94-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

“Traffic Signs” shall be measured and paid for as described in Project Requirements 4 of these specifications.

END OF SECTION 94
SECTION 100 – BASIC ELECTRICAL REQUIREMENTS

100-1 GENERAL

a. This Specification provides general electrical requirements. Refer to the specific equipment specifications for RWSL Contract Work requirements. The individual specific equipment specifications shall take precedence over the general requirements here in.

100-1.1 DESCRIPTION OF WORK

a. Contract Drawings: Drawings in laying out the work and verify spaces for the installation of the materials and equipment based on actual dimensions of equipment furnished. Where conflicts occur, the most stringent application shall apply wherever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Engineer before proceeding with the Work.

b. Equipment or Fixtures: Equipment and fixtures shall be connected to provide circuit continuity in accordance with the Specifications whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures, and the point of circuit origin.

c. Work Installed but Furnished Under Other Sections: The Electrical Work includes the installation or connection of certain materials and equipment furnished under other sections. Verify installation details. Foundations for apparatus and equipment will be furnished under other sections unless otherwise noted or detailed.

100-1.2 GENERAL REQUIREMENTS

a. Guarantee:

1) Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guaranty period, from date of Substantial Completion against defective workmanship and material, and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.

2) Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Engineer, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project.

b. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

c. Codes and Regulations:
1) Design, manufacture, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:

Institute of Electrical and Electronic Engineers - IEEE
National Electrical Manufacturers' Association - NEMA
California Fire Code - CFC
California Building Code - CBC
Underwriters' Laboratories, Inc. - UL
National Fire Protection Association - NFPA
American Society for Testing and Materials - ASTM
American National Standards Institute - ANSI
California Electrical Code - CEC
California Code of Regulations, Title 8, Subchapter 5
California Code of Regulations, Title 24
State & Municipal Codes in Force in the Specific Project Area
Occupational Safety and Health Administration - OSHA
City of Los Angeles Electrical Code
City of Los Angeles Testing Laboratories (CTL)

The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.

d. Seismic Design of Electrical Equipment:

1) All electrical prefabricated equipment is to be designed and constructed in such a manner that all portions, elements, sub-assemblies and/or parts of said equipment and the equipment as a whole, including their attachments, will resist a horizontal load equal to the operating weights of those parts multiplied times the following factors:

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Horizontal CP</th>
<th>Vertical CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid and rigidly supported piping or equipment such as boilers, chillers, pumps, motors, transformers, unit substations and control panels.</td>
<td>0.50</td>
<td>0.33</td>
</tr>
<tr>
<td>Flexible and flexibly supported equipment such as air-handling units, piping and other equipment so supported that the fundamental period of vibration of the equipment and its...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
supporting system is greater than 0.05
seconds. Communication
equipment and emergency
stand-by equipment. 1.00 0.67

2) Load is to be applied at the center of gravity of the part and to be in any direction horizontally. Design part and to be in any direction horizontally. Design stresses shall be in accordance with the specifications for design of the American Institute of Steel Construction. Anchorage, support and/or attachment of said prefabricated equipment to the structure shall be in accordance with the details found in the plans and specifications.

3) It is the entire responsibility of the Contractor to verify the design of equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

e. Requirements of Regulatory Agencies:

1) Codes, Permits and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply unless variance is approved. Where provisions in the drawings and specifications differ in regard to code application, size, quality, quantity or type of equipment, Contractor shall include in the bid, costs for the most costly provision either denoted in the specifications or on the drawings. This provision shall apply as an amendment to the California Public Contracts Code.

a) Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Work shall be obtained by the Contractor at his expense, unless otherwise specified.

b) Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

2) Substitutions: The materials, products, and equipment described in the Contract Documents establish a standard of required function, dimension, appearance, and quality. Engineer may consider requests for substitutions of specified equipment, materials, or products and then only when request are submitted in accordance with the provisions of the Contract Documents, Section PR-3, and are received by the Engineer a minimum of 21 days prior to the date established for the receipt of the bid. No substitutions will be considered after the date of the receipt of the bid or contract award unless there is cause for a substitution which complies in every respect to the provisions of the Contract Documents, Section PR-3. Substitution requests shall be made in accordance with Public Contracts Code (AB2084) revisions as follows:

a) No substitutions are allowed after bid opening.

b) All substitutions must be requested 21 days prior to bid opening date.
c) Final addendum naming approved substitutions of materials/equipment must be issued 7 days prior to bid date.

f. Record Drawings: Comply with General Requirements Specifications. Keep up to date, monthly payments withheld if not updated.

g. Shop Drawings:
   1) See General Conditions section and Special Conditions section for additional requirements.

2) Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.

3) Submittals will be checked for general compliance with drawings and specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.

4) Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.

5) Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review.

"It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals to be reviewed.

a) Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" or smaller, in sets with covers neatly showing titles.

b) The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.

c) Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.

d) Include complete catalog information such as construction, ratings, insulation systems, as applicable.

e) For any material specified to meet UL or trade standards, furnish the manufacturer's or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
f) Reference listings to the specifications' Sections and Article to which each is applicable.

g) Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and communication equipment room, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.

6) Contractor shall prepare coordinated drawings when required.

h. Interpretations: Requests for interpretations of drawings and specifications must be made by the Contractor through the Engineer. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.

i. Submit comprehensive material list, shop drawings and complete technical data on, but not limited to, for the following equipment and materials:

1) General Requirements:
   a) Switchboards, panelboards, generator, transfer switch, contactors, motor control centers, etc.
   b) Conductors, include selected insulation type.
   c) Wiring devices.
   d) Disconnect switches.
   e) Pullboxes and handholes.
   f) Standard lighting fixtures, specially fabricated fixtures, ballasts and lamps, with samples and sample of standard finish available (where requested).
   g) Control devices, standard and special receptacles, switches, plug strips and finish device plates, occupancy sensors.
   h) Cabinets for signal system, special terminals and cabinets.

j. Work Responsibilities:

1) The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply.

2) Locations shown on Engineerural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Engineer.

3) In the event changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost.
4) Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.

5) Lighting fixtures in mechanical spaces are shown in their approximate locations only. Do not install light outlets or fixtures until mechanical piping and ductwork are installed; then lights shall be installed in locations best suited for equipment arrangement as directed by the Engineer.

6) All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the equipment will fit into the spaces provided without violation of applicable Codes.

7) Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Engineer.

8) Be responsible for coordination of coordinated drawings.

9) Replace or repair, without additional compensation any new work which does not comply with these requirements.

k. Installation General:  For special requirements, refer to specific equipment under these requirements.

1) Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.

2) Locations of Openings:  Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Engineer. Furnish access panels as required.

3) Location of Sleeves:  Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.

4) Type of Sleeves:  Sleeves shall be steel pipe or galvanized sheet steel.

5) Finish Around Sleeves:  Rough edges shall be finished smooth. Space between conduit and sleeves where conduit passes through exterior walls shall be sealed to permit movement of conduit, but prevent entrance of water. Space between conduit and sleeves where conduit passes through fire rated interior walls and slabs shall be sealed with approved materials to provide a fire barrier conforming to the requirements of the governing authorities having jurisdiction, using UL Approved Firestopping Systems.

6) Wherever conduit extends through roof, install flashings in accordance with drawings and details.
7) Be responsible for cutting and patching which may be required for the proper installation of the electrical work.

8) Protect work, materials and equipment from weather and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.

9) Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior

10) Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.

11) Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.

12) Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish.

13) Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.

I. Trenching and Backfilling: All trenching and backfilling for electrical work shall be the responsibility of the contractor and shall be done in accordance with Section 115 “Underground Conduits for Airports”. The Contractor shall examine the drawings of all other sections to determine locations of all existing underground lines. The Contractor shall use extreme caution when working in the vicinity of these lines and shall be responsible for the proper and approved repair of any damage caused by his work.

m. Cutting and Patching:

1) Obtain written permission from the Engineer before core drilling or cutting any structural members. Exact method and location of conduit penetrations and/or openings in concrete walls, floors, or ceilings shall be as approved by the Engineer.

2) All core drilling, cutting and patching for this work shall be performed under this Section of the specifications. Use craftsmen skilled in their respective sections for cutting, fitting, repairing, patching of plaster and finishing of materials including carpentry work, metal work or concrete work required for this Work. Do not weaken walls, partitions or floor with cutting. Holes required to be cut in floors must be drilled without excessive breaking out around the holes. Patching and/or refinishing shall be determined by the Engineer.
3) Use care in piercing waterproofing. After the part piercing the waterproofing has been set in place, seal openings and make absolutely watertight.

4) Seal all openings to meet the fire rating of the particular wall floor or ceiling.

100-1.3 JOB CONDITIONS

a. Existing Conditions:

1) The contractor shall visit the site and verify existing conditions. Where existing conditions differ from the drawings, adjustment shall be made and allowances included for all necessary equipment to complete all parts of the drawings and specifications.

2) Electrical circuits affecting work shall be de-energized while working on or near them.

3) Arrange the work so that electrical power is available to all electrical equipment within existing facility at all times. Schedule all interruptions at the convenience of the Owner, including exact time and duration. Costs of all premium time (overtime) resulting from the scheduled power interruptions and all costs for providing temporary power shall be included in the cost of the Work.

b. Protection:

1) Protection of apparatus, materials and equipment. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment and installations from damage of any kind. The Engineer may reject any particular piece or pieces of material, apparatus or equipment scratched, dented or otherwise damaged.

2) Seal equipment or components exposed to the weather and make watertight and insect proof. Protect equipment outlets and conduit openings with temporary plugs or caps at all times that work is not in progress.

c. Sequencing and Scheduling:

1) Work lines and established heights shall be in strict accordance with the drawings and specifications insofar as these drawings and specifications extend. Verify all dimensions shown and establish all elevations and detailed dimensions not shown.

2) Layout and coordinate all work well enough in advance to avoid conflicts or interferences with other work in progress so that in case of interference the electrical layout may be altered to suit the conditions, prior to the installation of any work and without additional cost to the Owner.

Conflicts arising from lack of coordination shall be this Contractor's responsibility. Maintain all code required clearances about electrical equipment. Unless specifically noted otherwise, establish the exact location of electrical equipment based on the actual dimensions of equipment furnished.

d. Cleaning Up:
1) Upon completion of the work and at various times during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.

2) Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.

3) Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.

4) Leave the entire installation in a clean condition.

100-1.4 WORK IN COOPERATION WITH OTHER SECTIONS

a. Examine the drawings and specifications and determine the work to be performed by the electrical, mechanical and other disciplines. Provide the type and amount of electrical materials and equipment necessary to place this work in proper operation, completely wired, tested and ready for use. This shall include all conduit, wire, motor starters, disconnects, relays, time clocks and other devices for the required operation sequence of all electrical, mechanical and other systems or equipment. Where a conflict occurs on drawings, the most stringent shall apply.

b. Provide conduit and wire for all controls and other devices, both line and low voltage, described in this or other parts of the contract documents. Install all control housings and backboxes required for installing conduit and wire to the controls.

c. Install control wiring in separate conduit between each heating, ventilating and air conditioning sensing device and its control panel and/or control motor. Before installing any conduit for heating, ventilating and air conditioning control wiring, verify from the control manufacturer's shop drawings where these separate conduit runs are required.

d. Plan all work so that it proceeds with a minimum of interference with other sections. Inform all parties concerned of openings required for equipment or conduit required in the building construction for Electrical Work and provide all special frames, sleeves and anchor bolts as required. Coordinate the electrical work with the mechanical installation. Promptly report to the Engineer any delay or difficulties encountered in the installation of this work which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of other sections. Failure to so report shall constitute an acceptance of the work of other sections as being fit and proper for the execution of this work.

100-1.5 ELECTRICAL ACCEPTANCE TESTS

a. This standard covers the suggested field tests and inspections that are available to assess the suitability for initial energizing of electrical power distribution equipment and systems.
b. The purpose of these specifications is to assure that all tested electrical equipment and systems are operational and within applicable standards and manufacturer’s tolerances and that the equipment and systems are installed in accordance with design specifications.

c. The work specified in these specifications may involve hazardous voltages, materials, operations, and equipment. These specifications do not purport to address all of the safety problems associated with their use. It is the responsibility of the user to review all applicable regulatory limitations prior to the use of these specifications.

d. All inspections and field tests shall be in accordance with the latest edition of the following codes, standards, and specifications except as provided otherwise herein.

1) American National Standards Institute – ANSI
2) American Society for Testing and Materials – ASTM
   a) ASTM D 92-90. Test Method for Flash and Fire Points by Cleveland Open Cup
   b) ASTM D 445-88. Test Method for Kinematic Viscosity of Transparent and Opaque Liquids
   c) ASTM D 664-95 Test Method for Acid Number of Petroleum Products by Potentiometric Titration
   d) ASTM D 877-87. Test Method for Dielectric Breakdown Voltage of Insulating Liquids using Disk Electrodes
   e) ASTM D 923-91. Test Method for Sampling Electrical Insulating Liquids
   f) ASTM D 924-98 (1990). Test Method for A-C Loss Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids
   g) ASTM D 971-91. Test Method for Interfacial Tension of Oil against Water by the Ring Method
   h) ASTM D 974-95. Test Method for Acid and Base Number by Color-Indicator Titration
   l) ASTM D 1533-88. Test Methods for Water in Insulating Liquids (Karl Fischer Reaction Method)
n) ASTM D 2029-92. Test Methods for Water Vapor Content of Electrical Insulating cases by Measurement of Dew Point

o) ASTM D 2129-90. Test Method for Color of Chlorinated Aromatic Hydrocarbons (Askarels)

p) ASTM D 2284-95. Test Method of Acidity of Sulfur Hexafluoride


r) ASTM D 2477-84 (R1990). Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Insulating Gases at Commercial Power Frequencies

s) ASTM D 2685-95. Test Method for Air and Carbon Tetrafluoride in Sulfur Hexafluoride by Gas Chromatography

t) ASTM D 2759-94. Method for Sampling Gas from a Transformer under Positive Pressure

u) ASTM D 3284-90a (R1994). Test Method for combustible Gases in Electrical Apparatus in the Field

v) ASTM D 3612-95. Test Method of Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography

w) ASTM D 3613-92. Methods of Sampling Electrical Insulating Oils for Gas Analysis and Determination of Water Content

3) Association of Edison Illuminating Companies – AEIC

4) Canadian Standards Association – CSA

5) Institute of Electrical and Electronic Engineers – IEEE


b) ANSI/IEEE C37-1995, Guides and Standards for Circuit Breakers, Switchgear, Relays, Substations, and Fuses

c) ANSI/IEEE C57-1995, Distribution, Power, and Regulating Transformers

d) ANSI/IEEE C62-1995, Surge Protection


f) ANSI/IEEE Std. 48-1996. Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV

g) IEEE Std. 81-1983. IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part I)

j) IEEE Std. 100-1996. The IEEE Standard Dictionary of Electrical and Electronics Terms


t) ANSI/IEEE Std. 450-1995 IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications


aa) ANSI/IEEE Std. 1159-1995 – Recommended Practice for Monitoring Electric Power Quality


6) Insulated Cable Engineers Association – ICEA

7) InterNational Electrical Testing Association – NETA
   a) NETA MTS-97. NETA Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems

8) National Electrical Manufacturer’s Association – NEMA
   b) NEMA Publication MG1-1993. Motors and Generators

9) National Fire Protection Association – NFPA
   b) ANSI/NFPA 70B-1994. Recommended Practice for Electric Equipment Maintenance
   c) ANSI/NFPA 70E-1995. Electrical Safety Requirements for Employee Workplaces
   g) ANSI/NFPA 780-1995. Installation of Lightning Protection Systems

10) Occupational Safety and Health Administration – OSHA

11) Scaffold Industry Association – SIA
    a) ANSI/SIA A92.2-1990. Vehicle Mounted Elevating and Rotating Aerial Devices

12) State and local codes and ordinances

13) Underwriters Laboratories, Inc. – UL


f. The testing organization shall submit appropriate documentation to demonstrate that it satisfactorily complies with the following. An organization having a “Full Membership”
classification issued by the InterNational Electrical Testing Association meets this criteria.

1) The testing organization shall be an independent, third party, testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing organization.

2) The testing organization shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

g. The testing organization shall utilize technicians who are regularly employed for testing services.

h. Each on-site crew leader shall hold a current registered certification in electrical testing applicable to each type of apparatus to be inspected or tested.

The certification in electrical testing shall be issued by an independent, nationally-recognized, technician certification agency. The following entities shall qualify as independent, nationally-recognized, technician certification agencies:

1) InterNational Electrical Testing Association (NETA) Accepted certifications:
   Certified Technician/Level III
   Certified Senior Technician/Level IV

2) National Institute of Certification in Engineering Technologies (NICET) Accepted certifications specifically in Electrical Testing Engineering Technology:
   Engineering Technician/Level III
   Senior Engineering Technician/Level IV

i. The Owner’s Representative (Airports Development Group, ADG) shall provide the testing organization with the following:
   1) A short-circuit analysis, equipment evaluation study, and a protective device coordination study.
   2) A complete set of electrical plans and specifications along with any pertinent change orders.
   3) An itemized description of equipment to be inspected and tested.
   4) A determination of who shall provide a suitable and stable source of electrical power to each test site.
   5) Notification of when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

j. The installing contractor or testing firm shall perform certain preliminary low-voltage insulation-resistance, continuity, and/or rotation tests prior to and in addition to tests specified herein.
k. The testing organization shall provide the following:

1) All field technical services, tooling, equipment, instrumentation, and technical supervision to perform such tests and inspections.

2) Specific power requirements for test equipment.

3) Notification to the owner’s representative prior to commencement of any testing.

4) A timely notification of any system, material, or workmanship which is found deficient on the basis of acceptance tests.

5) A written record of all tests and a final report.

l. Safety and Precautions: This document does not include any procedures, including specific safety procedures. It is recognized that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Inherent in this determination is the prerequisite that individuals performing these tests be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved.

1) Safety practices shall include, but are not limited to, the following requirements:

   a) Occupational Safety and Health Act.


   c) Applicable state and local safety operating procedures.

   d) Owner’s safety practices.

   e) ANSI/NFPA 70E, Electrical Safety Requirements for Employee Workplaces

2) All tests shall be performed with apparatus de-energized except where otherwise specifically required.

3) The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

m. Suitability of Test Equipment:

1) All test equipment shall be in good mechanical and electrical condition.

2) Split-core current transformers and clamp-on or tong-type ammeters require consideration of the following in regard to accuracy:

   a) Position of the conductor within the core

   b) Clean, tight fit of the core pole faces

   c) Presence of external magnetic fields

   d) Accuracy of the current transformer ratio in addition to the accuracy of the secondary meter.

3) Selection of metering equipment shall be based on a knowledge of the waveform of the variable being measured. Digital multimeters may be average or RMS sensing
and may include or exclude the dc component. When the variable contains harmonics or dc offset and, in general, any deviation from a pure sine wave, average sensing, RMS scaled meters may be misleading.

4) Field test metering used to check power system meter calibration must have accuracy higher than that of the instrument being checked.

5) Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of two percent of the scale used.

6) Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

n. Test Instrument Calibration:

1) The testing firm shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2) The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

3) Instruments shall be calibrated in accordance with the following frequency schedule:
   a) Field instruments: Analog, 6 months maximum; Digital, 12 months maximum.
   b) Laboratory instruments: 12 months.
   c) Leased specialty equipment: 12 months where accuracy is guaranteed by lessor.

4) Dated calibration labels shall be visible on all test equipment.

5) Records, which show date and results of instruments calibrated or tested, shall be kept up-to-date.

6) Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.

7) Calibrating standard shall be of higher accuracy than that of the instrument tested.

o. Test Report:

1) The test report shall include the following:
   a) Summary of project.
   b) Description of equipment tested.
   c) Description of test.
   d) Test data.
   e) Analysis and recommendations.

2) Test data records shall include the following minimum requirements:
   a) Identification of the testing organization.
   b) Equipment identification.
c) Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.

d) Date of inspections, tests, maintenance, and/or calibrations.

e) Identification of the testing technician.

f) Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

g) Indication of expected results when calibrations are to be performed.

h) Indication of “as-found” and “as-left” results.

i) Sufficient spaces to allow all results and comments to be indicated.

3) The testing firm shall furnish a copy or copies of the complete report to the owner as required in the acceptance contract.

p) Short-Circuit and Coordination Studies:

1) Owner’s Representative Scope of Services: Provide a current and complete short-circuit study, equipment-interrupting or withstand evaluation, and a protective-device coordination study for the electrical distribution system. The studies shall reflect the complete electrical system design for the new Bradley West Terminal and tie-ins to existing Bradley core/concourse systems to remain. Temporary installations utilized for various phases of demolition shall be omitted from the analysis. Include within the studies all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum-fault conditions shall be thoroughly covered in the study.

2) Short-Circuit Study:

a) The study shall be in accordance with applicable ANSI and IEEE standards.

b) The study input data shall include the utility company’s short-circuit single- and three-phase contribution, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and all other applicable circuit parameters.

c) Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.

3) Equipment Evaluation Study: An equipment evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the maximum short-circuit momentary and interrupting duties. The evaluation study should be submitted prior to final approval of equipment submittals.

4) Protective-Device Coordination Study
a) A protective-device coordination study shall be performed to select or to verify the selection of power fuse ratings, protective-relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and settings.

b) The coordination study shall include all voltage classes of equipment from the utility’s incoming line protective device down to and including each motor control center and/or panelboard. The phase and ground overcurrent protection shall be included as well as settings for all other adjustable protective devices.

c) Coordination shall be in accordance with requirements of the National Electrical Code and the recommendations of ANSI/IEEE Standard 399, as applicable.

d) Protective device selection and settings shall be in accordance with requirements of the National Electrical Code and the recommendations of ANSI/IEEE Standard 399, as applicable.

5) Study Report:

a) Discrepancies, problem areas, or inadequacies shall be promptly brought to the owner’s attention.

b) The results of the power-system studies shall be summarized in a final report.

c) The report shall include the following sections:

   (1) Description, purpose, basis, and scope of the study and a single-line diagram of the portion of the power system which is included within the scope of study.

   (2) Tabulations of circuit breaker, fuse, and other equipment ratings versus calculated short-circuit duties and commentary regarding same.

   (3) Protective device coordination curves, with commentary.

   (4) The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system.

   (5) Fault-current tabulations including a definition of terms and a guide for interpretation.

6) Implementation: The Owner’s Representative shall engage an independent testing organization for the purpose of inspecting, setting, testing, and calibrating the protective relays, circuit breakers, fuses, and other applicable devices as recommended in the power-system study report.

q. Visual and Mechanical Inspection:

1) Inspect physical, electrical, and mechanical condition.
2) Remove all necessary covers prior to thermographic inspection. Utilize appropriate caution, safety devices, and personal protective equipment.

r. Equipment to be inspected shall include all current-carrying devices.
s. Provide report including the following:
   1) Description of equipment to be tested.
   2) Discrepancies.
   3) Temperature difference between the area of concern and the reference area.
   4) Probable cause of temperature difference.
   5) Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
   6) Identify load conditions at time of inspection.
   7) Provide photographs and/or thermograms of the deficient area.
   8) Recommended action.

100-1.6 FINAL INSPECTION AND ACCEPTANCE
a. After all requirements of the specifications and/or the drawings have been fully completed, representatives of the Owner will inspect the Work. The Contractor shall provide competent personnel to demonstrate the operation of any item of system, to the full satisfaction of each representative.

   The Contractor shall provide 4 hours of minimum scheduled operation and maintenance training for school maintenance staff on each system indicated above. See specific sections for additional training/operation hours required for school personnel.

b. Final acceptance of the work will be made by the Owner after receipt of approval and recommendation of acceptance from each representative.

c. The Contractor shall furnish Record Drawings before final payment of retention.

100-1.7 DEFINITIONS
The following definitions apply to terms used in these standards.

a. The words “work” or “electrical work” include products, labor, equipment, tools, appliances, transportation, and all related items directly or indirectly required to complete the specified and indicated electrical installation.

b. The word “concealed” shall mean that the installation will not be visible when all permanent or removable elements of the construction are in place. The word “exposed” shall mean that the installation is visible when all permanent or removable elements of the construction are in place.
c. The word “code” shall mean any and all regulations and requirements of regulatory bodies, public and private, having jurisdiction over the work involved.

d. The word “product” means all material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated electrical work.

e. The words “standard product” shall mean a manufactured product; illustrated and/or described in catalogs or brochures that is in general distribution prior to the date of issue of construction documents. Products will generally be identified by means of a specific catalog number and manufacturer’s name.

f. “Provide” means furnish, install, connect and test unless otherwise noted.

g. The words “conduit” and “duct” are used interchangeably, and have the same meaning.

100-1.8 SUBMITTALS.
The Contractor shall submit material specification for the items listed in Section 100 in accordance with Section PR-6, Submittal Procedures.

100-2 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.
No separate measurement or payment for Basic Electrical Requirements will be made. The cost associated with this work shall be applied to the associated bid items for the project.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 100
SECTION 101 – GROUNDING AND BONDING

101-1.1 GENERAL
a. This Specification provides general electrical requirements. Refer to the specific equipment specifications for FAA NAVAID, LADWP Relocation, or RWSL Contract Work requirements. The individual specific equipment specifications shall take precedence over the general requirements here in.

101-1.2 DESCRIPTION OF WORK
a. Grounding electrodes and conductors.
b. Equipment grounding conductors.
c. Bonding.

101-1.3 REFERENCES
b. UL 467 – Grounding and Bonding Equipment.

101-1.4 GROUNDING ELECTRODE SYSTEM
a. Metal underground water pipe.
b. Metal frame of the building.
c. Rod electrode.
d. Telecommunications Grounding Busbar.

101-1.5 PERFORMANCE REQUIREMENTS
b. Product Data: Provide data for grounding electrodes and connections.
c. Test Reports: Indicate overall resistance to ground and resistance of each electrode and system.
d. Manufacturer’s Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.
e. Provide equipment grounding connections to all new electrical devices including new switchboards, panelboards, transformers and any current carrying equipment.

101-1.6 PROJECT RECORD DOCUMENTS
a. Accurately record actual locations of grounding electrodes.

101-1.7 QUALIFICATIONS
a. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.

101-1.8 REGULATORY REQUIREMENTS
a. Conform to requirements of ANSI/NFPA 70.
b. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.
101-1.9 INSPECTION AND TESTING
a. Visual and Mechanical Inspection: Verify ground system is in compliance with drawings and specifications.

b. Electrical Tests
   1) Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the main grounding electrode or system.
   2) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

c. Test Values
   1) The resistance between the main grounding electrode and ground should be no greater than five ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner. (Reference: ANSI/IEEE Standard 142.)
   2) Investigate point-to-point resistance values which exceed 5 ohm.

101-1.10 PRODUCTS

101-1.11 ROD ELECTRODE
a. Material: Copper-clad steel.


c. Length: 10 feet.

101-1.12 CONNECTIONS
a. Direct Buried/Concrete Encased: Exothermic Welds

b. Within an Enclosure/Above Grade: Mechanical – Bronze or copper.

101-1.13 WIRE

b. Foundation Electrodes: 4/0 AWG.

c. Grounding Electrode Conductor: Size per drawing and to meet NFPA 70 requirements.

d. Equipment grounding conductor: Size conductors per drawings and based on NEC Table 250.122.

101-1.14 EXECUTION

101-1.15 EXAMINATION
a. Verify that final backfill and compaction has been completed before driving rod electrodes.

101-1.16 INSTALLATION
a. Install Products in accordance with manufacturer’s instructions.

b. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
c. Provide bonding to meet Regulatory Requirements.

d. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

e. Raceway Systems: Install metallic raceways mechanically and electrically secure at all joints and at all boxes, cabinets, fittings and equipment. At the point of electrical service entrance, bond all metallic raceways together with a ground conductor and connect to the system ground bus. Bond all boxes for equipment. Run ground conductor in all conduit runs.

f. Receptacles: Permanently connect the ground terminal on each receptacle to the green ground conductor.

g. Motors: Connect the ground conductor to the conduit with an approved grounding bushing and to the metal frame with a bolted solderless lug. Bolts, screws, and washers shall be bronze or cadmium plated steel.

h. Ductwork: Provide a flexible ground strap, No. 6 AWG equivalent, at each flexible duct connection at each air handler, exhaust fan, and supply fan, and install to preclude vibration.

i. Telecommunications, and Television Systems:
   1) Install a telecommunications grounding busbar in every room or space where an equipment cabinet is placed as part of this project.
   2) Weld a grounding clamp to the nearest structural building steel.
   3) Install a 1/2” conduit from the busbar to the grounding clamp.
   4) Install a minimum 6 AWG, stranded, copper, green, insulated conductor from the clamp to the telecommunications grounding busbar.
   5) Install a copper busbar of a minimum 2 inches x 10 inches x ¼ inch with a minimum of eight (8) wire connection lugs attached to it. Insulate the busbar from its support.
   6) Install a 1/2” conduit from the busbar to the equipment cabinet.
   7) Install a minimum 6 AWG, stranded, copper, green, insulated conductor from the telecommunications grounding busbar to the equipment cabinet’s grounding busbar. Connect the busbars of adjacent cabinets with a minimum 6 AWG, stranded, copper, green, insulated conductor.
   8) Acceptable Products: B-Line #SB-477-K Busbar or approved equal.

101-1.17 FIELD QUALITY CONTROL

1) Inspect grounding and bonding system conductors and connections for tightness and proper installation.
2) Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

101-2 SUBMITTALS. The Contractor shall submit material specification for the items listed in Section 101 in accordance with Section PR-6, Submittal Procedures.

101-3 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

No separate measurement or payment for Grounding and Bonding will be made. The cost associated with this work shall be applied to the associated bid items for the project.
No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.
SECTION 102 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

102-1  GENERAL
a. This Specification provides general electrical requirements. Refer to the specific equipment specifications for FAA NAVAID, LADWP Relocation, or RWSL Contract Work requirements. The individual specific equipment specifications shall take precedence over the general requirements here in.

102-1.2 SUMMARY
a. This Section includes the following:
   1) Wires and cables rated 600 V and less.
   2) Connectors, splices, and terminations rated 600 V and less.
   3) Sleeves and sleeve seals for cables.

102-1.3 QUALITY ASSURANCE
a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
b. Comply with NFPA 70.

102-2  PRODUCTS

102-2.1 CONDUCTORS AND CABLES
a. Copper Conductors: Comply with NEMA WC 70.
b. Conductor Insulation: Comply with NEMA WC 70 for Types USE, THW, THHN-THWN and XHHW.
c. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC, metal-clad cable, Type MI, nonmetallic-sheathed cable, Type NM with ground wire.

102-2.2 CONNECTORS AND SPLICES
a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) AFC Cable Systems, Inc.
   2) Hubbell Power Systems, Inc.
   3) O-Z/Gedney; EGS Electrical Group LLC.
   4) 3M; Electrical Products Division.
   5) Tyco Electronics Corp.
c. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
102-2.3 SLEEVES FOR CABLES
   a. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
   b. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

102-2.4 SLEEVE SEALS
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   c. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
      1) Advance Products & Systems, Inc.
      2) Calpico, Inc.
      3) Metraflex Co.
      4) Pipeline Seal and Insulator, Inc.
   d. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
      1) Sealing Elements: EPDM, NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
      2) Pressure Plates: Plastic, Carbon steel. Include two for each sealing element.
      3) Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

102-3 EXECUTION

102-3.1 CONDUCTOR MATERIAL APPLICATIONS
   a. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
   b. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

102-3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
   a. Service Entrance: Type USE or Type XHHW, single conductors in raceway.
   b. Exposed Feeders: Not used.
   c. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW single conductors in raceway.
102-3.3 INSTALLATION OF CONDUCTORS AND CABLES
   a. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
   b. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
   c. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
   d. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
   e. Support cables according to Section 104 "Hangers and Supports for Electrical Systems."
   f. Identify and color-code conductors and cables according to Section 105 "Electrical Identification."
   g. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
   h. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
      1) Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
   i. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches.

102-3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS
   a. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
   b. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
   c. Cut sleeves to length for mounting flush with both wall surfaces.
   d. Extend sleeves installed in floors 2 inches above finished floor level.
   e. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
   f. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
   g. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.
   h. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
   i. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
j. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

102-3.5 SLEEVE-SEAL INSTALLATION
a. Install to seal underground exterior-wall penetrations.

b. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

102-3.6 FIELD QUALITY CONTROL
a. Perform tests and inspections and prepare test reports.

b. Tests and Inspections:
   1) After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
   2) Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   3) Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
      a) Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
      b) Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      c) Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

c. Test Reports: Prepare a written report to record the following:
   1) Test procedures used.
   2) Test results that comply with requirements.
   3) Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

d. Remove and replace malfunctioning units and retest as specified above.

102-4 SUBMITTALS. The Contractor shall submit material specification for the following items listed in Section 102 in accordance with Section PR-6, Submittal Procedures:
a. Product Data: For each type of product indicated.
b. Field quality-control test reports.
102-5 MEASUREMENT AND PAYMENT

102-5.1 MEASUREMENT AND PAYMENT
No separate measurement or payment for Low-Voltage Electrical Power Conductors and Cables will be made as part of this section. The cost associated with this work shall be applied to the associated bid items for the project.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 102
SECTION 103 – EQUIPMENT WIRING SYSTEMS

103-1 GENERAL

a. This Specification provides general electrical requirements. Refer to the specific equipment specifications for FAA NAVAID, LADWP Relocation, or RWSL Contract Work requirements. The individual specific equipment specifications shall take precedence over the general requirements here in.

103-1.2 DESCRIPTION OF WORK

a. Electrical connections to equipment specified under other sections.

103-1.3 REFERENCES

a. NEMA WD 1 - General Purpose Wiring Devices.
b. NEMA WD 6 - Wiring Device Configurations.
c. ANSI/NFPA 70 - National Electrical Code.

103-1.4 REGULATORY REQUIREMENTS

a. Conform to requirements of ANSI/NFPA 70.
b. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

103-1.5 COORDINATION

a. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
b. Determine connection locations and requirements.
c. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
d. Sequence electrical connections to coordinate with start-up schedule for equipment.

103-2 PRODUCTS

103-2.1 CORDS AND CAPS

a. Manufacturers:
   1) Hubbell
   2) General Electric
   3) Leviton
b. Attachment Plug Construction: Conform to NEMA WD 1.
c. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

d. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

e. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

103-3 EXECUTION

103-3.1 EXAMINATION

a. Verify that equipment is ready for electrical connection, wiring, and energization.

103-3.2 ELECTRICAL CONNECTIONS

a. Make electrical connections in accordance with equipment manufacturer's instructions.

b. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.

c. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

d. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

e. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

f. Install disconnect switches, controllers, control stations, and control devices as indicated.

g. Modify equipment control wiring with terminal block jumpers as indicated.

h. Provide interconnecting conduit and wiring between devices and equipment where indicated.

103-4 SUBMITTALS. The Contractor shall submit material specification for the following items listed in Section 103 in accordance with Section PR-6, Submittal Procedures:

a. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

b. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
103-5   METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

No separate measurement or payment for Equipment Wiring Systems will be made. The cost associated with this work shall be applied to the associated bid items for the project.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 103
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SECTION 104 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

104-1 GENERAL
a. This Specification provides general electrical requirements. Refer to the specific equipment specifications for FAA NAVAID, LADWP Relocation, or RWSL Contract Work requirements. The individual specific equipment specifications shall take precedence over the general requirements here in.

104-1.2 SUMMARY
a. This Section includes the following:
   1) Hangers and supports for electrical equipment and systems.
   2) Construction requirements for concrete bases.

104-1.3 DEFINITIONS
a. EMT: Electrical metallic tubing.
   b. IMC: Intermediate metal conduit.
   c. RMC: Rigid metal conduit.

104-1.4 PERFORMANCE REQUIREMENTS
a. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, licensed in California, using performance requirements and design criteria indicated.
   b. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
   c. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   d. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

104-1.5 QUALITY ASSURANCE
   b. Comply with NFPA 70.

104-1.6 COORDINATION
a. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 90 – Structural Concrete.

104-2 PRODUCTS

104-2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
a. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a) Allied Tube & Conduit.
   b) Cooper B-Line, Inc.; a division of Cooper Industries.
   c) ERICO International Corporation.
   d) GS Metals Corp.
   e) Thomas & Betts Corporation.
   f) Unistrut; Tyco International, Ltd.
   g) Wesanco, Inc.

2) Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3) Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4) Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5) Channel Dimensions: Selected for applicable load criteria.

b. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a) Allied Tube & Conduit.
   b) Cooper B-Line, Inc.; a division of Cooper Industries.
   c) Fabco Plastics Wholesale Limited.
   d) Seasafe, Inc.

2) Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3) Fitting and Accessory Materials: Same as channels and angles.

4) Rated Strength: Selected to suit applicable load criteria.

c. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

d. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

e. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
f. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

g. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1) General: All anchors and fasteners shall be prequalified and installed in manner that has been tested and approved for such an application per a Los Angeles Research Report, and per the Los Angeles Building Code. Contractor shall maintain copies of L.A. Research Reports for each such fastener and product at the job site.

2) Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

3) Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

4) Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

5) Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

6) Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

7) Toggle Bolts: All-steel springhead type.


104-2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES
a. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

104-3 EXECUTION

104-3.1 APPLICATION
a. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

b. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

c. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1) Secure raceways and cables to these supports with two-bolt conduit clamps.

d. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
104-3.2 SUPPORT INSTALLATION
   a. Comply with NECA 1 and NECA 101 for installation requirements except as specified in
      this Article.
   b. Raceway Support Methods: In addition to methods described in NECA 1, RMC may be
      supported by openings through structure members, as permitted in NFPA 70.
   c. Strength of Support Assemblies: Where not indicated, select sizes of components so
      strength will be adequate to carry present and future static loads within specified loading
      limits. Minimum static design load used for strength determination shall be weight of
      supported components plus 200 lb.
   d. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and
      fasten electrical items and their supports to building structural elements by the following
      methods unless otherwise indicated by code:
         1) To Wood: Fasten with lag screws or through bolts.
         2) To New Concrete: Bolt to concrete inserts.
         3) To Masonry: Approved toggle-type bolts on hollow masonry units and expansion
            anchor fasteners on solid masonry units.
         4) To Existing Concrete: Expansion anchor fasteners.
         5) Instead of expansion anchors, powder-actuated driven threaded studs provided with
            lock washers and nuts may be used in existing standard-weight concrete 4 inches
            thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for
            slabs less than 4 inches thick.
         6) To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock
            washers and nuts.
         7) To Light Steel: Sheet metal screws.
         8) Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount
            cabinets, panelboards, disconnect switches, control enclosures, pull and junction
            boxes, transformers, and other devices on slotted-channel racks attached to
            substrate by means that meet seismic-restraint strength and anchorage
            requirements.
   e. Drill holes for expansion anchors in concrete at locations and to depths that avoid
      reinforcing bars.

104-3.3 INSTALLATION OF FABRICATED METAL SUPPORTS
   a. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and
      elevation to support and anchor electrical materials and equipment.
   b. Field Welding: Comply with AWS D1.1/D1.1M.

104-3.4 CONCRETE BASES
   a. Construct concrete bases of dimensions indicated but not less than 4 inches larger in
      both directions than supported unit, and so anchors will be a minimum of 10 bolt
      diameters from edge of the base.
b. Use 4000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 90, Structural Concrete.

c. Anchor equipment to concrete base.
   1) Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2) Install anchor bolts to elevations required for proper attachment to supported equipment.
   3) Install anchor bolts according to anchor-bolt manufacturer’s written instructions.

104-3.5 PAINTING
a. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1) Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

b. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

104-4 SUBMITTALS. The Contractor shall submit material specification for the following items listed in Section 104 in accordance with Section PR-6, Submittal Procedures.

a. Product Data: For the following:
   1) Steel slotted support systems.
   2) Nonmetallic slotted support systems.

b. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1) Trapeze hangers. Include Product Data for components.
   2) Steel slotted channel systems. Include Product Data for components.
   3) Nonmetallic slotted channel systems. Include Product Data for components.
   4) Equipment supports, anchorage, and fasteners.

c. Welding certificates.

104-5 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.
No separate measurement or payment for Hangars and Supports for Electrical Systems will be made. The cost associated with this work shall be applied to the associated bid items for the project.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 104
SECTION 105 – ELECTRICAL IDENTIFICATION

105-1.1 GENERAL
   a. This Specification provides general electrical requirements. Refer to the specific equipment specifications for FAA NAVAID, LADWP Relocation, or RWSL Contract Work requirements. The individual specific equipment specifications shall take precedence over the general requirements here in.

105-1.2 DESCRIPTION OF WORK
   a. Nameplates and labels.
   b. Wire and cable markers.

105-1.3 REFERENCES

105-1.4 REGULATORY REQUIREMENTS
   a. Conform to requirements of ANSI/NFPA 70.
   b. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

105-1.5 PRODUCTS

105-1.6 NAMEPLATES AND LABELS
   a. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
   b. Locations:
      1) Each electrical distribution and control equipment enclosure.
      2) Communication cabinets.
      3) Transformer.
   c. Letter Size:
      1) Use 1/8 inch letters for identifying individual equipment and loads.
      2) Use 1/4 inch letters for identifying grouped equipment and loads.
   d. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

105-1.7 WIRE MARKERS
   a. Description: Tape, split sleeve, or tubing type wire markers.
   b. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
   c. Legend:
      1) Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
2) Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

105-1.8 UNDERGROUND WARNING TAPE
a. Description: 6 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

105-1.9 EXECUTION

105-1.10 PREPARATION
a. Degrease and clean surfaces to receive nameplates and labels.

105-1.11 APPLICATION
a. Install nameplate and label parallel to equipment lines.
b. Secure nameplate to equipment front using screws, rivets, or adhesive.
c. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
d. Identify underground conduits using underground warning tape. Install one tape per trench at 6 inches below finished grade, unless otherwise noted on the plans.

105-1.12 WIRE IDENTIFICATION
a. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams of equipment manufacturer’s shop drawings for control wiring.

105-1.13 NAMEPLATE ENGRAVING
a. General: Provide nameplates to identify all circuits in the service distribution and power distribution panelboards; motor control centers; branch circuit panelboards; separately mounted starting switches; disconnecting switches; motor control push button stations; selector switches; transformers; terminal cabinets; telephone cabinets, etc. Clearly identify on the nameplate the equipment such as “Air Handling Unit AH-1” and “Hot Water Circ. Pump P-1” in lieu of abbreviated plan references such as “AH-1” or “P-1”.
b. Letter Height: Provide nameplates of minimum letter height as scheduled below:

1) Panelboards, Switchboards and Motor Control Centers: 1/4 inch; identify equipment designation, voltage rating, and source.
2) Individual Circuit Breakers, Switches, and Motor Starters In Panelboards, Switchboards, and Motor Control Centers: 1/8 inch; identify circuit and load served, including location.
3) Individual Circuit Breakers, Switches, and Motor Starters: 1/8 inch; identify voltage rating, ampere rating and load served including location.
4) Transformers: 1/4 inch; identify equipment designation. 1/8 inch; identify primary and secondary voltages, KVA rating, primary source, and secondary load and location.
5) HVAC and Plumbing Control Equipment: 1/8 inch; identify equipment designation and equipment served including location.

6) Communication Terminal Cabinets and Racks: 1/4 inch; identify cabinet or rack designation and type of system.

105-1.14 PANELBOARD DIRECTORIES
a. Panelboard directories shall be typewritten, arranged in numerical order, and shall show the number of the room in which each outlet served by each panelboard circuit is located. The room numbers used shall be verified and shall not necessarily be those used on the drawings. Directories shall be mounted in a 6 by 8 inch metal frame under glass or transparent plastic inside each panelboard door.

b. SUBMITTALS. The Contractor shall submit material specification for the following items listed in Section 105 in accordance with Section PR-6, Submittal Procedures.

c. Product Data: Provide catalog data for nameplates, labels, and markers.

d. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

105-1.15 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.
No separate measurement or payment for Electrical Identification will be made. The cost associated with this work shall be applied to the associated bid items for the project.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 105
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SECTION 110 – AIRFIELD ELECTRICAL WORK

110-1.1 GENERAL
The Contractor shall perform all work required by the plans and specifications for installation of airfield lighting and signage systems on runways, taxiways and aprons as shown on the Plans, and in accordance with these specifications. In addition, for topics relevant to the construction of airfield lighting systems but not addressed in Section 110, Sections 113 (Underground Cable for Airports) and 115 (Underground Conduits for Airports) of the Standard Specifications shall be applicable unless otherwise stipulated.

The Electrical work to be done under this contract shall include the furnishing of all supervision, labor, materials, tools, equipment and incidentals necessary to install, remove, and modify taxiway and runway lighting, taxiway and runway internally illuminated signage, electrical vault work, power supply, cabling, electrical conduit, ducts, manholes, pull boxes and all other electrical work shown on the drawings, as specified herein and in accordance with Federal Aviation Administration Advisory Circular No. 150/5370-10, latest edition, “Standards for specifying Construction of Airports,” other FAA Advisory Circulars and Specification referred to herein, the Standard Specifications for Public Works Construction as modified herein, and other requirements as specified herein.

The Electrical Contractor and the Job Superintendent shall be required to have at least 5 years of verifiable experience with installing and modifying airfield electrical systems in order to work on this project.

The Contractor shall obtain and pay for all electrical inspections and permits required. All electrical materials and workmanship shall conform to the requirements of the City of Los Angeles Electrical Code, Latest Edition.

All electrical equipment and assemblies shall conform to the provisions of the City of Los Angeles Electrical Code.

110-1.2 SUMMARY OF WORK
The work to be performed shall include furnishing all labor, supplies, materials, equipment, plant, transportation, and services required to augment, move, install, and complete electrical work as specified herein and as shown on the contract drawings.

This work includes but is not limited to the following:

a. Maintain, in operation, electrical facilities and circuits while this improvement work is in progress, including; furnish and maintain temporary circuits, and place temporary airport lighting into operation.

b. Remove miscellaneous airfield electrical items. Removal includes removal of base cans, isolation transformers, control devices, conduits, cables, connectors, fittings, foundations and appurtenances, where indicated.

c. Protect the existing airport vaults and control tower from any damage to the building, equipment, and wiring while adding or improving the existing equipment in accordance with the plans and/or specifications.
d. Maintain in operation all existing field electrical facilities and circuits while this improvement work is in progress, including protection of airport personnel, aircraft and vehicles; furnish and maintain temporary circuits, and place augmented airport lighting into operation. Field lighting on active runways and taxiways shall be operable each night, each day when fog conditions exist, or when the airport calls an emergency.

e. Furnish, install, test and tag underground cable (L-824) in accordance with specifications. Excavate and backfill trenches, place the cable in concrete encased duct bank, and testing all circuit loops in accordance with the testing procedures in contract documents, and all incidentals activities related to them.

f. Furnish and install signs at locations shown on the drawings, complete with filters for ALCMS, base can, isolation transformer, connectors, all hardware, cabling and associated conduits.

g. In new and existing pavement, furnish and install new elevated and in-pavement lights of various types, complete with base can, isolation transformer, connectors, all hardware, cabling, and associated conduit.

h. Install new base cans in new and existing pavement for future use.

i. Install new blank steel covers on existing base cans that are to remain in place after the removal of the light fixtures.

j. Furnish and install new pullboxes and manholes in the appropriate locations shown on the drawings.

k. Provide temporary airfield lighting and power connections as required, to be used during construction.

l. Ground all equipment, enclosures, neutrals, and conduits installed under this contract, including grounding to light bases, and all incidentals.

m. Reconnect, re-tag and re-identify marking of the existing circuits to match revised airfield lighting circuitry.

110-1.3 INVESTIGATION OF UNKNOWN CABLES:

The areas of work under this contract have manholes and pull boxes, which contain existing cables, the functions of which are unknown. The cables are power, signal, lighting circuits, controls, fiber optics and other circuits. Some of the cables are spares, some cables are abandoned, some cables are active, but they are not identified in as-built drawings and other records.

As a part of this contract, the contractor shall investigate these cables and identify if they are operational, abandoned or spare. The cables shall be traced to its origin. All abandoned cables and spare cables shall be removed by the contractor. Cables that are active shall be tagged with their use and shall be reflected in the as-built drawings, from its source to the utilization point.

During the execution of the contract work, upon detection of unknown cables, the contractor shall notify the Engineer about the cables, schedule the detection and remedial work and furnish man-hour and material required to accomplish the task.
110-1.4 GUARANTEE AS REQUIRED BY THE PERFORMANCE AND MAINTENANCE BOND.

Other items required to complete the work shown on the plans. The omission of expressed reference to any parts necessary for or incidental to the complete installation shall not be construed as releasing the Contractor from furnishing such parts.

110-1.5 DEFECTIVE WORK

Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

110-1.6 RELATED SECTIONS

Section 27 – Construction Barricades, Fencing, Markers and Signs

Section 73 – Joint Sealing Filler (FAA P-605)

Section 113 – Underground Cable for Airports (FAA L-108)

Section 115 – Underground Conduit for Airports (FAA L-110)

Section 120 – Adhesive Compounds, Two-component for Sealing Wire and Lights in Pavement (FAA P-606)

Section 121 – Modifications to Existing Airport Lighting Control and Monitoring System

Section 125 – Installation of Runway Status Light System

Other Sections, Tests, Specifications, and Standards referenced herein.

110-1.7 LIMITED ACCESS / NIGHT CONSTRUCTION

See PR-1, Scope of Work and Phasing Summary, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

110-1.8 FAA-APPROVED EQUIPMENT

Before any electrical equipment is ordered, the Contractor shall furnish the Engineer a list of the equipment and materials he/she plans to incorporate into the work. Only airport lighting equipment that is listed on the latest edition of the FAA approved list (AC 150/5345-53C Addendum) shall be acceptable for use on this contract. All other equipment and materials covered by other referenced specifications shall be UL approved and subject to acceptance through manufacturer’s certification of compliance with the applicable specification. The Contractor shall furnish written proof of FAA approval on all equipment covered by FAA specifications.
The equipment list shall include the name of each item, the Federal Aviation Administration Specification Number, the manufacturer's name, the manufacturer's catalog number, and the size, type, and/or rating of each item.

After the list has been approved, the Contractor shall assemble the equipment and materials at a single location and request inspection by the Engineer. None of the equipment or materials may be used on the job until such an inspection has been completed.

All work shall be performed in strict accordance with these contract specifications, and project drawings and any instructions as may be furnished by the Engineer during execution of the work to aid in interpretation of said drawings, and specifications. Installation details and material and equipment specifications shall be in conformance with all applicable FAA Advisory Circulars.

110-1.9 SPECIFICATIONS AND STANDARDS
As a supplement to the installation requirements of this Section, the following standard specifications and regulations of the issues in effect on the date of the bid opening are incorporated herein by reference and are made a part hereof for electrical work.

* IMPORTANT NOTE: Current version for all references, including any changes *

FAA-STD-019E  Lighting Protection, Grounding, Bonding and Shielding Requirements for Facilities
FAA-C-1391B  Installation and Splicing of Underground Cables
FAA-C-1217F  Electrical Work, Interior
AC 150/5340-18  Standard for Airport Sign Systems
AC 150/5340-30  Design and Installation Details for Airport Visual Aids
AC 150/5345-1  Approved Airport Equipment
AC 150/5345-7  Specification for L-824, Underground Electrical Cables for Airport Lighting Circuits
AC 150/5345-26  Specification for L-823 Plug and Receptacle, Cable Connections
AC 150/5345-42  Specification for Light Base and Transformer Housings, Junction Boxes and Accessories
AC 150/5345-44  Specification for Runway and Taxiway Signs
AC 150/5345-46  Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47  Specifications for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-53  Airport Lighting Equipment Certification Program
NEC  National Electrical Code
City of Los Angeles  Building Safety Code (Electrical)
UL  Underwriters Laboratories

110-1.10 SHOP DRAWINGS AND MATERIAL LISTS
Prior to the installation of any material and equipment and within 30 days of contract award, the CONTRACTOR shall submit to the ENGINEER for approval 6 copies of manufacturers'
brochures containing complete dimensional and performance characteristics, wiring diagrams, installation and operation instructions, etc., for the equipment listed in the L-Series Specification Items. CONTRACTOR will provide systems training to the ENGINEER’s appointed operation and maintenance staff member(s). A materials list shall be included with the submittal listing each Specifications paragraph number.

The submittal shall be complete and made in one submission in booklet form with hard-bound cover. Partial submissions will not be reviewed or considered.

Submittals shall be in accordance with above for the following equipment:

- a. Standing red barricade lights
- b. Installation tools and details
- c. L-867/868 base cans
- d. L-867/868 extension, shims, and spacers
- e. Permanent and temporary isolation transformers
- f. Base can cover plates, temporary and permanent
- g. Runway Centerline Lights
- h. In-pavement Runway Guard Lights
- i. Elevated Runway Guard Lights
- j. Taxiway Centerline Lights
- k. Taxiway Edge Lights
- l. Logitrac Devices for In-pavement Runway Guard Lights
- m. Airfield Guidance Signs
- n. Sign Filters (as needed)
- o. Light Fixture Locations vs. Pavement Joints.

**110-1.11 LIGHT FIXTURE LOCATIONS & PCC JOINT SUBMITTAL.** The Contractor shall provide a submittal in the form of a drawing indicating the proposed light locations and PCC pavement joints for review and acceptance to the Engineer. The Contractor shall indicate on the drawing light fixture conflicts with the proposed PCC pavement joints. The Engineer will review the layout and adjust light locations based on FAA allowable tolerances. If PCC joint conflicts remain after the incorporation of light spacing tolerances, the installation of the light fixture will
require a modified installation which will include a concrete ‘Box-out’ of the area surrounding the light fixture.

110-1.12. SUBMITTALS. The Contractor shall submit material specification for the items listed in this Specification Section in accordance with PR-6, Submittal Procedures.

110-1.13 MANUFACTURER QUALIFICATIONS. Manufacturers shall be approved as described in Article 125-2.1.

110-1.14 APPLICABLE DOCUMENTS

The publications listed above are incorporated herein by reference and form a part of this Item to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of this bid shall be applicable. In the text of this Item, such publications are referred to by basic designation only. Additional details and specifications pertaining to a specific system are contained in these documents and are to be considered as part of this Item. Perform all work in accordance with these documents except as specified herein. In the event of a conflict between the Plans and Specifications and the referenced documents, the more stringent rule shall be applied.

110-1.15 INSTALLATION SCHEDULING AND COORDINATION

a. There are significant task and task time constraints between paving-related work and electrical work:

b. Before any paving-related work (removal, milling, or paving) in a given area can proceed, all existing light locations must be surveyed, existing light units must be removed and the temporary covers installed.

c. Sufficient time must be scheduled after paving and prior to contract time completion to allow for the surveying back, coring, extension, shim, flange ring installation work, sealing, and light fixture reinstallation work.

d. The drawings and these specifications often indicate a construction sequence. In some cases, for various reasons, the sequence cannot be altered; but in other cases, altering the sequence may be possible and beneficial. Submittal of proposed alternates is encouraged; these shall be submitted to the Engineer for review and possible approval prior to making these sequence changes.

e. Based on the review of the light fixture locations and PCC joint layout submittal, as referenced in section 110-1.11, the Contractor shall layout by survey all new airfield lights and PCC paving joints on the base layer below stabilized base (asphalt or econcrete). LAWA will review layout, and reserves the right to make minor adjustments to light locations at no additional cost. Contractor shall permit adequate time for this layout and review. Light can and conduit installation shall not begin until layout is approved by LAWA. Any lights that are modified by LAWA shall be recorded in the Contractor’s as-built drawings.
110-1.16 PHASING

All existing runway and taxiway lights not included in the construction phasing must be kept in operation, except as permitted otherwise by the Engineer. Maintain FAA facilities unless noted otherwise.

The Contractor shall be responsible for troubleshooting and investigative work necessary to install completely operational temporary circuits. These shall be incidental to the other electrical work and no separate payment will be made.

The Contractor shall be responsible for installing, maintaining, and removing all required temporary light fixtures and jumper cables. The use of floodlights provided and maintained by the contractor is required for night work. Floodlights shall face away from tower.

Contractor shall coordinate with the Airport Operations and Maintenance at the end of each work shift to ensure that all required airfield lighting circuits are operational. Contractor shall provide all labor and material for this work.

Contractor shall provide and maintain on hand sufficient equipment required to provide temporary circuit extensions in addition to those shown on the plans. This includes, but is not limited to the following:

a. 1000 LF of two-inch RGS conduit.
b. 2000 LF #8 L-824 cable.
c. 100 L-823 connector kits.

These items will not be available from LAWA Maintenance.

110-1.17 INTERRUPTIONS AND TEMPORARY CIRCUITS

Interruptions of runway and taxiway lighting circuits may be necessary during construction. The Contractor may use salvaged cable to prepare a reliable jumper cable to provide temporary continuity of service to taxiway lights during construction where required. The Contractor shall not interrupt air traffic or perform any work that might endanger any airport operation until approval of the Director of Operations and the Airport’s Engineer has been received.

From the permanent installation, all temporary connections and re-routing of circuits shall be replaced with new materials installed in accordance with specifications and as shown on the plans.

NOTE: The Contractor shall use lock-out/tag-out procedures on all circuit cables from their respective power sources in the vault before working on the cables in the field in coordination with the Airport electrician and the FAA. This work is incidental to the electrical work and no separate payment will be made.

110-1.18 REMOVALS

The Contractor shall remove all existing cables, conduits, light fixtures, signs, sign foundations, isolation transformers, base cans, duct banks, duct bank markers, pull boxes, manholes, and accessories from the areas shown on the removal plans, and as directed by the Engineer.
Contractor shall exercise due care to remove existing light fixtures and transformers, and shall protect the light bases which are to remain free from damage and in good working order.

All light fixtures airfield signs and isolation transformers, power transformers which are not to be reinstalled, shall be delivered to the Airport Maintenance Yard at 7411 World Way West. Cables, conduits, ducts, and light bases removed shall be disposed of off Airport property. Lighting fixtures including base plates shall be cleaned of all epoxy sealing material, pavement, dirt, etc. by sandblasting if necessary prior to delivery to LAWA. Transformers shall be cleared loose of dirt prior to delivery. All debris shall be removed off Airport property.

110-1.19 MAINTENANCE DURING CONSTRUCTION

Contractor shall maintain all systems and equipment provided under contract from startup of system or equipment to Final Acceptance. The maintenance activity shall include the recommendation of the manufacturers for maintenance of systems and equipment.

110-1.20 CODES

The Contractor shall comply with all ordinances, laws, regulations, and codes applicable to the work involved. This does not relieve the Contractor from furnishing and installing work shown or specified which may be beyond the requirements of such ordinances, laws, regulations, and codes.

Regular inspections shall be requested by the Contractor as required by any and all regulations. All charges for the inspection called for by the regulating agencies of installation or plans and specifications shall be arranged and shall be paid by the Contractor.

110-1.21 MAINTENANCE AND OPERATING INSTRUCTIONS

The Contractor shall provide the Airport’s Engineer with complete instructions in the proper care and operation of the equipment installed under this contract. This is considered as part of the final inspection, and final acceptance will not be given until these instructions have been delivered.

110-1.22 MAINTENANCE AND OPERATING MANUAL

The Contractor shall collect and assemble ten (10) hardcover books containing the installation details, repair and operation instructions, schematics of actual equipment and operations, and directions supplied by the manufacturer with all equipment. Three copies of the draft maintenance and operating manuals shall be submitted to the Engineer for review and comments. Final acceptance of the work will be withheld until such data has been presented complete to the Engineer.

110-1.23 AS-BUILT DRAWINGS

The Contractor shall mark up one set of redline prints to show the as-built conditions, which differ from the original, including any existing utilities discovered during the course of the work. The Engineer will furnish a newly printed set of drawings for this purpose. As-builts shall be kept up daily and initialed off by Contractor and Engineers’ inspector weekly. There shall be
sufficient detail, including station numbers, conduits/duct bank routing, actual location of electrical equipment markers, panel circuit numbers, etc., to allow for easy location and correction of drawings. This work shall be completed and accepted by the Engineer before

110-1.24 SPARE PARTS FOR AIRFIELD LIGHTING AND SIGNAGE SYSTEM

The Contractor shall furnish 5% spare parts (unless otherwise noted) to LAWA C&M at the end of the constructions for Owner furnished or Contractor furnished material. The spare parts for the light fixtures, signs and obstructions lights as specified on lighting fixture schedule shall include but not limited to the following:

a. Lamps of all sizes and types.
b. Lamp holders/sockets of all sizes and types.
c. Gaskets, seals and O-rings for all light fixtures and signs.
d. Reflectors for all light fixtures.
e. Lens replacement kits for all light fixtures.
f. LED power supply units for light fixtures.
g. Heat sink assembly with LED for taxiway light fixtures.
h. Isolation transformers of all types and sizes.
i. Breakable couplings for elevated airfield light fixtures.
j. Contractor shall furnish 15% spare LED Runway Centerline Lights. This shall be in addition to the lamps, lenses, power supply, and heat sinks previously noted.

The Contractor shall submit a schedule of spare parts for airfield lighting to the Engineer for review and comment.

110-1.25 QUALITY ASSURANCES

a. Workmanship. Workmanship shall be consistent with the best commercial and NECA practices for installation of this type.

b. Materials. Materials and equipment shall be UL and/or FAA approved as specified herein. When material are used that are not specifically designate herein, they shall be in accordance with the best industry standards and practices for equipment of this type. All components and parts shall be suitable for operation under the environmental conditions specified herein. Metal parts shall be either inherently corrosion-resistant or shall be suitably protected to resist corrosion or oxidation during extended service life.

c. Parts Rating. All parts shall be of adequate rating for the application and shall not operate above the parts manufacturers recommended ratings.

d. Environmental Conditions. The equipment installed in vault and outdoors shall be designated for continuous outdoors operation under the following environmental conditions:

(1) Temperature: Any ambient temperature from minus 20°F to plus 120°F.
(2) Altitude: 800 Ft above MSL.

(3) Humidity: Up to 100 percent.

(4) Sand and Dust: Exposure to windblown sand and dust particles.

(5) Wind: Operation at wind velocities up to 200 miles per hour.

(6) Water: Components provided for underground installation, or installed in underground housing, shall be suitable for continuous operation submerged in water.

110-2.0 MATERIALS

110-2.1 TEMPORARY LIGHTING

The Temporary Lighting shall be installed at locations shown on the plans and in conformance with the details. The Temporary Lighting shall include all new equipment, light fixtures, spare lamps, conduit, electrical cans, cables splices, connections, lighting fixtures, isolation transformers, concrete weights, required cores and connections, and other appurtenances necessary to construct the Temporary Lighting. The Contractor shall assemble and install lighting elements as shown on the plans.

Installation and testing performed under this item shall be as specified in the applicable Advisory Circulars. Once the permanent lighting improvements are installed and accepted by the Engineer. Following completion of work, the Contractor shall remove the temporary lighting and signage and restore to existing or permanent conditions as shown in the drawings.

Temporary lighting components shall include but not limited to the following:

Obstruction Lights. Temporary obstruction lights shall be installed in accordance with the locations and details shown on the plans or as directed by the Engineer.

   a. Standing Red Barricade Lights. Standing red light barricades shall be installed in accordance with the locations and details shown on the plans or as directed by the Engineer. Electrical components shall be in accordance with the requirements of this Section. The Contractor shall coordinate with the Engineer prior to connection of existing airfield lighting circuitry to confirm exact circuit connection.

   b. Isolation Transformers. Isolation transformers shall conform to the requirements of permanent isolation transformers as listed in this Section and be sized by the manufacturer to supply power for the temporary lights.

   c. Light Base Plates, Couplings, and Accessories. All base plates, couplings, mounting bolts, columns, and other accessories required to complete the temporary lighting system as shown on the plans shall be provided by the Contractor.

   d. Conduit. Temporary conduit shall conform to the requirements listed in Section 115, Underground Conduit for Airports (FAA L-110).
e. **Power Cable.** Temporary power cable shall conform to the requirements listed in Section 113, Underground Cable for Airports (FAA L-108).

f. **Squeeze Connectors.** Squeeze connectors, shall be equal to Crouse-Hinds Company, Type CGB cable connector with neoprene rubber bushing, or equal approved.

g. **Temporary Light Can Cover Plates.** Temporary cover plates for base cans within runway or taxiway safety areas shall meet the requirements of permanent cover plates (blank covers). Temporary cover plates outside of the runway and taxiway safety areas shall be metallic and bolt directly to the base cans. Plywood covers shall not be used for temporary or permanent base can covers.

### 110-2.2 LIGHT BASES AND JUNCTION CANS

All required light bases and mounting hardware shall meet the requirements of FAA AC 150/5345-42, current version. Light bases and junction cans shall be:

a. **In-pavement Lights:** L-868B bases shall have 11.25-inch bolt circle, meeting the requirements of FAA AC 150/5345-42, current version. Provide base can with internal and external grounding lug per the details on the drawings. Base cans shall be furnished with flexible conduit connection openings (grommets) for the specified conduit sized and located on the drawings. Depth of base cans shall be as shown in the drawings.

b. **Edge Light, Junction Cans, and Sign Cans:** L-867 bases shall be, class 1, meeting the requirements of the FAA AC 150/5345-42, current version. Diameters for specific installations shall be as shown in the drawings. Provide base can with internal and external grounding lug per the details on the drawings. Base cans shall be furnished with flexible conduit connection openings (grommets) for the specified conduit sized and located on the plans. Depth of base cans shall be as shown in the drawings.

### 110-2.3 BLANK COVERS, EXTENSIONS, SPACER RINGS, SHIMS AND BASE PLATES

Blank cover, extensions, spacer rings and base plates shall meet the requirements of FAA AC 150/5345-42, current version. All items shall be sized to the base can being installed, adjusted, or modified. Base plates for temporary lights shall be sized to fit the can type and sized specified on the plans and be compatible with the fixture provided. Blank base can covers for new junction cans shall be steel, minimum ¾ inches thick, with traffic rating of 100,000 lbs. Temporary base can covers for installation during milling and paving shall be compatible with L-867 and L-868 base cans as indicated on the drawings.

### 110-2.4 RUNWAY AND TAXIWAY LIGHT FIXTURES

Runway and taxiway light fixtures shall meet the requirements of FAA AC 150/5345-46, current version and shall be of the type indicated on the drawings. All runway and taxiway light fixtures shall be from a signal manufacturer, and shall be as manufactured by Eaton/Crouse-Hines Airfield Lighting.
110-2.5 RUNWAY AND TAXIWAY LIGHT FIXTURE LAMPS

All runway and taxiway light fixture lamps shall be LED of size and type to provide the distributions and minimum output requirements of iso-candela curves shown for each size in AC 150/5345-46B.

110-2.6 ELEVATED AND INPAVEMENT RUNWAY GUARD LIGHT FIXTURES

Elevated and inpavement runway guard light fixtures shall meet the requirements of FAA AC 150/5345-46, current version and shall be of the type indicated on the drawings. All elevated and inpavement runway guard light fixtures shall be self-flashing and from a signal manufacturer, and shall be as manufactured by Eaton/Crouse-Hines Airfield Lighting.

110-2.7 ELEVATED AND INPAVEMENT RUNWAY GUARD LIGHT FIXTURE LAMPS

Elevated runway guard light fixture lamp shall be quartz and inpavement runway guard light fixture lamps shall be LED of size and type to provide the distributions and minimum output requirements of iso-candela curves shown for each size in AC 150/5345-46B.

110-2.8 PERMANENT OBSTRUCTION LIGHTS

Obstruction lights shall be L-810 fixtures meeting the requirements of AC 150/5345-43F and listed under FAA AC 150/5345-46, current version. Single and dual incandescent fixture shall be supplied as shown in the drawings. The center of the vertical beam spread must be between +4 and +20 degrees. With a minimum vertical beam spread of 10 degrees and at all radials throughout 360 degrees, there must be a minimum intensity of 32.5 candela. Mechanical interface for installation must be 3/4 National Pipe Thread (NPT) side and/or bottom. Obstruction lights shall operate on a 120V circuit.

110-2.9 ISOLATION TRANSFORMERS

Isolation transformers for light fixtures and signs shall conform to FAA Specification L-830, “Isolation Transformers for Airport Lighting Systems,” and shall be of the size (wattage and amperage) as required on the drawings.

110-2.10 OWNER FURNISHED CONSTANT CURRENT REGULATOR

a. Constant current regulators shall conform to FAA Advisory Circular 150/5345-10.

b. Constant Current Regulators shall be: Type L-828, Regulator, Class 1, 6.6 amperes or 20 amperes; Style 1, three brightness steps or five brightness steps. Constant Current Regulators shall be suitable for connection to a 480 volt, 1 phase, 60 Hertz supply. Constant Current Regulators shall be air-cooled ferroresonant dry type of the Kilowatt rating indicated on the Plans. SCR type regulators are not acceptable.

c. Provide integral multi step local control switch, ammeter, lightning and surge protection on input and output lines, open circuit protection and indication, over current protection and indication.
d. Constant Current Regulator minimum input power factor shall be 95 percent when measured on the highest intensity setting.

e. Constant Current Regulator minimum efficiency shall be 90 percent when measured on the highest intensity setting.

f. The regulators shall be suitable for remote control from a 120 volt control source and shall be capable of remote reset.

g. Provide with interface for the ALCMS from remote locations. Existing monitoring system is manufactured by Eaton/Crouse-Hinds Airport Lighting Products. CCR shall be provided with dry contacts for ‘local’ and ‘remote’ positions.

h. Provide and Install, or provide ready for installation, as specified, floor mounted regulators within the Airfield Lighting Vault at the locations indicated. If specified for installation, inter-connect equipment and devices to provide a complete installation.

i. Install and adjust in accordance with manufacturers’ requirements. Install all conductors in conduit.

j. Demonstrate the operation of all features of the system.

110-2.11 AIRFIELD GUIDANCE SIGNS

a. General.

Airfield guidance, location and runway distance remaining signs shall be as manufactured by “Lumacurve” to match existing airfield signs, or approved equal, and shall be furnished and installed in accordance with this specification and with the dimensions, locations, and details as shown on the plans. This work includes furnishing and installing filters, transformers, base cans, mounting assemblies, including base plate and mounting flanges and concrete footing. Also included are all cable connections, all lamps, testing of the installations, and all incidentals necessary to place these signs in operation as completed units.

b. Sign Construction.

1) Signs shall be constructed of light weight, nonferrous materials, and shall be designed for installation on a concrete pad foundation. All required mounting hardware, except anchor bolts, shall be supplied with the sign. Loose parts shall be tethered to, or otherwise prevented from blowing away from, the installed sign enclosure. All screws or latches shall be the captive type, and shall be easy to open and close.

2) Mounting legs for each sign shall have frangible points located 2 inches or less above the concrete pad foundation. The frangible points shall withstand wind loads due to jet blast of 300 mph, as simulated by an applied static load of 0.9 psi, but shall break before reaching an applied static load over the legend panel of 1.3 psi. Legend panels and panel supports shall withstand, at a minimum, the pressure at which the frangible points break. A production sample of two-module sign of proposed signs shall be tested using an inflatable air bag to verify conformance to the strength requirements herein and FAA AC 150/5345-44. There shall be no permanent deformation to the sign body or face as a result of the test. The strength tests shall be certified by the manufacturer.
3) Taxiway and runway guidance signs shall be of a modular design, which shall consist of three (3) lamps per sign module. Multiple module signs shall be equipped with a lamp bypass circuit which shall maintain a reduced illumination level upon failure of one lamp.

4) Signs shall have legends on one or both sides, as required by the Drawings. The sign face shall be curved – not flat - panel style.

5) The color of the sign enclosure shall be black. Reflective material shall be applied to the sides of the sign (and back if blank) such that the sign will be visible to vehicles during the hours of darkness.

6) The sign shall be completely sealed against sand and dust so that all internal surfaces will remain bright and clean. The lamp(s) shall be easily changeable, and ballast and all electrical control equipment shall be easily accessible in enclosures mounted to the exterior of the sign structure.

7) Each sign shall be supplied with a minimum of two tethers, with not less than two tethers per five sign legs. The tethers shall be installable such that each sign, when knocked down by a wind of greater than 300 mph, shall remain attached to the sign foundation. Tethers shall be 1/8" stainless steel aircraft cable and shall be secured to the sign enclosure and to a support leg base flange anchor bolt with lock nuts and large diameter washers.

c. Sign Electrical Features.

1) The signs shall be re-lampable without the use of tools. Loose parts shall be tethered to, or otherwise prevented from blowing away from, the installed sign enclosure. All screws and latches shall be the captive type.

2) Power input from the lighting circuit shall be made through an isolation transformer conforming to requirements of this section.

3) Power input leads shall be at least two feet in length and shall allow for lead termination in a Type 1, Class A, Style 9 receptacle conforming to AC 150/5345-26.

4) All new signs shall utilize LED lamps.

5) All signs shall be provided with externally mounted (on the unit) on/off power switch, which “off” position shall short the secondary of the transformer. The switch shall be “make before break” type.

6) All wiring shall conform to the requirements of NFPA 70. All wiring shall be color-coded and shall be clearly labeled. There shall be no exposed wiring, except for the power cord.

7) All electrical materials and equipment for which there is a nationally recognized standard shall bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories, Inc., Factory Mutual, or ETL.
110-2.12 SIGN PANELS FOR EXISTING SIGNS
Sign panels (faces) for installation in existing signs shall be as shown in the drawings. Each existing sign to receive a new sign panel shall be field measured by the Contractor to confirm panel size prior to ordering.

110-2.13 CONCRETE
Concrete for airfield lighting installations shall conform to the requirements of Section 90, Structural Portland Cement Concrete (FAA Item P-610).

110-2.14 BASE CAN SEALANT
Base can sealant shall be as follows:

   a. Section 73, Joint Sealing Filler (FAA P-605) for sealant to be used around flange rings and shims.
   b. See Section 120 - Adhesive Compounds, Two-component for Sealing Wire and Lights in Pavement (FAA P-606) for sealant to be used around extensions and base can top sections.
   c. Silicone Sealant for base can extensions and shims. Liquid gasket material placed between base cans, extensions, and shims shall be General Electric Co. RTV Silicone Rubber adhesive-sealant, or equal.

110-2.15 CONDUIT
Conduit for airfield lighting shall conform to the requirements of Section 115, Underground conduits for Airports (FAA Item L-110).

Where new conductors/cables are to be installed in an existing conduit, the Contractor shall remove the existing the cable, unless otherwise indicated in the Plans, clean the conduit with a cylindrical wire brush, and blow out the conduit with compressed air prior to installing the new cable.

110-2.16 HARDWARE
All bolts, nuts, washers and lock washers shall be stainless steel and meet FAA requirements. All bolts ¼ in and larger shall be hex head type. All bolts smaller than ¼ in trade sized shall be recessed Allen type. All bolted connection shall utilize and anti-rotational locking type device. The base can cover and fixture mounting bolts shall extend through the base can mounting flange into the base can a minimum of ½ inch. The bolts shall have enough thread length so they do not shoulder out before the fixture is securely tightened. All hardware shall be stainless steel 316.

The Contractor shall use anti-seize compound manufactured by Ideal: “Noalox”, or approved equal. Use Dow Corning Compound 111 valve lubricant, no curing sealant, or approved equal to seal between section of base cans, spacer rings, adapter rings, or fixtures.
110-2.17 ELECTRICAL TAPE
Electrical tape shall be as specified in Section 113, Underground Cable for Airports.

110-2.18 IDENTIFICATION NUMBER PLATES
The identification number plates for all elevated lights shall be non-corrosive metal disc of 2-inch minimum diameter, with numbers permanently stamped with steel dies or cut out, installed on the base plate of all elevated lights. The identification tag shall contain the ID/Circuit Number corresponding to the information shown on the drawings.

110-2.19 CABLE TAGS
Cable and equipment tags shall be as specified in Section 113, Underground Cable for Airports.

110-3.0 CONSTRUCTION METHODS AND TESTING REQUIREMENTS

110-3.1 GENERAL. The Contractor shall at all times keep the construction areas free from accumulations of waste material and rubbish, and prior to completion of work, remove any rubbish from and about the Work site, and all tools, reels, equipment, and materials, not a part of the Work. Upon completion of the construction, the Contractor shall leave the work and premises in a clean, neat and workmanlike condition satisfactory to the Engineer. The Contractor shall be responsible for the proper performance in all respects, in whole and in part, of the electrical equipment until acceptance of the entire Work by the Engineer.

The electrical construction and installation shall be complete, and the Contractor shall furnish all equipment necessary for the satisfactory installation and operation of electrical apparatus and for the operation of the electrical system as indicated, whether specifically mentioned or not. Materials shall bear the Underwriter Laboratories’ seal of approval.

110-3.2 The construction drawings, which constitute an integral part of this Contract, are diagrammatic in nature. They indicate the extent and general layout of the lighting system, arrangement of circuits, cables through ducts, connections to existing circuit cables and other work near the construction area. Field verification of scale dimensions is required to determine actual locations, distances, and levels. No extra compensation will be allowed because of differences between work shown on the drawings and as in the field. The Contractor shall check the plans and specifications and, if any portion of the work is found to be omitted, unclear, or in error, the Contractor shall immediately notify the Engineer. The directions of the Engineer shall be followed and the work completed accordingly.

The construction drawings may be utilized in the preparation of the as-built drawings showing the permanent construction as actually made.

The plans and specifications are complementary and what is called for in either one shall be as binding as if called for in both.

Where a disagreement exists between the plans and specifications, the item or arrangements of better quality, greater quantity, or higher cost shall be included in the base bid.
Any discrepancies between the drawing, Advisory Circulars, and field condition must be resolved with the Engineer before proceeding. All agreements shall be verified in writing.

The responsibility for the correct and satisfactory installation and operation of all materials and equipment required herein shall rest with the Contractor. Before any equipment is ordered or commencement of installation of the lighting installations and electrical systems, a complete schedule of materials and detailed shop drawings covering all items of equipment and brochures of the lighting fixtures and signs proposed for installation shall be submitted for approval by the Engineer. The schedule of materials and shop drawings shall initially include five sets of catalog cuts, diagrams, drawings, brochures, or other such descriptive data as may be required by the Engineer. No equipment shall be ordered or put into manufacture until these shop drawings or brochures have been approved by the Engineer. Samples of conduit, duct, fittings, cables, tapes, fixtures, etc., may be required for approval. After they have been approved, samples will be returned in tested condition to the Contractor. In the event any items of material or equipment contained in the schedule fail to comply with specification requirements, such items will be rejected.

110-3.3 SAFETY PROCEDURES FOR WORKING ON AIRPORT LIGHTING SYSTEM

The Contractor shall follow the safety procedures working on airfield lighting as specified below:

a. Procedures for Taking Circuits Out of Service:
   1) Contractor will notify the Engineer which circuits are to be taken out of service and the specified portions to be worked on.
   2) Inspector will notify the Engineer, who will notify the Tower, to verify that the circuits can be removed from Tower control.
      i. If the Tower relinquishes control, the Engineer will notify the Airport Manager.
      ii. If the Tower does not relinquish control, no work can be done on the circuits at this time. (With the Tower in control, the circuits can be energized at any time.)
   3) If the Tower relinquishes control, the Airport manager and the contract electrician will proceed to the vault where the regulator will be taken out of service by Airport maintenance and tagged by the contract electrician.
   4) Airport maintenance will log - time, circuits and Contractor - into the vault log.
   5) After shutdown, the Contractor shall field test the circuits to verify that they are not energized before starting work on the circuits in the field.

b. Procedures for Placing Circuits Back in Service:
   1) The Contractor will notify the Engineer when circuits are ready to be tested.
   2) The Engineer will contact all other inspectors who are working with the Contractor's electricians and notify them that the lighting circuits are about to be energized. When it has been verified that all personnel are clear, the Engineer will call Operations requesting a "burn".
   3) Operations will notify Airport maintenance. Airport maintenance and the contract electrician will meet at the vault, where the contract electrician will remove its tag. Airport maintenance will then energize the circuits.
4) Airport maintenance will notify Operations who will verify that the lights are burning.
   i. If all lights are operating, control of the lights will be given back to the Tower.
   ii. If all lights are not operating, Airport maintenance will work with the contract electrician to rectify the problem.

110-3.4 EXISTING UTILITIES. Prior to any excavation or trenching, locate any existing cables and utilities that will be crossed by the trench. Ensure these utilities are permanently disconnected if they are going to be demolished. The existing service lines shall be exposed by hand digging in those areas that will be crossed and shall be protected from any possible damage. If any damage occurs, it shall be the Contractor's responsibility to immediately repair such damage with materials and methods approved by the Engineer and in compliance with applicable codes and standards, at no additional cost to the Engineer.

The Contractor shall protect existing airport lighting systems. Any portion of the existing airport lighting systems damaged or disconnected during installation of the new systems shall be repaired and reconnected and must be fully functional prior to dusk each day or during adverse weather conditions, to the satisfaction of the Engineer. This work shall be completed at the Contractor's sole expense.

The Contractor shall be responsible for troubleshooting and investigative work necessary to install completely operating lighting circuits and temporary circuits. These shall be incidental to the other electrical work and no separate payment will be made.

110-3.5 REMOVALS, DEMOLITION, AND SALVAGE.

a. Existing lights immediately adjacent to work area and which may be subject to damage due to construction activities shall be temporarily removed.

   1) As soon as a fixture is removed, the base can shall be immediately covered by bolting a temporary cover in place.

      a. Bolts, six per cover, are to be hex-head-socket button-head type.
      b. Gaskets utilized under the elevated edge lights shall be removed with the light units, and they will be ultimately reused in the reinstallation.
      c. O-rings used under the lights shall be removed and saved for reuse when the light units are reinstalled.
      d. All bolts shall be secured to prevent the possibility of loosening (and becoming a hazard to aircraft operations).

   2) Each light unit shall be marked with its assigned number immediately after it is removed. Use masking tape and a waterproof marking pen. Additionally, it is recommended that the interior of each can be provided with some type of marker, identifying it by its assigned number - it will be beneficial to future Contractor work.
a. All lights shall be handled carefully to prevent damage to the secondary conductors (between bottom of fixture and hard surfaces). After removal lights shall be kept in a dry and protective area until reinstallation.

b. The bolts on the edge light fixture may have to be cleaned to be able to get a socket over the head due to the possible buildup of asphalt products.

b. Removal of airfield electrical equipment included under this Item shall include, but not be limited to the specific elements, of the following:

1) All existing airfield in-pavement and elevated lights, airfield signs, isolation transformers, and Logitrac devices noted for removal shall be removed, cleaned, and turned over to LAWA C&M.

2) Existing equipment noted for removal and reinstallation shall be removed, cleaned, stored as needed for project phasing requirements, and reinstalled as shown on the drawings.

3) Cables, conduit, ducts, junction cans, handholes, base cans, concrete foundations, and concrete encasements shall be removed and disposed of off Airport property at a properly licensed facility.

110-3.6 TEMPORARY LIGHTING AND CIRCUITS. Temporary airfield electrical equipment shall be installed as shown in the plans and specified herein.

110-3.7 PHASING. All existing runway and taxiway lights not included in the construction phasing must be kept in operation, except as permitted otherwise by the Engineer.

The Contractor shall be responsible for troubleshooting and investigative work necessary to install completely operative temporary circuits. These shall be incidental to the other electrical work and no separate payment will be made unless otherwise specified.

The Contractor shall be responsible for installing, maintaining, and removing all required temporary jumper cables, conduits and splices.

The Contractor shall test and verify that the circuits and lights involved in construction that are necessary for operation of aircraft are in working order at the end of each working day.

110-3.8 INTERRUPTIONS. Interruptions of lighting circuits may be necessary during construction. The Contractor shall not interrupt any circuit or perform any work that might endanger any circuit until approval of the Engineer has been received.

The Contractor shall remove all circuit cables from their respective power sources in the vault before working on the cables in the field. This work is incidental to the electrical work and no separate payment will be made.
110-3.9 ORIENTATION OF LIGHT BEAM FOR TAXIWAY CENTERLINE LIGHTS. Taxiway centerline lights should be oriented as follows with a horizontal tolerance of plus or minus 1 degree:

a. On Straight Segments: On all straight portions of taxiway Centerlines, the axis of the light beam should be parallel to the Centerline of the taxiing path.

b. On Curved Portions (Excluding High Speed Exit Taxiways with Standard Fillets): Orient the axes of the two beams of bidirectional lights parallel to the tangent of the nearest point of the curve designated as the true centerline of the taxiway path. Orient the axis of the un-directional light beam so that it is “toe-in” to intersect the centerline at a point approximately equal to four times the spacing of lights on the curved portion. Measure this spacing along the chord of the curve.

c. High speed Exit Taxiways: Orient the axis of a unidirectional Light beam so that it is “toed-in” to intersect the centerline at a point approximately equal to four times the spacing of the lights on the curved portion. Measures this spacing along the chord of the curve. Orient the axis of the two beams of bidirectional lights parallel to the tangent of the nearest point of the curve designated as the true centerline of the taxiing path with a tolerance of plus or minus one-half a degree.

110-3.10 ELEVATED EDGE LIGHT BASE CAN AND JUNCTION CAN INSTALLATION

a. Details for the installation of elevated edge light base cans and junction cans are shown on the drawings.

b. Survey light location.

c. Saw cut or core drill an opening in the asphalt or econcrete stabilized base and base course to a size large enough to install the can and connect to the conduit.

d. The light base can duct holes shall be fitted with the appropriate rubber grommets, supplied with the base can.

e. The base shall be supported in place in the excavated area so that the top flange is within 2 degrees of level and at the elevation and location required to meet the requirements of light unit installation and alignment. PVC duct sections shall be installed into the can as required. The base can shall be installed as described in this section.

f. Check can position. Proceed with concrete backfill around the base; the can shall be held secure to prevent movement.

g. Backfill to the level shown on the drawings. Concrete backfill shall be worked under any portion of duct elevated in the process of leveling the light base, to relieve any strain at the light base connection which may develop during backfilling operation. Final base can and conduit backfilling may then proceed as specified, to the level required for the base of the extension.

h. Install a target plate on the base can prior to the final asphalt paving operation.

i. Following the final asphalt or PCC paving, the contractor shall raise the light base to the finish grade using one the following methods; core drill with 13” diameter core or sawcut and remove a 24” by 24” area of asphalt centered over the can.
j. Following the core drilling or sawcutting and material removal, install extension and/or shims to extend the base can to finish grade.

k. For the sawcut method, place a concrete collar around the can as shown. The top of exposed concrete shall be smoothly finished so that it slopes away from the top edge of the flange. In no case shall any concrete be above or over the top edge of the top flange, and all spillage onto the flange shall be immediately and completely removed.

110-3.11 INSTALLATION OF ELEVATED LIGHT FIXTURES. Assemble the light unit on the base plate following the manufacturer's instructions. Connect the secondary L-823 plug and receptacle without taping the joint. Plug the transformer into the primary circuit, taping joints; secure the secondary receptacle to the bottom of the base plate. Place the transformer in the can. Bolt the base plate to the base can using the specified hardware. Care shall be taken to keep the flange and gasket clean, attaining a water tight seal.

110-3.12 FLUSH (IN-PAVEMENT) LIGHT BASE CAN INSTALLATION IN PORTLAND CEMENT CONCRETE PAVEMENT

a. Details for the installation of in-pavement light base cans are shown on the drawings.

b. Survey light location.

c. Saw cut a 4-foot by 4-foot opening in the stabilized base (asphalt or econocrete) and base course to install the can, connect to the conduit, and place the concrete anchor base. Asphalt, concrete and other materials removed during the installation shall be disposed off airport property.

d. The light base can duct holes shall be fitted with the appropriate rubber grommets, supplied with the base can. Where an unused hole exists due to the geometry of a given location the opening shall be plugged prior to concrete placement.

e. The base shall be supported in place in the excavated area so that the top flange is level and at the elevation and location required to meet the requirements of light unit installation and alignment. PVC duct sections shall be installed into the can and the reinforcing bar cage shall be installed as required.

f. Check can position. Proceed with concrete backfill around the base; the can shall be held secure to prevent movement.

g. Backfill to the level of the asphalt/econcrete base or as shown on the drawings. Concrete backfill shall be worked under any portion of duct, can, and reinforcing cage.

h. Prior to paving the portland cement concrete pavement (PCCP), install a temporary target plate or plywood cover on the base can. The base can elevation shall be set to allow the installation of the flange ring, shims and extension if applicable. At the Contractor's option, the extension may be installed following the PCCP placement via a core-drill method. The flange ring shall not be used during the paving operation but the Contractor may install temporary shims, furnished at the Contractor's expense, to temporarily build up the base can to the desired elevation. If a cookie-cutter type finish method will be used an approximate 1/2-inch gap shall be provided around the can to allow placement of sealant. The installation and elevation of the base can shall be coordinated with the paving operation to ensure the slipform paving machine will clear the top of the base can.
Contractor may elect to use either a core or cookie-cutter finish method for finishing around the base can. The finishing method/procedure shall be submitted to the Engineer for review and approval prior to commencing the paving operation.

i. After the PCCP has had time to cure, remove the temporary cover plate, shims, and any other temporary items placed during the paving operation. Core drill for installation of top section and flange ring, the core drill shall be sized to create an approximate 1/2-inch gap around the flange ring. Install the flange ring and appropriate spacers to set the elevation per the specified tolerances.

j. Fill void around extension with P-606 sealant. P-605 sealant shall be used to fill the void above the P-606 material, around any shims and the flange ring.

110-3.13 FLUSH (IN-PAVEMENT) LIGHT BASE CAN INSTALLATION IN ASPHALT CONCRETE PAVEMENT

a. Details for the installation of in-pavement light base cans are shown on the drawings.

b. Following the milling operation or prior to the final asphalt paving, survey the light location.

c. Saw cut or trench the asphalt pavement for installation of the PVC conduit. To the extent possible, trenches shall be cut in a straight line between base cans. Deviations in straight line routing shall be pre-approved by the Engineer prior to sawcutting or trenching. The trench line shall be neat and clean following the operation. Raveling and tearing of the asphalt surface will not be accepted.

d. The Contractor shall core drill for the light base installation. The core shall be drilled to the depth detailed on the drawings.

e. Survey light location.

f. Reinforcing bars and the ground rod shall be installed in the cored hole as shown in the drawings.

g. The light base can duct holes shall be fitted with the appropriate rubber grommets, supplied with the base can. Where an unused hole exists due to the geometry of a given location the opening shall be plugged prior to concrete placement. Install temporary overlay protection plate on the base can.

h. The base can shall be supported in place in the cored area so the top flange is level and at the elevation and location required to meet the requirements of light unit installation and alignment. Connect the base can to the ground rod with the bare copper wire.

i. Install conduit in the trench and into the base can. Check can position. Proceed with concrete backfill around the base can and conduit. The base can shall be held securely to prevent movement.

j. Proceed with final asphalt paving.

k. Core drill new asphalt concrete pavement to top of overlay protection plate, remove core, and install extension, flange ring and shims.

l. Fill void around extension with P-606 sealant. P-605 sealant shall be used to fill the void above the P-606 material, around any shims and the flange ring.
110-3.14 INSTALLATION OF FLUSH LIGHT FIXTURES.

a. Remove the temporary base plate and install shims, flange ring, o-ring, and sealant as shown in the drawings and within the tolerances specified.

b. Install the light unit on the flange ring following the manufacturer's instructions. Connect the secondary L-823 plug and receptacle without taping the joint. Plug the transformer into the primary circuit, taping joints. Place the transformer in the can. Connect the ground wire from the base can internal lug to the fixture.

c. Bolt the fixture to the base can using the specified hardware. Bolts and washers shall be provided by the Contractor and shall be sufficient length to thread into the base can or extension.

d. Care shall be taken to keep the flange and gasket clean, attaining a water tight seal.

110-3.15 LIGHT BASE GROUNDING. See the drawings for ground rod and conductor installation details and requirements.

110-3.16 LIGHT FIXTURE AND BASE PLATE GROUNDING. Each light fixture or base plate shall be bonded to the light base internal ground lug using a #6 AWG, stranded copper wire rated from 600 volts with green XHHW insulation. The ground wire shall be 36-inches long and connected to the base can interior ground lug by mechanical means and to the fixture by a mechanical connector.

110-3.17 AIRFIELD SIGN INSTALLATION. Signs shall be installed where shown on the drawings and as follows:

a. Concrete Pads. Concrete sign foundations shall be constructed to the dimensions as detailed on the drawings. Exposed concrete surface shall be finished smooth with a street trowel or rubbed to a smooth finish. All horizontal edges shall be chamfered ¾ inch at 45 degrees. Install a minimum of one transformer base in each concrete pad. Place anchor bolts for additional flange supports in concrete pad in correct position.

b. Nameplate. Each sign shall have a nameplate giving the sign name and number as shown on the plans, Type, Size, Style, Class, manufacturer's name, address, catalog number, and the total load and power factor of the sign, including required adapter units.

c. Leveling. During construction of pad, transformer base shall be adjusted and firmly held in place so that the machined upper surface of the base flange will be level within 2 degrees and shall not protrude above the surface of pad. All other bearing areas for additional flange supports shall be in the same horizontal plane as transformer base flange.

d. Identification Tags. A non-corrosive metal disc of 2 inches minimum diameters, with numbers permanently stamped or cut out. Attach to sign housing with two sheet metal screws.

e. Cable Entrance. Seal cable entrance to the base (or to conduit or tee leading into the base) by squeeze connectors. Use galvanized conduit reducers where required. Provide squeeze connectors with a rubber bushing of correct size to fit outside diameter of cable.
Tighten connectors sufficiently to provide a watertight seal without deforming insulation and sheath of cable.

f. **Cable Connection.** In making cable connections to airfield signs, pull underground supply cable into each light base, leaving 5'-0” slack cable inside the base to permit all connections to be made above ground.

g. **Assembling Unit.** Assemble signs and connect in accordance with manufacturer's installation instructions. Connect transformer secondary leads to fixture leads by means of a disconnecting plug and receptacle and do not tape connection. Install lamps of proper rating in the fixture.

h. **Sign Filters.** Existing airport light system control and monitoring system (ALCMS) is Digitrac/Logitrac as manufactured by Crouse-Hinds Airfield Lighting Products. For signs not equipped with an integral sign filter, special filters are required in the sign unit base cans for the monitoring and control system to operate trouble free. Contractor shall coordinate with Crouse-Hinds to obtain technical data and filter units that are required.

i. **Testing.** After installation of the signs, the current to the lamps shall be checked with a true RMS ammeter. The current shall be adjusted to the value recommended by the manufacturer. Fully test installation by continuous operation for a period of not less than ½ hour as completed until prior to acceptance. These tests shall include functioning of each control not less than ten times. Test completed circuit in accordance with applicable provisions of section specifying underground cable.

110-3.18 **ISOLATION TRANSFORMER.** Transformers shall be installed in L-867/868 bases at location and position as indicated on the Plans. The primary cable connections shall be made by use of the L-823 plug and receptacle cable connectors per Section 113, Underground Cable for Airports (FAA Item L-108).

110-3.19 **CABLE CONNECTIONS.** All airfield lighting connections to cable, transformers, and fixtures shall be made with L-823 5 kV connectors in accordance with Section 113, Underground Cable for Airports (FAA Item L-108).

110-3.20 **AIRFIELD LIGHT FIXTURE IDENTIFICATION**

All new airfield light shall be identified with new Painted identification/circuit numbers as indicated on the plans. Painted numbers shall be 4” high applied with stencils, black in color. Background shall be white, 6” high, of length required for identification/circuit numbers. Location of painted ID numbers for elevated fixtures shall be immediately adjacent to the fixtures. Location of painted ID numbers for runway and centerline fixtures shall be 2 feet away from the painted edge stripe. On East/west direction runways and taxiways, locate the stencil on the north side. On north/south or angled runways or taxiways, locate the stencil on the west side. At intersections where centerline fixtures occur, place the stencil adjacent to the fixture as directed by the Engineer.

110-4 **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**
The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. Removal of Electrical Items (25R Pavement Rehab)
2. Removal of Electrical Items (Construct Taxiway B-17)
3. Removal of Electrical Items (Replace Runway Hold Position at Taxiway G)
4. LED Sign 2-Module and Foundation
5. LED Sign 3-Module and Foundation
6. LED Sign 3-Module on Existing Foundation
7. LED Sign 4-Module and Foundation
8. Owner Furnished LED TW CL Light w/Can and Iso Xformer in New PCC
9. LED TW CL Light w/Can and Iso Xformer in New PCC
10. LED TW CL Light w/Can and Iso Xformer in Existing PCC
11. Owner Furnished LED TW CL w/ Iso Xformer on Existing Base Can
12. LED TW CL Light w/Can & Iso Xformer in Over-Tunnel PCC Slabs
13. LED Elevated TW Edge Light w/Can & Iso Xformer in New PCC
14. LED Elevated TW Edge Light w/Can & Iso Xformer in New AC
15. LED Elevated TW Edge Light w/Can & Iso Xformer in Existing Pavement
16. LED Elevated TW Edge Light w/Can & Iso Xformer on Existing Base Can
17. Owner Furnished LED Elevated TW Edge Light w/Can & Iso Xformer on Exist Base Can
18. LED In-pavement TW Edge Light w/Can & Iso Xformer in New PCC
19. LED In-pavement TW Edge Light w/Can & Iso Xformer in New AC
20. 3/4" Blank Plate on Existing Base Can
21. Owner Furnished RW CL Light w/Can & Iso Xformer in New PCC
22. RW CL Light w/Can & Iso Xformer in Over-Tunnel PCC Slabs
23. Owner Furnished RW CL Light w/ Iso Xformer on Existing Base Can
24. RW CL Light w/ Iso Xformer on Existing Base Can
25. Elevated RGL w/Can & Iso Xformer in Existing Pavement
26. LED In-pavement RGL w/Can, Iso Xformer in Existing PCC
27. Miscellaneous Electrical Work (RWY 25R Pavement Rehabilitation)
28. Miscellaneous Electrical Work (Construct Taxiway B-17)
29. Miscellaneous Electrical Work (Runway Hold Position at Twy G)

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.
END OF SECTION 110
SECTION 113 – UNDERGROUND CABLE FOR AIRPORTS (FAA L-108)

113-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for installation of underground cable for airports on runways, taxiways and aprons as shown on the Plans, and in accordance with FAA Specification Item L-108 as included and modified hereafter. In addition, for topics relevant to the construction of airfield lighting systems but not addressed in L-108, Sections 110 (Airfield Electrical Work) and 115 (Underground Conduit for Airports) of the Standard Specifications shall be applicable unless otherwise stipulated.

113-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

113-3 RELATED SECTIONS

Section 110 – Airfield Electrical Work (FAA L-125)

Section 115 – Underground Conduit for Airports (FAA L-110)

Section 125 – Installation of Runway Status Light System

Section 130 – RWSL Electrical Installation Testing

Other Sections, Tests, Specifications, and Standards referenced herein.

113-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1, Scope of Work and Phasing Summary, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS

DESCRIPTION

108-1.1 GENERAL. This Item shall consist of underground and temporary above grade power cable furnished and installed in accordance with this Specification at the locations and in accordance with the design, dimensions, and details shown in the Plans. This Item shall include the installation of cable in duct or conduit. It shall include splicing, cable marking, and testing of the installation and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the ENGINEER. This Item shall not include the installation of the duct or conduit.

New cable required for the Work is shown on the Plans along with some of the existing cable which shall remain in place. Other existing cables, including those to remain, are shown on the Plans for clarity, but the Plans do not purport to show exact field conditions and all cables. The record drawings are available from Van Nuys Airport and LAWA, Los Angeles, California, which show the majority of the existing cable and shall be used to supplement the Plans. However, the CONTRACTOR shall field verify the existing conditions with the as-built drawings and the
Plans prior to beginning the Work. The CONTRACTOR shall identify and mark the cable to distinguish between the cable to be removed and the cable to remain in place.

108-1.2 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions, apply to work specified in this Item.

108-1.3 APPLICABLE DOCUMENTS. The publications listed in this specification are incorporated herein by reference and form a part of this Item to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of this bid shall be applicable. In the text of this Item, such publications are referred to by basic designation only. Additional details and specifications pertaining to a specific system are contained in these documents and are to be considered as part of this Item. Perform all work in accordance with these documents except as specified herein. In the event of a conflict between the Plans and Specifications and the referenced documents, the more stringent rule shall be applied.

108-1.4 SHOP DRAWINGS AND MATERIAL LISTS. Shall be in accordance with Section 110, Article 125-1.3, for the following equipment:

1) 5 kV airfield lighting cable.
2) 600 V cable.
3) L-823 5 kV connector kits.
4) Copper grounding conductors with green insulation.
5) Bare copper counterpoise conductors.
6) Ground Rods.

108-1.5 REFERENCED PUBLICATIONS

*** IMPORTANT NOTE: Current version for all references, including any changes ***

FEDERAL AVIATION ADMINISTRATION (FAA) SPECIFICATIONS AND STANDARDS REFERENCED IN SECTION L-108

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC 150/5340-30</td>
<td>Design and Installation Details for Airport Visual Aids</td>
</tr>
<tr>
<td>AC 150/5345-1</td>
<td>Approved Airport Equipment</td>
</tr>
<tr>
<td>AC 150/5345-7</td>
<td>Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits</td>
</tr>
<tr>
<td>AC 150/5345-26</td>
<td>Specification for L-823 Plug and Receptacle, Cable Connectors</td>
</tr>
<tr>
<td>AC 150/5345-53</td>
<td>Airport Lighting Equipment Certification Program</td>
</tr>
<tr>
<td>FAA-C-1391b</td>
<td>Installation and Splicing of Underground Cables</td>
</tr>
<tr>
<td>FAA-STD-019e</td>
<td>Lightning Protection, Grounding, Bonding and Shielding</td>
</tr>
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Requirements for Facilities

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) SPECIFICATIONS REFERENCED IN SECTION L-108

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<th>Title</th>
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<td>Soft or Annealed Copper Wire</td>
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<tr>
<td>ASTM BB-8-86</td>
<td>Concentric-Lay-Stranded Copper Conductor, Hard, Medium-Hard or Soft</td>
</tr>
<tr>
<td>ASTM B33</td>
<td>Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes</td>
</tr>
<tr>
<td>ASTM D4388</td>
<td>Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes</td>
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ADDITIONAL REFERENCE DOCUMENTS

<table>
<thead>
<tr>
<th>Commercial Item</th>
<th>Description</th>
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<td>A-A-59544</td>
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<tr>
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<td>National Electrical Code (NEC)</td>
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<td>Standard for the Installation of Lightning Protection Systems</td>
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<tr>
<td>780</td>
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MATERIALS

108-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.
b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the ENGINEER. Manufacturer's certifications shall not relieve the CONTRACTOR of the CONTRACTOR's responsibility to provide materials in accordance with these specifications and acceptable to the ENGINEER. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the ENGINEER and replaced with materials, which do comply with these specifications, at the sole cost of the CONTRACTOR.

c. All materials and equipment used to construct this item shall be submitted to the ENGINEER for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner as per Section 110. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to the Work. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). CONTRACTOR is solely responsible for delays in the project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the ENGINEER, to determine compliance with the Plans and Specifications. The ENGINEER. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. reserves the right to reject any and all equipment, materials, or procedures, which, in the ENGINEER's opinion, does not meet the system design and the standards and codes, specified herein.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the ENGINEER. The defective materials and/or equipment shall be repaired or replaced, at the ENGINEER's discretion, with no additional cost to the Owner. The CONTRACTOR shall be responsible to maintain a minimum insulation resistance per AC 150/5340-26B, Maintenance Airport Visual aid Facilities, Table 5-1 and paragraph 5.1.3.1, with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period.

f. All Advisory Circulars referenced in these Specifications shall be the version indicated or the latest version.

g. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturers' certification of compliance with the applicable specification, when requested by the ENGINEER.

108-2.2 CABLE INSTALLATION TOOLS. The CONTRACTOR shall supply all tools necessary to install and test all new airfield lighting and power cables.

108-2.3 5kV AIRFIELD LIGHTING POWER CABLE. All underground power cable for airfield lighting and signage shall be approved under the current AC 150/5345-53 certification program
and manufactured by an FAA approved manufacturer per AC 150/5345-7, current version. The cable shall also conform to the current requirements of AC 150/5345-7, current version, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits.

Airfield lighting cable and Runway Status Light System cable used on this project shall be L-824 Type "C" with 5,000 volt cross-linked polyethylene insulation, 7-strand, #8 AWG for 6.6 amp circuits and 7-strand, #6 AWG for 20 amp circuits. Airfield lighting cable shall be supplied with red or black insulation as shown on the drawings. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer’s recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Power cables for other items shall be sized as noted on Plans. These limits on conductor sizes shall not apply to leads furnished by manufacturers on transformers and fixtures.

108-2.4 600 VOLT WIRE. Secondary power wiring shall be single conductor copper, 600V, Type THWN-2, and conform to UL83 (Federal Specification A-A-59544A). Provide the number and size as indicated on Plans. Secondary power wiring shall not be less than No. 10 AWG unless otherwise noted.

108-2.5 TEMPORARY AIRFIELD LIGHTING CABLE. Temporary airfield lighting cable shall meet the requirements of 5kV airfield lighting cable or 600V airfield lighting cable, as appropriate for the system and defined on the plans. The CONTRACTOR shall maintain on hand throughout construction enough airfield lighting cable to provide temporary jumpers and rerouted cables for each construction phase. Temporary cable will be paid for under the various temporary electrical lump sum items in Section 110, Airfield Electrical Work.

108-2.6 INSULATED EQUIPMENT GROUND. Ground wire shall be #6 AWG, type XHHW, stranded conforming to ASTM B3 and B8. For the Runway Status Lights System, ground wire shall be #6 AWG, type XHHW, solid copper.

The Contractor shall install a continuous electrical grounding system throughout the new series lighting systems. Insulated Green No. 6 AWG XHHW conductors shall be used to bond all light bases, junction cans, metal conduits and enclosures, and ground rods in the concrete pull boxes together into one continuously ground system. All connections of grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except Each junction can and light base shall be supplied with a grounding lug for ground wire connections. See AC 150/5340-30 for additional information about methods of attaching a ground to a galvanized light base. All exothermic connections shall be made in accordance with the manufacturer’s recommendations and listings.

108-2.7 COUNTERPOISE (GUARD) WIRE. Bare copper wire for counterpoise and guard wire shall conform to ASTM Specifications B3 and B8 and shall be solid bare copper wire, #1/0 AWG conforming to the requirements of ASTM D33. For the Runway Status Lights System, wire for “guard” (i.e. counterpoise) wire installations shall be No. 1/0 AWG stranded bare copper.
All connections of counterpoise and ground rods shall be made by the exothermic process or approved equivalent. All exothermic connections shall be made in accordance with the manufacturer’s recommendations and listings.

108-2.8 GROUND RODS. Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 10-foot long nor less than $\frac{3}{4}$-inch in diameter.

108-2.9 5kV CABLE CONNECTIONS. In-line connections of 5kV underground primary cables shall be of the type called for on the Plans, and shall be completed with pre-molded connector kits approved under the current AC 150/5345-53 certification program and manufactured by an FAA approved manufacturer per AC 150/5345-1, current version. The connector kits shall also conform to the AC 150/5345-26, current version, Specification for L-823 Plug and Receptacle, Cable Connectors, for field attachment to single conductor cable.

Taped splices are not allowed.

In all cases, connections of cable conductors shall be made using crimp connectors utilizing a crimping tool designed to make a complete crimp before the tool can be removed. Crimped connections of #6 AWG and larger conductors utilized on the Runway Status Lights System shall be crimped hydraulically with a concentrically-applied force of 12 tons. All L-823/L-824 splices and terminations shall be made in accordance with the manufacturer’s recommendations and listings.

108-2.10 SPLICER QUALIFICATIONS. Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The CONTRACTOR shall submit to the ENGINEER proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

108-2.11 CABLE IDENTIFICATION TAGS. Cable tags shall be copper, circular in shape, a minimum on 2 inches in diameter, and not less than 0.020-inch thick. Each tag shall be clearly stamped with $\frac{1}{8}$-inch high letters by steel lettering dies to indicate the circuit it is on. The tags shall be securely attached to the cable with No. 14 AWG TW wire. Tagging of cables will be considered incidental to other electrical work and will not be measured for payment.

108-2.12 TAPE. Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

108-2.13 ELECTRICAL COATING. Scotchkote shall be as manufactured by 3M Company, or approved equivalent.
108-2.14 EXISTING CIRCUITS. Existing circuits shall be tested in accordance with Section 110.

CONSTRUCTION METHODS AND TESTING REQUIREMENTS

108-3.1 GENERAL. The CONTRACTOR shall install the specified cable at the locations indicated on the Plans. This Item includes the underground installation of all power and control cables. The CONTRACTOR shall provide all materials. Cable pulling tensions shall not exceed manufacturer's requirements, and continuous tape readout from pulling winch strain gauge shall be provided and notated for ENGINEER's review at completion of project.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers or in handholes. The CONTRACTOR shall be responsible for providing cable in continuous lengths for homeruns or other long cable runs without connections, unless otherwise authorized in writing by the ENGINEER or shown on the Plans.

Cables shall only be spliced at light bases, handholes, or manholes per requirements on the Plans.

The underground cable work to be performed under this contract shall consist of furnishing and installing new cables, or removing and reinstalling certain existing cables and making all necessary connections to modify and/or re-route the existing circuits, all as shown on the plans and/or as directed by the Engineer. All temporary jumper wires shall be properly protected and secured in place.

108-3.2 PHASING, INTERRUPTIONS, AND TEMPORARY CABLES. Airfield power cables shall be kept in service to maintain runway and taxiway lighting as required for airfield operations. Temporary cable shall be run to maintain circuits to keep lighting operational. Temporary cable shall be placed above ground in temporary conduit or below ground in existing conduit. The surface mounted conduit and cable shall be secured in place as shown in the plans. The use of temporary cable shall be approved by the ENGINEER prior to installation and shall be promptly removed when the permanent construction is able to be used.

108-3.3 CABLE INSTALLATION IN DUCT OR CONDUIT. This Item includes the installation of the cable in duct or conduit as described below. The maximum number and voltage ratings of cables installed in each single duct or conduit and the current-carrying capacity of each cable shall be in accordance with the latest California Electrical Code.

Conductors shall be loaded into multiway conduit assemblies and ducts as follows:

1) Start installing conductors in lower level of conduits first.
2) Leave pull ropes in each spare conduit.
3) Install one ground wire for each ductbank.

The CONTRACTOR shall make no connections or joints of any kind in cables installed in conduits or ducts except at light bases and handholes.
Ducts or conduits shall be installed as a separate item in accordance with Section 115, Underground Electrical Conduit for Airports (FAA Item L-110).

The CONTRACTOR shall run a mandrel through ducts or conduit prior to installation of cable to insure that the duct or conduit is open, continuous and clear of debris. Mandrel size shall be compatible with conduit size. The CONTRACTOR shall swab out all conduits/ducts and clean base can, manhole, etc., interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed, the base cans and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the various pay items in the contract. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the CONTRACTOR’s sole expense. All accessible points shall be kept closed when not installing cable. The CONTRACTOR shall notify the ENGINEER of any blockage in the existing ducts.

The cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cables shall be pulled in the conduit at the same time.

The pulling of a cable through ducts or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum cable pulling tensions shall be governed by cable manufacturer’s recommendations. A non-hardening lubricant recommended for the type of cable being installed shall be used where pulling lubricant is required.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

The manufacturer's minimum bend radius or the California Electric Code requirements, whichever is more restrictive, shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the CONTRACTOR’s option, the CONTRACTOR may submit a plan, for review by the ENGINEER, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

A cable slack loop of 13 feet ±6 inches shall be left on each end of cable runs in manholes, 6 feet ±6 inches in handholes, and 3 feet ±6 inches at all other locations as shown on the Plans. Cable slack shall have at least one (1) 360 degree loop around the interior prior to exiting the junction enclosure. Cable slack shall be left in an orderly fashion, looped and placed in saddle racks when available.
108-3.4 INSTALLATION OF NEW CABLES IN EXISTING OCCUPIED CONDUIT. Existing cable(s) occupying existing conduit in which new cable is to be added shall be disconnected and pulled back to the new cable pulling point. Upon approval from the Engineer, the existing cable(s) shall be pulled back in the existing conduit along with the new cable(s). The Engineer must also approve the reconnection of the existing pull-in connectors. If the Engineer does not approve the use of existing cables or plug-in connectors, the Contractor shall use new material to match existing. All the existing circuits involved with reconnection must be tested as described in Section L-108.

Megger existing cables before removal, prior to installation and after being reinstalled in order to determine suitability.

108-3.5 5kV POWER CABLE SPLICES. Cable splicing materials shall be as shown on the project Plans or as specified herein. All splicing methods shall be as recommended by the manufacturer of the splicing material for the particular type of cable being spliced and shall be approved by the ENGINEER prior to installation.

Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

A. Field-attached Plug-in Splices. These shall be assembled in accordance with manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. In all cases the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1 1/2-inches on each side of the joint.

B. Factory-Molded Plug-in Splices. These shall be made by plugging directly into mating connectors. The joint where connectors come together, shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1 1/2-inches on each side of the joint.

C. Taped or Heat-Shrinked Splices. Not allowed.

All splices shall be made only in base cans, manholes, or handholes.

108-3.6 INSULATED EQUIPMENT GROUND WIRE INSTALLATION. Insulated ground wire shall be installed in all new conduits and ducts (one conductor per multi-conduit array). Conductors shall also be installed in existing conduits/ducts where such connects between new portions of conduits/ducts. Ground conductor shall be connected to grounding lug in every fixture base and ground rod in every manhole or handhole. A ground conductor shall be installed in each segment of power conduit/duct systems. A single conductor shall be installed in any multiway duct or conduit array which terminates all conduits at the same handhole or manhole at each end.

For the Runway Status Lights System, terminations of equipment grounds to the base can interior grounding lug may require the use of a ground bus to make all necessary connections, as shown on the details in the Plans. The individual conductors shall be connected to the bus by bolting connectors which have been crimped to the individual conductors. Connectors for #6
AWG and larger conductors shall be crimped hydraulically with a concentrically-applied force of 12 tons. Smaller conductor connectors shall follow manufacturer’s recommendations.

The grounding conductors shall be exothermically bonded to ground rods which are to be installed in each handhole or manhole. Ground rods shall be driven to full depth before exothermic weld is accomplished. Driving ground rod after exothermic weld will not be accepted. Ground rods for grounding conductor installation shall be incidental to the respective conduit, duct bank, manhole, handhole, fixture base, or sign base installation.

At connections to existing duct or conduit systems that are without ground conductor(s): Install a grounding conductor per above, from the duct or conduit point of connection back to the point of either 1) the next grounding conductor and/or ground rod or 2) the termination of the duct or conduit system at a site facility (building, equipment shelter, etc.). Bond this new grounding conductor to the next existing (or new) grounding system element (conductor or ground rod).

108-3.7 COUNTERPOISE (GUARD) WIRE INSTALLATION. Counterpoise (guard) wire installation shall be incidental to the respective conduit, ductbank, manhole, handhole, fixture base or sign base. Counterpoise wire shall be installed per the requirements of Section 115 – Underground Conduit for Airports (FAA L-110).

108-3.8 EXOTHERMIC BONDING. Bonding of counterpoise wire shall be by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

The CONTRACTOR shall demonstrate to the satisfaction of the ENGINEER, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer’s recommendations and the following:

All slag shall be removed from welds.

For welds at light fixture base cans, all galvanized coated surface areas and "melt” areas, both inside and outside of base cans, damaged by exothermic bond process shall be restored by coating with a liquid cold-galvanizing compound conforming to U.S. Navy galvanized repair coating meeting Mil. Spec. MILP-21035. Surfaces to be coated shall be prepared and compound applied in accordance with manufacturer’s recommendations. All buried copper and weld material at weld connections shall be thoroughly coated 6 mil of 3M “Scotchkote,” or approved equivalent, or coated with coal tar bitumastic material to prevent surface exposure to corrosive soil or moisture.

108-3.9 CABLE IDENTIFICATION. All power (5 kV) shall be identified at every handhole, manhole, light base and termination cabinet by use of engraved or stamped brass tags as detailed on the Plans or herein.

108-3.10 POWER CABLE TESTING. CONTRACTOR shall furnish all necessary equipment and appliances for testing the underground cable circuits after installation. As well as tests required in Section 110. CONTRACTOR shall test and demonstrate to the satisfaction of the ENGINEER the following:
That all lighting power circuits are continuous and free from short circuits and open circuits.

1) That all circuits are free from unspecified grounds.

2) That the insulation resistance to ground of all nongrounded series 5 kV lighting circuits is not less than 100 mega ohms.

3) That the insulation resistance to ground of all nongrounded conductors of multiple circuits is not less than 100 mega ohms.

4) That all circuits are properly connected in accordance with applicable wiring diagrams.

5) That all circuits are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than ½ hour.

6) Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

7) Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

8) That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

9) Six copies of tabulated results of all cable tests performed shall be supplied by the CONTRACTOR to the ENGINEER for review and approval. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

10) There are no approved "repair" procedures for items that have failed testing other than complete replacement.

END OF ITEM L-108
113-5 SUBMITTALS. The Contractor shall submit material specification for the items listed in Article 108-1.4 in accordance with PR-6, Submittal Procedures.

113-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. #6, 5KV, Black or Red, Type L-824 Unshielded Cable
2. #8, 5KV, Black or Red, Type L-824 Unshielded Cable
3. #6, 600V, Insulated Green Ground Wire, Stranded

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 113
SECTION 115 – UNDERGROUND CONDUIT FOR AIRPORTS (FAA L-110)

115-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for installation of underground conduit for airports on runways, taxiways and aprons as shown on the Plans, and in accordance with FAA Specification Item L-110 as included and modified hereafter. In addition, for topics relevant to the construction of airfield lighting systems but not addressed in L-110, Sections 110 (Airfield Electrical Work) and 113 (Underground Cable for Airports) of the Standard Specifications shall be applicable unless otherwise stipulated.

115-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

115-3 RELATED SECTIONS

Section 110 – Airfield Electrical Work (FAA L-125)
Section 113 – Underground Cable for Airports (FAA L-108)
Section 125 – Installation of Runway Status Light System
Section 130 – RWSL Electrical Installation Testing
Other Sections, Tests, Specifications, and Standards referenced herein.

115-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1, Scope of Work and Phasing Summary, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM L-110 UNDERGROUND CONDUIT FOR AIRPORTS

DESCRIPTION

110-1.1 GENERAL. This item shall consist of underground and temporary above grade electrical conduits and ducts and electrical manholes and handholes furnished and installed in accordance with this Specification at the locations and in accordance with the dimensions, designs, and details shown in the Plans. It shall also include all trenching, backfilling, removal, and restoration of any paved areas; concrete encasement, mandreling, installation of nylon pull rope, capping, reinforcing steel, ladders, appurtenances, dewatering and restoration of surfaces and the testing of the installation as a completed duct/conduit system ready for installation of cables, to the satisfaction of the ENGINEER. This item shall include furnishing and installing conduits and all incidentals for providing positive drainage of the system.

As used in this Item, ducts shall mean an array of raceways encased in concrete in accordance with the details shown on the Plans. Conduit shall mean single raceway encased in concrete as detailed on the Plans.

110-1.2 RELATED DOCUMENTS. The General Provisions of the Contract, including General and Special Conditions, apply to work specified in this Item.
110-1.3 APPLICABLE DOCUMENTS. The publications listed at the end of this Item are incorporated herein by reference and form a part of this Item to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of this bid shall be applicable. In the text of this Item, such publications are referred to by basic designation only. Additional details and specifications pertaining to a specific system are contained in these documents and are to be considered as part of this Item. Perform all work in accordance with these documents except as specified herein. In the event of a conflict between the Plans and Specifications and the referenced documents, the more stringent rule shall be applied.

110-1.4 SHOP DRAWINGS AND MATERIAL LISTS.

A. Shall be in accordance with Section 110, Airfield Electrical Work, Article 125-1.3, for the following equipment:

1) Conduit.
2) Conduit fittings.
3) Spacers for Conduits.
4) Warning Tape.
5) Manholes.
6) Manhole Lids.

REFERENCED PUBLICATIONS

*** IMPORTANT NOTE: Current edition for all references, including any changes ***

FAA SPECIFICATION REFERENCED IN SECTION L-110

<table>
<thead>
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<th>Number</th>
<th>Title</th>
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<tr>
<td>FAA-C-1391b</td>
<td>Installation and Splicing of Underground Cables</td>
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<tr>
<td>Advisory Circular (AC) 150/5340-30</td>
<td>Design and Installation Details for Airport Visual Aids</td>
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FEDERAL SPECIFICATIONS REFERENCED IN SECTION L-110

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<tr>
<td>W-C-1094</td>
<td>Conduit and Fittings; Nonmetallic, Rigid (Plastic)</td>
</tr>
<tr>
<td>WW-C-581E</td>
<td>Conduit, Metal, Rigid; and Coupling, Elbow; and Nipple, Electrical Conduit: Zinc-Coated</td>
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AMERICAN SOCIETY FOR TESTING AND MATERIALS

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<th>Title</th>
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ASTM A615  Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM D1556  Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557  Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN-m/m³))
ASTM D2167  Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2922  Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

UNDERWRITERS LABORATORIES STANDARD

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<th>Number</th>
<th>Title</th>
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<tr>
<td>514B</td>
<td>Conduit fittings all types, classes 1 thru 3 and 6 thru 10.</td>
</tr>
<tr>
<td>514C</td>
<td>All types, class 5 junction box and cover in plastic (PVC).</td>
</tr>
<tr>
<td>651</td>
<td>Rigid PVC Conduit, types I and II, class 4.</td>
</tr>
<tr>
<td>651A</td>
<td>Rigid PVC Conduit and HDPE Conduit type III and class 4.</td>
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</table>

MATERIALS

110-2.1 GENERAL. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the ENGINEER.

Manufacturer's certifications shall not relieve the CONTRACTOR of the CONTRACTOR's responsibility to provide materials in accordance with these specifications and acceptable to the ENGINEER. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the ENGINEER and replaced with materials, which do comply with these specifications, at the sole cost of the CONTRACTOR.

All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the ENGINEER. The defective materials and/or equipment shall be repaired or replaced, at the ENGINEER's discretion, with no additional cost to the ENGINEER.

110-2.2 NON-METALLIC CONDUIT. Non-metallic conduit and fittings shall conform to the requirements of Fed. Spec. W-C-1094, Underwriters Laboratories Standards UL-651 and Article 347 of the current National Electrical Code shall be one of the following, as shown on the plans:

1) Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.
2) **Type II–Schedule 80 PVC suitable for either above ground or temporary use.**

The type of adhesive shall be as recommended by the conduit/fitting manufacturer. All joints shall be solvent welded in accordance with the recommendation of the manufacturer. The plastic conduit, fittings, expansion joints and joint adhesive/solvent shall be products of one manufacturer to assure compatibility.

**110-2.3 STEEL CONDUIT.** Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out to conform to the requirements of the Underwriters Laboratories /standard 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a 10 mil thick coat of asphaltum sealer or shall have a factory bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mil of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions.

**110-2.4 LIQUIDTIGHT FLEXIBLE STEEL CONDUIT.** Liquidtight flexible steel conduit shall conform to Federal Spec. WW-C-566. Liquidtight flexible steel conduit shall be limited to a maximum length of 6 ft., as permitted by the NEC.

**110-2.5 CONCRETE.** Concrete backfill and encasement shall conform to the requirements of Section 90, Structural Concrete (FAA P-610), using 1 inch maximum size coarse aggregate with a minimum 28 day compressive strength of 4,000 psi. Concrete shall be red when used to encase ducts. The contractor shall use High Early Strength Concrete for encasement and anchors as required to meet operational constraints and requirements. Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A 615 Grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

**110-2.6 FLOWABLE BACKFILL.** Flowable backfill shall be per Section 43, Controlled Low Strength Material (FAA Item P-153).

**110-2.7 DETECTABLE WARNING TAPE.** Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film, 4-mil thickness, impervious to all known alkalis, acids, chemical reagents, and solvents, with a metallized foil core and shall be 3-6 inches wide wide with the word "ELECTRICAL" or similar imprinted on it. Detectable tape is incidental to the respective bid item. Contractor shall install marker tape over ducts, 8 inches below surface. Underground marker tape shall not be required where conduit is installed via horizontal directional drilling.

**110-2.8 CONDUIT/DUCT SPACER SYSTEM.** On all multiple conduit arrays, the CONTRACTOR shall furnish and install a conduit spacer system as required to maintain uniform conduit spacing. The system shall consist of plastic spacers that interlock vertically and horizontally. A spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly. Install spacers per
manufacturer's instructions, but provide a minimum of five spacer assemblies per 20 ft of 2 in conduit array or a minimum of four spacer assemblies per 20 ft of 4 in and larger conduit arrays.

**110-2.9 HORIZONTAL DIRECTIONAL DRILLING.** Not Used.

**110-2.10 CONCRETE MANHOLES, HANDHOLES, AND PULLBOXES.** All manholes, handholes, and pullboxes shall be reinforced precast concrete as shown on the Plans and shall be furnished with the appropriate load-rated covers as listed below and as detailed on the Plans. All new manhole and handhole covers shall be marked “Electrical” or “Power” or “Communication”, or as otherwise indicated on the Plans.

1) Decks and covers, unless noted otherwise on the plans, shall be designed to withstand aircraft loading defined in this section.

2) Manholes
   a. Aircraft Load Rated. One- or two-piece vault with slab roof, 6-foot x 8-foot or as noted otherwise on the plans, all manholes, frames and covers shall be designed to withstand aircraft loading defined in this section.
   b. Provide each new manhole with the appurtenances listed below and as shown on Plans.
   c. As detailed on the Plans, provide an aircraft rated, hinged, spring-assist open, 30 inch x 30 inch clear manway. Spring assembly shall consist of a minimum of two 302 stainless steel springs capable of lifting 70 percent of the lid weight. Hinged lid shall be provided with pivoting galvanized steel hold-open bar and a minimum of 2 stainless steel hold-down bolts. Square manways shall be provided with load-rated ductile/cast iron cast in flange.

3) Aircraft Rated Pullboxes and Handholes
   a. Aircraft Load Rated. One- or two-piece vault with slab roof, 4-foot x 4-foot or as noted otherwise on the plans, all structures, frames and covers shall be designed to withstand aircraft loading defined in this section.
   b. Provide each new structure with the appurtenances listed below and as shown on Plans.
   c. As detailed on the Plans, provide an aircraft rated, hinged, spring-assist open, 30 inch x 30 inch clear manway. Spring assembly shall consist of a minimum of two 302 stainless steel springs capable of lifting 70 percent of the lid weight. Hinged lid shall be provided with pivoting galvanized steel hold-open bar and a minimum of 2 stainless steel hold-down bolts. Square manways shall be provided with load-rated ductile/cast iron cast in flange.

4) Traffic Rated Handholes
   a. Traffic Rated. One- or two-piece vault with slab roof, 4-foot x 4-foot or as noted otherwise on the plans, all pullboxes, frames and covers shall be designed to withstand H-20 loading.
b. Provide each new handhole with the appurtenances listed below and as shown on Plans.

c. As detailed on the Plans, provide a traffic rated, hinged, spring-assist open, 36 inch x 36 inch clear manway.

5) **All Structures Shall:**

a. Be fitted on each wall with two 24 inch galvanized inserts for cable racks (Unistrut P-3000 or equal). Each rack shall be provided with a minimum of two saddle rack type arms with two saddles. Rack arms shall be made of galvanized steel or of non-flammable polymer as manufactured by Underground Devices, Inc., or equal, or as detailed on the Plans.

b. Be provided with ½ inch diameter threaded inserts for pull eye on each inside wall and a drainage sump in the bottom.

c. Be provided with ¾ inch x 10 foot copper-clad ground rod in each handhole/manhole for use as a standard for circuit testing. Exothermically bond ground rod to the grounding conductor system. Bond all metal parts to ground rod including spring assist lid.

d. Be provided with ¾ inch x 10 foot copper-clad ground rod external to each handhole/manhole to which an encircling #6 solid, bare counterpoise conductor shall be exothermically bonded.

e. All hardware shall be stainless steel 316.

6) **AIRCRAFT RATED STRUCTURE LOAD RATINGS.** All structures, frames, grates and lids within the Runway Safety Area and Taxiway Safety areas shall be capable of supporting the following loads. Certificates of load rating for pre-cast concrete structures, and for all castings, shall be provided by the manufacturer.

Should the Contractor propose a method of construction which differs from the detailing shown on the plans, the Contractor shall submit structural calculations from a Civil Engineer, registered in the State of California, verifying conformance with loading requirements prior to fabrication.

a. Dual-wheel, 83,000# per wheel, gear assembly of the Boeing 737; 30.5 inch center-to-center wheel spacing;

b. Contact tire pressure should be assumed to be 204 psi.

**110-2.11 GROUND RODS.** Ground rods shall be in accordance with Section 113, Underground Cable for Airports (FAA L-108). Ground rods for grounding conductor installation shall be incidental to the respective conduit, duct bank, manhole, or handhole installation.

**110-2.12 DUCT MARKERS.** Duct markers for ductbanks shall be as shown in the details on the Plans. The markers shall be located above the ends of all ducts or ductbanks, except where ducts terminate in a handhole, manhole, or building. Markers shall be installed directly above the ductbank. Duct markers shall be incidental to the cost of the duct back
CONSTRUCTION METHODS

110-3.1 GENERAL. The CONTRACTOR shall install underground duct banks and conduits at the approximate locations indicated on the Plans. The ENGINEER shall indicate specific locations as the work progresses, if required to differ from the Plans. Ducts and conduits shall be of the size, material, and type indicated on the Plans or Specifications. Where no size is indicated on the Plans or in the Specifications, conduits shall be not less than 2 inches inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the Plans, grades shall be at least 3 inches per 100 ft. On runs where it is not practicable to maintain the grade all one way, the duct and conduit lines shall be graded from the center in both directions toward access points or conduit ends. Pockets or traps where moisture may accumulate shall be avoided. No duct or underground conduit shall be less than 18 inches below finished grade, unless otherwise noted. Where under pavement, the top of the duct shall not be less than 18 inches below the subgrade, unless otherwise noted.

The CONTRACTOR shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct. An iron-shod mandrel, not more than ¼ inches smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The CONTRACTOR shall swab out all conduits/ducts and clean base can, manhole, handholes, etc., interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the base cans, manhole, handhole, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, handholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be reclaned at the CONTRACTOR’s sole expense. All accessible points shall be kept closed when not installing cable. The CONTRACTOR shall verify existing ducts proposed for use in the Work as clear and open. The CONTRACTOR shall notify the ENGINEER of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, shall be provided with a 200 lb test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the Plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminate from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet.

Unless otherwise shown on the Plans, all conduits and duct banks shall be concrete encased.
All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Underground electrical warning (caution) tape shall be installed in the trench above all underground ducts and conduits in paved and unpaved areas. The CONTRACTOR shall submit a sample of the proposed warning tape for approval by the ENGINEER. If not shown on the Plans, the warning tape shall be located 8 inches below finish grade or 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared in accordance with the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 ft.

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

All conduits and ducts shall be provided with a bare copper counterpoise conductor and a bare copper grounding conductor in accordance with Section 113, Underground Cable for Airports.

110-3.2 TRENCHING. Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and ducts may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be sawcut or excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches below the required conduit or duct depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a ¼ inch screen. Flowable backfill may alternatively be used. The CONTRACTOR shall ascertain the type of soil or rock to be excavated before bidding. All excavation shall be unclassified and incidental to the conduit or duct bank installation.

Whether or not specifically indicated on the Plans, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the ENGINEER, the unsuitable material shall be removed in accordance with Section 41, Excavation and Embankment (FAA Item P-152) and replaced with suitable material. Alternatively, additional duct supports that are adequate and stable shall be installed, as approved by the ENGINEER.

All excavation shall be unclassified and shall be considered incidental to the respective Section 115 pay item of which it is a component part. Dewatering necessary for duct installation, erosion and turbidity control, in accordance with Federal, State, and Local requirements is
incidental to its respective pay item as a part of this section. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid each item of this section.

Unless otherwise specified, excavated materials that are deemed by the ENGINEER to be unsuitable for use in backfill or embankments shall be removed and disposed of off site.

Any excess excavation shall be filled with suitable material approved by the ENGINEER and compacted in accordance with Section 41, Excavation and Embankment (FAA Item P-152).

It is the CONTRACTOR’s responsibility to locate existing utilities within the Work area prior to excavation. Where existing active cables cross proposed installations, the CONTRACTOR shall insure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the Plans. Installation of new cable where such crossings must occur shall proceed as follows:

1) Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.

2) Trenching, etc., in cable areas shall then proceed with approval of the ENGINEER, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the CONTRACTOR shall be responsible for the complete repair.

110-3.3 DUCTS (CONDUITS) ENCASED IN CONCRETE. Unless otherwise shown in the plans, ducts shall be installed so that the top of the concrete envelope is not less than 18 inches below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, ducts under paved areas shall be concrete encased. Trenches for ducts shall be opened the complete length before concrete is placed so that if any obstructions are encountered, proper provisions can be made to avoid them.

Unless otherwise shown on the plans, all ducts shall be placed on a layer of concrete not less than 3 inches thick prior to its initial set. Where two or more conduits in the duct are intended to carry conductors of same or differing voltage insulation rating, the CONTRACTOR shall space the conduits not less than 3 inches apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers, unless otherwise noted, applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches thick unless otherwise shown on the plans. End bells or couplings shall be installed flush with the concrete encasement at access points. Do not cover the ends or couplings with concrete.

Conduits forming the duct shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5 foot intervals.
Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the ENGINEER for review prior to use.

For the Runway Status Lights System, where two or more ducts are encased in concrete, the CONTRACTOR shall space them not less than 7 inches apart (measured from outside wall to outside wall), as shown in the details on the Plans. All conductors for the Runway Status Lights System shall be installed in dedicated ductbank, not shared with other airfield electrical systems.

When specified, the CONTRACTOR shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the CONTRACTOR shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5 foot intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation, sawcutting, and removal shall be included in the contract price for the duct.

Install a detectable warning tape above all underground conduit, duct lines, or counterpoise wire not installed under pavement. In paved areas install detectable warning tape at the interface of the controlled low-strength material and the pavement section. For duct banks equal to or greater than 24 inches in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

110-3.4 CONDUIT INSTALLED IN FULL-STRENGTH ASPHALT PAVEMENT. New conduit installed in existing pavement shall be installed as shown in the drawings. The conduit shall be supported in the trench as detailed on the drawings and backfilled with P-610 Concrete, as dictated by phasing or Contractor’s construction sequence.

110-3.5 COUNTERPOISE (GUARD) WIRE INSTALLATION. Counterpoise (guard) wire installation shall be incidental to the respective conduit, duct bank, manhole, handhole, fixture base or sign base. Counterpoise wire shall be installed adjacent to or above every new conduit or duct array per details on the Plans. Counterpoise wires shall be connected as detailed in the plans. Additionally, counterpoise wire shall be installed 4 inches above the uppermost conduit within the ductbank. This dimension may be less than 4 inches where conduit is to be embedded in existing pavement. Counterpoise wire shall not be installed in conduit.

For the Runway Status Lights System, the “guard” wire shall be installed continuously a minimum of 10 inches above the conduit within a single conduit ductbank, and a minimum of 17 inches above the conduits of a two-way conduit ductbank, as detailed in the Plans. The guard wire shall be connected to each light fixture base, mounting stake, or junction/access structure.

Provide ground rods at 90 feet on center (approximate), bond with exothermic weld to conductor. These ground rods need not be accessible. Ground rods for counterpoise conductor installation shall be incidental to the respective conduit, duct bank, manhole, or handhole installation.
When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise wire shall be bonded to the existing counterpoise system.

110-3.6 AIRFIELD LIGHTING CONDUITS. The following summarizes the type of conduit typically installed in the various locations on the airfield. The specific callouts in the plans shall take precedence over these general instructions.

1) PVC conduit shall be used for airfield lighting conduits unless otherwise shown in the drawings.

2) Conduit under pavement but outside of the defined limits of a taxiway or runway (outside of the painted edge stripe) including conduit outside of all paved area shall be defined as “Conduit in Shoulder/Non-Paved Area”. This designation includes conduits between base cans that run under full-strength ACP areas of the shoulder.

3) Conduit within the defined limits of a taxiway or runway (inside the painted edge stripe) and within an asphalt milling/replacement area shall be defined as “Conduit in ACP”.

4) All conduits entering base cans shall extend approximately 2-inches into the base with an end bell or bushing installed at the conduit end.

110-3.7 INTERCEPTING EXISTING CONDUIT(S). Where existing concrete encased ducts/conduit are to be extended, the duct/conduit extension shall be concrete encased plastic conduit. The fittings to connect the ducts/conduit together shall be standard manufactured connectors designed and approved for the purpose. The Contractor shall remove existing circuits between lights, signs, or pull boxes. Locate existing conduits, excavate, and cut conduit. Extend conduit to new pull box or sign base can. Pull new conductors to reclose the circuit and provide new splices.

110-3.8 CONDUIT CONNECTIONS TO MANHOLES, JUNCTION CANS, OR PULL BOXES. The Contractor shall penetrate the structure in a manner that will preserve their integrity and the integrity of connecting conduits, wires, and associated systems. Penetrations may be made by core drilling only. Seal interior conduit and handhole or pull box wall with silicone foam sealant and exterior with concrete grout.

110-3.9 BACKFILLING FOR DUCTS (PAVED AREAS). After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 “Excavation and Embankment” except that the material used for backfill shall be select material not larger than 4 inches in diameter. In addition to the requirements of P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet of duct bank or one work period’s construction, whichever is less. Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface. Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.
110-3.10 BACKFILLING FOR DUCTS AND CONDUITS (NON-PAVED AREA). After concrete-encased ducts have been properly installed and the concrete has had time to set, the trench shall be backfilled and compacted in accordance with Item P-152 "Excavation and Embankment". Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement. Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

110-3.11 CONCRETE MANHOLES AND HANDHOLES.

1) It is the CONTRACTOR’S responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the ENGINEER without additional expense to the ENGINEER.

2) The CONTRACTOR shall perform excavation for structure and structure footings to the lines and grades or elevations shown on the plans or as staked by the ENGINEER. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure footings shown.

3) All Excavation shall be unclassified and shall be considered incidental to the respective manhole or handhole pay item of which it is a component part. Dewatering necessary for either manhole or handhole structure installation, erosion and turbidity control, in accordance with Federal, State, and Local requirements is incidental to its respective pay item. The cost of all excavation regardless of type of material encountered shall be included in the unit price bid for manhole installation.

4) Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the ENGINEER. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

5) The CONTRACTOR shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

6) After each excavation is completed, the CONTRACTOR shall notify the ENGINEER. Structures shall be placed after the ENGINEER has approved the depth of the excavation and suitability of the foundation material.

7) Installation shall be in accordance with manufacturer's requirements and as follows:
   a. Be set flush to finished pavement or 1 inch above finished grade.
b. Structures shall be bedded on compacted aggregate base, 12 inch minimum depth, with ¾ inch gradation.

c. Have ducts stubbed into the manholes or handholes, which shall terminate in end bells cast in concrete flush with inside walls.

8) Manholes and handholes shall be located where indicated on the Plans.

110-3.12 GROUNDING. Ground rods shall be installed in precast bottom slab of structures by removing knockout and installing the ground rod so that the top of the rod extends 6 inches above the floor and filling the hole with grout. Bottom slab penetration shall be sealed watertight with portland cement grout around the ground rod. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the CONTRACTOR shall drill a 4 inch diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with portland cement grout.

A grounding bus of No. 2 AWG stranded copper wire, with green insulation, shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of 1 foot above the floor of the structure and separate from other cables. No. 2 AWG bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. Hardware connections may be mechanical, using a lug designed for that purpose.

110-3.13 RESTORATION.

All restoration shall be considered incidental to the respective L-110 pay item

1) Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed

2) Pavement Subgrade. Material removed from trenches in subgrade shall be removed from the immediate vicinity.

3) All Nonpavement Areas. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction, and other work shall be restored to their original condition. The CONTRACTOR shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance.

4) The Contractor shall grade around structures as required to provide positive drainage away from the structure. Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

5) Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

110-3.14 INSPECTION. Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to
ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested utilizing the fall-of-potential ground impedance test as described by ANSI IEEE Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

END OF ITEM L-110

115-5 SUBMITTALS. The Contractor shall submit material specification for the items listed in Article 110-1.4 in accordance with PR-6, Submittal Procedures.

115-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:
1. 1-2" PVC Concrete-Encased Conduit
2. 2-4" PVC Concrete-Encased Ductbank
3. 4-4" PVC Concrete-Encased Ductbank
4. 8-4" PVC Concrete-Encased Ductbank
5. 2" RGS Conduit in Shallow kerf
6. 2" PVC Conduit in Sawkerf in Keel Section
7. 4'x4'x4' Aircraft Rated Manhole
8. 6'x8' Aircraft Rated Manhole

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 115
Section 116 - Horizontal Directional Drilling for HDPE Conduit

DESCRIPTION

116-1.1 The work specified in this section consists of furnishing and installing HDPE schedule 80 conduit using the directional boring (horizontal directional drilling, HDD) method of installation. This work shall include all services, equipment, materials, and labor for the complete installation, testing, and site restoration. This specification refers to the series of drawings.

116-1.2 SUBMITTALS

A. Prior to beginning of work, Contractor must submit a detailed work plan to the Airport outlining the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable), list of sub-contractor(s), schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used, an environmental protection plan and contingency plans for possible problems including a frac-out and surface spill contingency plan.

B. Submit for approval a pre-construction bore-log depicting the plan and profile (horizontal and vertical alignment) of the proposed bore path. The bore-log shall show all utility crossings and existing structures. Ground Penetrating Radar and vacuum excavation shall be utilized to prove the bore drill pre-construction pathway is clear of unknown subsurface obstructions.

C. Record Drawings: Submit for Airport approval the as-built records within five days after completing the pull back. The as-built records shall include a plan, profile (data every 25 linear feet of main, at a minimum), and all information recorded during the progress of the work, including all subsurface anomalies identified by Ground Penetrating Radar and vacuum excavation. The HDD contractor shall certify the accuracy of all as-built record drawings.

D. HDPE Schedule 80 conduit.

116-1.3 QUALITY ASSURANCE

The requirements set forth in this specification specify a wide range of procedural precautions necessary to insure that the very basic, essential aspects of a directional bore installation are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this specification. Adherence to the specifications contained herein, or the Airport’s approval of any aspect of any directional bore operation covered by this specification, shall in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under this Contract.

116-1.4 PERSONNEL QUALIFICATIONS CERTIFICATION
A. Directional Boring
   1. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. (Each person must have been fully trained for over 1,000 hours on all facets of directional drilling, including, but not limited to machine operations, mud mixing, locating, and material fusion.) A responsible representative who is thoroughly familiar with the equipment and type of work to be performed, must be in direct charge and control of the operation at all times. In all cases the Contractor supervisor must be continually present at the job site during the actual directional bore operation. The Contractor shall have a sufficient number of competent works on the job at all times to insure the directional bore is made in a timely and satisfactorily manner.

B. HDPE PVC Schedule 80 Joining
   1. Joints between HDPE PVC Schedule 80 conduit cannot be made via fusion but by connecting the conduits together. Refer to drawings for typical details. Contractor shall order sizes and lengths as required to pull the correct length of HDPE.

116-1.5 ENVIRONMENTAL PROTECTION

A. Contractor shall place silt fence between all boring operations and any drainage, wetland, waterway or other area designated for such protection by contract documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or boring fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Contractor shall adhere to all applicable environmental regulations. Fuel or oil may not be stored in bulk containers within 200’ of any water-body, wetland or runway.

116-1.6 SAFETY

A. Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner.

116-1.7 WARRANTY

A. The contractor shall supply the Airport a two (2) year unconditional warranty. The warranty shall include materials and installation and shall constitute complete replacement and delivery to the site of materials and installation of same to replace defective materials or defective workmanship with new materials/workmanship conforming to the specifications.

EQUIPMENT AND MATERIALS

116-2.1 HDPE SCHEDULE 80 CONDUIT

A. Conduit: Conduit shall be 2” or 4” Diameter HDPE Schedule 80.
B. Surface Marking. The jacket surface shall be printed, size of duct, year of manufacture
C. Joints: Unless otherwise specified, provide continuous runs between handholes or connect HDPE as shown on the drawings.

D. Conduit Markings: Per manufacturer’s recommendations.

E. Warranty: The pipe and fusion shall be warranted for 2 years.

F. Counterpoise Conductors: Counterpoise conductor shall be solid bare copper wire, #1/0 AWG.

116-2.2 GENERAL

A. The directional boring equipment shall consist of a directional boring rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to complete the drill, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be re-used, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system. All equipment shall be in good, safety operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

116-2.3 DRILLING SYSTEM

A. Drilling Rig: The directional boring machine shall consist of a power system to rotate, push and pull hollow pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power boring operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be grounded during boring and pull-back operations. Sufficient spares shall be kept on hand for any break-downs which can be reasonably anticipated.

B. Bore head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and boring fluid jets.

C. Mud Motors (if required) shall be of adequate power to turn the required boring tools.

D. Drill pipe shall be constructed of high quality 4130 seamless tubing, grade D or better.

116-2.4 GUIDANCE SYSTEM

A. Magnetic Guidance System (MGS) or proven gyroscopic system shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all the depths up to eighty feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate to +/- 2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 5’ horizontally.
B. The guidance system shall be of a proven type and shall be setup and operated by personnel trained and experienced with the system. The operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

C. Bore Tracking/Monitoring: At all times during the pilot bore the Contractor shall provide and maintain a bore tracking system that is capable of accurately locating the position of the drill head in the x, y, and z axis. The Contractor shall record these data at least once per drill pipe length of every twenty-five feet, whichever is more frequent.

D. Surface Grid Tracking System: Contractor shall monitor and record x, y, and z coordinates relative to an established surface survey benchmark. The data shall be continuously monitored and recorded at least once per drill pipe length or every twenty-five feet, whichever is more frequent.

E. Drilling Fluid Pressure/Flow Rates: Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the Contractor. The pressures shall be monitored at the pump. These measurements shall be made during pilot bore drilling, reaming, and pullback operations.

116-2.5 DRILLING FLUID SYSTEM

A. Mixing System: A self-contained, closed, boring fluid mixing system shall be of sufficient size to mix and deliver boring fluid composed of bentonite clay, potable water and appropriate additives. Mixing system shall continually agitate the boring fluid during boring operations.

B. Drilling Fluids: Drilling fluids shall be composed of clean water and an appropriate additive. Water shall be from a clean source with a pH of 6.0. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used.

C. Delivery System: The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used boring fluid and boring fluid spilled during boring operations shall be contained and properly disposed of. A berm, minimum of 12” high, shall be maintained around boring equipment, boring fluid mixing system, entry and exit pits and boring fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps and/or vacuum truck(s) of sufficient size shall be in place to convey excess boring fluid from containment areas to storage facilities.

D. Drilling Fluid Recovery System: The drilling fluid recycling system shall separate sand, dirt, and other solids from the drilling fluid to render the drilling fluid re-usable. Spoils separate from drilling fluid will be stockpiled for later use or disposal.

E. Control of Drilling Fluids: The Contractor shall follow all requirements of the frac-out and surface spill contingency plan as submitted and approved and shall control operational pressures, drilling mud weights, drilling speeds, and any other operational factors required to avoid hydro-fracture fluid losses to formations, and control drilling fluid spillage. This includes any spillages or returns at entry and exit locations or any intermediate point. All
inadvertent returns or spills shall be promptly contained and cleaned up. The Contractor shall maintain on-site mobile spoil removal equipment during all drilling, pre-reaming, reaming and pullback operations and shall be capable of quickly removing spoils.

116-2.6 OTHER EQUIPMENT

A. Pipe Rollers, if required, shall be of sufficient size to fully support the weight of the pipe while being hydro tested during the pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe.

B. Hydraulic or pneumatic pipe rammers may only be used if necessary and with Airport approval.

C. Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Airport prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

EXECUTION

116-3.1 DRILLING PROCEDURE

A. Bore Path Survey

1. Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within areas indicating on drawings. If contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.

B. Guidance System

1. Contractor shall provide and maintain instrumentation necessary to accurately locate the pilot-hole (both horizontal and vertical displacements), measure pilot string torsional and axial and measure drilling fluid discharge rate and pressure. The Airport shall have access to these metrics at all times during operation.

C. Pilot-Hole

1. The pilot-hole shall be drilled along the path shown on the plans and profile drawings or as directed by the Airport in the field. Unless approved otherwise, the pilot-hole tolerances shall be as shown on the plans.

D. Pull Back

1. After successful reaming bore hole to the required diameter, Contractor will pull the HDPE through the bore hole along with the #1/0 counterpoise cable. In front of the pipe will be a swivel. Once pull-back operations have commenced, operations must continue without interruption until conduit is completely pulled into bore hole. During
pull-back operations contractor will not apply more than the maximum safe pipe pull (tensile) strength at any time.

2. Torsional stress shall be minimized by using a swivel to connect a pull section to the reaming assembly.

3. The pullback section of the pipeline shall be supported during pullback operations so that it moves freely and the pipe is not damaged.

4. External pressure shall be minimized during installation of the pullback section in the reamed hole. Damaged pipe resulting from external pressure shall be replaced at no cost to the Airport.

5. Buoyancy modification shall be at the discretion of the Contractor and shall be approved the Airport. The Contractor shall be responsible for any damage to the pull section resulting from such modifications.

6. In the event the conduit becomes stuck, Contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If conduit remains stuck, Contractor will notify the Airport and discuss options to proceed.

116-3.2 PIPE ASSEMBLY

A. Conduit shall be installed together in one length, if space permits. Pipe may be placed on pipe rollers before pulling into bore hole to minimize damage to the conduit.

B. Cuts or gouges that reduce the wall thickness by more than 10% is not acceptable and must be discarded.

METHOD OF MEASUREMENT

The following items shall be measured and paid for as described in Project Requirements PR–4 of these specifications.

- 1-2" HDPE Horizontal Directional Drilled in Existing Pavement
- 8-4" HDPE Horizontal Directional Drilled in Existing Pavement

END OF SECTION 116
SECTION 120 – ADHESIVE COMPOUNDS, TWO-COMPONENT FOR SEALING WIRE AND LIGHTS IN PAVEMENT (FAA P-606)

120-1 GENERAL. The Contractor shall perform all work required by the plans and specifications for construction of sealant for airfield lighting installations as shown on the Plans, and in accordance with FAA Specification Item P-606 as included and modified hereafter. In addition, for topics relevant to the construction of airfield lighting systems but not addressed in P-606, Section 125, Airfield Electrical Work of the Standard Specifications shall be applicable unless otherwise stipulated.

120-2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor's expense.

120-3 RELATED SECTIONS.

- Section 110 – Airfield Electrical Work (FAA L-125)
- Section 125 – Installation of Runway Status Light System
- Other Sections, Tests, Specifications, and Standards referenced herein.

120-4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1, Scope of Work and Phasing Summary, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

ITEM P-606 ADHESIVE COMPOUNDS, TWO-COMPONENT FOR SEALING WIRE AND LIGHTS IN PAVEMENT

DESCRIPTION

606-1.1 This specification covers two types of material; a liquid suitable for sealing electrical wire in saw cuts in pavement and for sealing light fixtures or bases in pavement, and a paste suitable for embedding light fixtures in the pavement. Both types of material are two-component filled formulas with the characteristics specified in paragraph 606-2.4. Materials supplied for use with bituminous concrete pavements must be formulated so they are compatible with the bituminous concrete.

EQUIPMENT AND MATERIALS

606-2.1 CURING. When prewarmed to 77°F (25°C), mixed, and placed in accordance with manufacturer's directions, the materials shall cure at temperatures of 45°F (7°C) or above without the application of external heat.
606-2.2 STORAGE. The adhesive components shall not be stored at temperatures over 86°F (30°C).

606-2.3 CAUTION. Installation and use shall be in accordance with the manufacturer's recommended procedures. Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well-ventilated areas. Keep in cool place. Keep away from children.

606-2.4 CHARACTERISTICS. When mixed and cured in accordance with the manufacturer's directions, the materials shall have the properties shown in Table 1.

SAMPLING, INSPECTION, AND TEST PROCEDURES

606-3.1 TENSILE PROPERTIES. Tests for tensile strength and elongation shall be conducted in accordance with ASTM D 638.

606-3.2 EXPANSION. Tests for coefficients of linear and cubical expansion shall be conducted in accordance with ASTM D 1168, Method B, except that mercury shall be used instead of glycerine. The test specimen(s) shall be mixed in the proportions specified by the manufacturer, and cured in a glass tube approximately 2 inches long by 3/8 inch in diameter. The interior of the tube shall be pre-coated with a silicone mold release agent. The hardened sample shall be removed from the tube and aged at room temperature for 1 week before conducting the test. The test temperature range shall be from 35°F (2°C) to 140°F (60°C).

606-3.3 TEST FOR DIELECTRIC STRENGTH. Test for dielectric strength shall be conducted in accordance with ASTM D 149 for sealing compounds to be furnished for sealing electrical wires in pavement.
Table 1 PROPERTY REQUIREMENTS

<table>
<thead>
<tr>
<th>Physical or Electrical Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>ASTM Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tensile</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>1,000 psi</td>
<td></td>
<td>D 638</td>
</tr>
<tr>
<td>Bituminous Concrete</td>
<td>500 psi</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elongation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>8%(^a)</td>
<td></td>
<td>D 638</td>
</tr>
<tr>
<td>Bituminous Concrete</td>
<td>50%</td>
<td></td>
<td>D 638</td>
</tr>
<tr>
<td>Coef. Of cub. exp. cu. Cm/cu. cm/degree C</td>
<td>0.00090</td>
<td>0.00120</td>
<td>D 1168</td>
</tr>
<tr>
<td>Coef. Of lin. Exp. cm/cm/degree C</td>
<td>0.00030</td>
<td>0.00040</td>
<td>D 1168</td>
</tr>
<tr>
<td><strong>Dielectric strength, short time test</strong></td>
<td>350 volts/mil.</td>
<td></td>
<td>D 149</td>
</tr>
<tr>
<td><strong>Arc resistance</strong></td>
<td>125 secs.</td>
<td></td>
<td>D 495</td>
</tr>
<tr>
<td><strong>Adhesion to steel</strong></td>
<td>1,000 psi</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adhesion to portland cement concrete</strong></td>
<td>200 psi</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adhesion to asphalt concrete</strong></td>
<td>(no test available)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)20% or more (without filler) for formulations to be supplied for areas subject to freezing.

**606-3.4 TEST FOR ARC RESISTANCE.** Test for arc resistance shall be conducted in accordance with ASTM D 495 for sealing compounds to be furnished for sealing electrical wires in pavement.

**606-3.5 TEST FOR ADHESION TO STEEL.** The ends of two smooth, clean, steel specimens of convenient size (1 inch by 1 inch by 6 inches would be satisfactory) when bonded together with adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure on a Riehle (or similar) tensile tester. The thickness of adhesive to be tested shall be 1/4 inch.

**606-3.6 ADHESION TO PORTLAND CEMENT CONCRETE**

a. **Concrete Test Block Preparation.** The aggregate grading shall be as shown in Table 2.

The coarse aggregate shall consist of crushed rock having a minimum of 75% of the particles with at least one fractured face and having a water absorption of not
more than 1.5%. The fine aggregate shall consist of crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a water-cement ratio of 5.5 gallons of water per bag of cement, a cement factor of 6, plus or minus 0.5, bags of cement per cubic yard of concrete, and a slump of 2-1/2 inches, plus or minus 1/2 inch. The ratio of fine aggregate to total aggregate shall be approximately 40% by solid volume. The air content shall be 5.0%, plus or minus 0.5%, and it shall be obtained by the addition to the batch of an air-entraining admixture such as vinsol resin. The mold shall be of metal and shall be provided with a metal base plate. Means shall be provided for securing the base plate to the mold. The assembled mold and base plate shall be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be such that several 1-inch by 2-inch by 3-inch test blocks can be cut from the specimen with a concrete saw having a diamond blade. The concrete shall be prepared and cured in accordance with ASTM C 192.

### Table 2
**AGGREGATE FOR BOND TEST BLOCKS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate</td>
<td>3/4 inch</td>
<td>97 to 100</td>
</tr>
<tr>
<td></td>
<td>1/2 inch</td>
<td>63 to 69</td>
</tr>
<tr>
<td></td>
<td>3/8 inch</td>
<td>30 to 36</td>
</tr>
<tr>
<td></td>
<td>No. 4</td>
<td>0 to 3</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>No. 8</td>
<td>82 to 88</td>
</tr>
<tr>
<td></td>
<td>No. 16</td>
<td>60 to 70</td>
</tr>
<tr>
<td></td>
<td>No. 30</td>
<td>40 to 50</td>
</tr>
<tr>
<td></td>
<td>No. 50</td>
<td>16 to 26</td>
</tr>
<tr>
<td></td>
<td>No. 100</td>
<td>5 to 9</td>
</tr>
</tbody>
</table>

b. **Bond Test.** Prior to use, oven-dry the test blocks to constant weight at a temperature of 220 to 230°F (104°C to 110°C), cool to room temperature, 73.4 plus or minus 3°F (23°C plus or minus 1.6°C), in a desiccator, and clean the surface of the blocks of film or powder by vigorous brushing with a stiff-bristled fiber brush. Two test blocks shall be bonded together on the 1-inch by 3-inch sawed face with the adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure in a Riehle (or similar) tensile tester. The thickness of the adhesive to be tested shall be 1/4 inch.

606-3.7 **COMPATIBILITY WITH ASPHALT CONCRETE.** Test for compatibility with asphalt in accordance with ASTM D 5329.
606-3.8 ADHESIVE COMPOUNDS CONTRACTOR'S RESPONSIBILITY. The Contractor shall furnish the vendor's certified test reports for each batch of material delivered to the project. The report shall certify that the material meets specification requirements and is suitable for use with portland cement concrete and/or bituminous concrete pavements. The report shall be delivered to the Engineer before permission is granted for use of the material. In addition the Contractor shall obtain a statement from the supplier or manufacturer that guarantees the material for one year. The supplier or manufacturer shall furnish evidence that the material has performed satisfactorily on other projects.

606-3.9 APPLICATION. Adhesive shall be applied on a dry, clean surface, free of grease, dust, and other loose particles. The method of mixing and application shall be in strict accordance with the manufacturer's recommendations.

TESTING REQUIREMENTS

- **ASTM C 192**  Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory.
- **ASTM D 149**  Tests for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies.
- **ASTM D 495**  Test for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation Materials
- **ASTM D 638**  Test for Tensile Properties of Plastics
- **ASTM D 1168**  Test for Hydrocarbon Waxes Used for Electrical Insulation
- **ASTM D 5329**  Joint Sealants, Hot-poured, for Concrete and Asphalt Pavements

END OF ITEM P-606

120-5 SUBMITTALS. The Contractor shall submit material product description, data, certification and test reports for adhesive compounds in accordance with Section PR-6, Submittal Procedures.

120-6 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

Adhesive compound, two-component for sealing wire and lights in pavement will not be measured for payment. Adhesive compound will be considered incidental to the associated airfield light base installation and no separate payment will be made.
No separate payment will be made for constructing the item under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 120
SECTION 121 – MODIFICATIONS TO EXISTING AIRPORT LIGHTING
CONTROL AND MONITORING SYSTEM

121-1 DESCRIPTION

Under this item, the Contractor shall coordinate, furnish and install material and provide all labor, equipment and service for the modifications of the existing Airport Lighting Control and Monitoring System (ALCMS) described herein and shown on the drawings.

121-2 BACKGROUND

Runway 7L-25R and adjacent taxiways at the Los Angeles International Airport (LAX) will be modified under the Safety Area and Pavement Rehabilitation Project.

The existing Runway 7L-25R centerline lights, edge lights, touchdown zone lights and threshold lights are controlled by the existing ALCM system. The modification and of pavement for Runway 7L-25R will require modifications to the existing ALCMS as a part of this contract.

The existing ALCMS is manufactured and supplied by Crouse-Hinds Airfield Lighting Products. The modification to the existing system shall be carried out by the Contractor, with the participation of Crouse-Hinds Airfield Lighting Product Company or by an equal capable manufacturer that have experience in the existing ALCMS.

121-2.1 Qualifications

The selected manufacturer that will carry out the modifications to the existing ALCMS shall demonstrate knowledge of the existing system, listed in FAA Approved Equipment List AC-150/5345-53 and shall be FAA Approved Supplier of L890 Airport Lighting Control and Monitoring System.

The ALCMS modifications supplier must demonstrate the ability to use the existing system hardware and software and integrate the modification to the existing system under this contract.

121-2.2 Project Scope

Following are the salient features of the ALCMS scope of work:

A. Tag and log the identification number and location of any Logitrac sensors and repeaters removed under this scope of work, so that they can be reinstalled at their existing locations. Store the component in a safe manner for reinstallation.

B. The new signs for the runway and taxiway guidance tend to create radio frequency interference (RFI) with the ALCMS. The new signs shall be provided with in-line filters in the base cans to control RFI. Signs not supplied with an integral filter shall be supplied with a filter as manufactured by Crouse-Hinds Lighting Product Company for compatibility with the existing ALCMS. Where existing signs are reused and relocated, existing filters may be utilized.
C. Due to extension of Runway 7L-25R, the graphic displays at Airfield Lighting Vaults No. 1, No. 2S, No. 2N, No. 3, Maintenance Facility and Control Tower shall be modified to include the changes. All necessary software and hardware changes shall be incorporated.

D. All Digitrac/Megatrac control cabinets located in Airfield Lighting Vaults No. 1, 2S, 2N and 3 that are affected by the modifications under this contract shall be re-calibrated to accommodate the changes.

E. The selected manufacturer shall be responsible for the following:
   (1) Fully functional and complete ALCMS
   (2) Providing Field Service Personnel as needed to complete system, coordinate with and provide direction to Contractor, and maintain project schedule
   (3) Software and programming upgrades to include the updated Runway and Taxiway geometry modifications
   (4) Configuration and programming of all new and reinstalled Logitrac Devices and Logitrac Adaptors
   (5) ALCMS screens, maps, and data base updates
   (6) System Commissioning
   (7) System Calibration
   (8) On-site training (Maintenance and Air Traffic Control)
   (9) System manuals and documentation
   (10) Coordinate and perform final inspection
   (11) Run site acceptance test
   (12) 7L and 25R Displace Threshold Lighting Control and Software Modifications

121-2.3 Project Coordination

A. ALCMS upgrade manufacturer shall provide an experienced and qualified technician to support contractor and airport throughout the installation and life of the system.

B. The ALCMS modification work requires close coordination and scheduling with the Engineer, LAWA, and FAA. When the work requires access to the Airfield Lighting Vaults, Maintenance Facility, Control Tower and other areas, the Contractor shall give 2 weeks prior notice to the Engineer for scheduling the work.

C. Contractor shall furnish a work schedule describing the basic cycle of event and sequence of work, to the Engineer for review, prior to the start of the project.
121-2.4 Installation and Commissioning

A. The installing contractor shall be responsible for the physical installation of all associated ALCMS upgrade components.

B. Manufacturer shall perform as a minimum, the following installation and commissioning tasks:
   (1) Verify Contractor connections including power, control and monitoring.
   (2) Perform all hardware calibrations.
   (3) Perform system testing including control, monitoring and diagnostic.
   (4) Perform System Acceptance Testing (SAT).

121-2.5 System Acceptance Test (SAT)

A. Detailed field test plan shall be submitted to the Engineer for review.

B. Following the final installation, commissioning and calibration of the system, manufacturer shall perform on-site a demonstration of the system performance. This demonstration shall include but not limited to, the following:
   (1) Control functions
   (2) Monitoring functions
   (3) Surveillance functions
   (4) Alarm functions
   (5) Print functions
   (6) Display functions

   The SAT must be witnessed by the Engineer and LAWA. The SAT must demonstrate operation of the software and hardware to the satisfaction of the Engineer and LAWA. A report of the SAT must be provided by the manufacturer when the testing is complete and results accepted by the Engineer.

C. As part of the SAT, the system must also complete one (1) week of continuous operation.

121-2.6 As-Built Drawings

A. Contractor shall provide updated as-built drawings incorporating the modifications to the ALCMS.

121-2.7 Operation and Maintenance Manuals

A. Manufacturer shall provide six (6) typewritten, easy to understand hard cover instruction manuals suitable for daily operation and maintenance of the system. The instruction manuals shall include as a minimum the following information:
(1) Operational overview and system description
(2) Logic and block diagrams
(3) Graphical User Interface Screen operation
(4) User configuration tools instruction manual
(5) System Block Diagram
(6) Drawings and data sheets of major system components
(7) Detailed external wiring diagrams (Electrical Contractor wiring)
(8) Detailed assembly drawings and wiring diagrams
(9) Original Equipment Manufacturer (OEM) Manuals

B. Manufacturer shall provide six (6) operation manuals for the Air Traffic Controllers (ATC) that are hard-covered and suitable for daily operation of the system. As a minimum, the manuals shall include the following information:
   (1) Touch screen operation (human machine interface)
   (2) Touch screen maintenance (i.e. calibration)

121-2.8 On-site Training

A. After the SAT is complete, manufacturer shall provide one (1) one-day training classes for airport operations and maintenance personnel. This training shall include but not limited to, discussion and review of the following:
   (1) System block diagram
   (2) Theory of Operation
   (3) System assemblies
   (4) System wiring diagrams
   (5) Graphical User Interface (GUI) Screens (Hands-on)
   (6) Touch screen Operation
   (7) Maintenance and Troubleshooting (Hands-on)

Training shall consist of classroom type and hands-on field activities.

B. During the on-site training period, manufacturer shall provide one (1), one-day training class and one-night shift training class dedicated for the Air Traffic Controllers (ATC), similar to the airport operations and maintenance personnel.

121-2.9 System Warranty

A. All new equipment shall be warranted against defects in workmanship, hardware and software for a period of twelve (12) month after substantial completion of the project.
121-2.10  Spare Parts

A. A recommended spare parts list shall be included with the Submittal including part numbers and pricing. These prices shall be valid for (12) months from date of substantial completion.

121-3  EQUIPMENT AND MATERIALS

121-3.1  General

A. New equipment and material for the modifications to the existing ALCMS shall match the existing equipment and material.

B. Logitrac sensing devices for use with in-pavement runway guard lights shall be compatible with the new in-pavement runway guard light fixtures and the existing ALCMS. In the current system, the Logitrac device shall only be used for “pulsing” the lights per FAA Advisory Circular 150/5340-30. The Logitrac device shall have the capability of being monitored in the future without update to the individual Logitrac device. Logitrac devices shall be paid for under the applicable bid item for In-pavement Runway Guard Light Fixture installation.

121-4  METHOD OF MEASUREMENT AND BASIS OF PAYMENT

An Allowance has been set aside in the Bid Schedule for “Modifications to ALCMS” in accordance with Special Conditions Section SC-6. All other work required under this section shall be considered incidental to other items.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.

END OF SECTION 121
SECTION 125 – INSTALLATION OF RUNWAY STATUS LIGHT SYSTEM

125-1.1 GENERAL. The Contractor shall perform all work required by the plans and specifications for installation of the runway status light system on the runway and taxiways as shown on the Plans, in accordance with the applicable FAA Advisory Circulars, and as directed by the Engineer.

This item includes the furnishing and installation of all equipment, materials, services, and incidentals necessary to place the system in operation as completed units to the satisfaction of the Engineer.

125-1.2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

125-1.3 RELATED SECTIONS

Section 27 – Construction Barricades, Fencing, Markers and Signs

Section 73 – Joint Sealing Filler (FAA P-605)

Section 113 – Underground Cable for Airports (FAA L-108)

Section 115 – Underground Conduit for Airports (FAA L-110)

Section 120 – Adhesive Compounds, Two-component for Sealing Wire and Lights in Pavement (FAA P-606)

Section 130 – RWSL Electrical Installation Testing

Other Sections, Tests, Specifications, and Standards referenced herein.

125-1.4 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1, Scope of Work and Phasing Summary, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.

125-1.5 SUBMITTALS. The Contractor shall submit material specification for the items listed in this Section in accordance with PR-6, Submittal Procedures.

125-1.6 QUALITY ASSURANCE

A. Comply with the National Electrical Code for components and installation.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the National Electrical Code.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
125-1.7 PROJECT CONDITIONS. Coordinate layout and installation of cable with other installations. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Engineer.

125-2.0 EQUIPMENT AND MATERIALS

125-2.1 GENERAL. Airport signage, lighting equipment and materials covered by FAA specification shall have the prior approval of the Federal Aviation Administration, Airports Service, Washington, D.C. 20591, and shall be listed in Advisory Circular 150/5345-53, Airport Lighting Equipment Certification.

All other equipment and materials covered by other referenced specifications shall be subject to acceptance through the manufacturer's certification of compliance with the applicable specifications.

Before purchasing materials, the Contractor shall submit manufacturer's shop drawings, photometric reports on all fixture types, specification sheets and engineering data for all materials as described in L-100 “Airfield Electrical Work”.

The fixtures, flange and spacer rings, base cans, isolation transformers, and Individual Light Controllers listed as materials will be provided to the Contractor for installation.

125-2.2 LIGHT FIXTURES. All RWSL fixtures shall meet the requirements of AC 150/5345-46. All lights shall be suitable for use with 6.6 amp circuits. Lights and base cans shall be compatible with each other as indicated in the following table:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Designation</th>
<th>Can</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runway Entrance Light (REL)</td>
<td>L-852S</td>
<td>L-868</td>
</tr>
<tr>
<td>Takeoff Hold Light (THL)</td>
<td>L-850T</td>
<td>L-868</td>
</tr>
</tbody>
</table>

125-2.3 RUNWAY ENTRANCE LIGHT - (L-852S). Runway Entrance Lights (RELs) shall be L-852S, Class 2 (base mounted), Mode 1 (6.6 amp constant current), Style 3, uni-directional, 105 watt lamp, provided at locations indicated on the Contract Documents. Fixture housings shall be of a one piece casting aluminum alloy with no sharp edges, screws or bolts on top surface of fixture. Fixtures shall be 12 inch diameter with no adapter rings to fit base cans. Filter lens color shall traffic signal red per the ITE standard for vehicle traffic control signal heads (ST-017). All RELs will require the use of an Individual Light Controller (ILC).

125-2.4 TAKEOFF HOLD LIGHT - (L-850T). Takeoff Hold Light (THLs) shall be L-850T, Class 2 (base mounted), Mode 1 (6.6 amp constant current), Style 3, uni-directional, 105 watt lamp, provided at locations indicated in the Contract Documents. Fixture housings shall be of a one piece casting aluminum alloy with no sharp edges, screws or bolts on top surface of fixture. Fixtures shall be 12 inch diameter with no adapter rings to fit base cans. Filter lens color shall traffic signal red per the ITE standard for vehicle traffic control signal heads (ST-017). All THLs will require the use of an Individual Light Controller (ILC).

125-2.5 ISOLATION TRANSFORMERS. All isolation transformers shall be type L-830, and shall meet the requirements of AC 150/5345-47. All transformers shall be 60 hertz, 6.6 amp
primary, 6.6 amp secondary, and rated as required for specific fixture type. The transformers identified lamp loads shall be 150 watts.

125-2.6 INDIVIDUAL LIGHTING CONTROLLERS (ILC). All Individual Lighting Controllers (ILC) shall be a single remote for controlling one fixture each. The ILCs shall be type Brite III, as manufactured by ADB Airfield Lighting, no exceptions. ILCs shall be placed in the base can and connected between the isolation transformer and fixture.

125-2.7 NEW BASE CANS. All base cans shall meet the requirements of AC 150/5345-42. Provide flange and spacer rings as required to bring fixture into proper alignment. Bases shall be galvanized steel with concrete encasement. Base cans shall be ordered with holes to accommodate the raceways indicated on the drawings. Provide nylon/rubber grommet at each hole as required on the drawings. Grommets shall be located at the depths shown on the drawings, and shall be sized per the conduit used. Conduit penetrating base cans shall be supplied with a bushing to prevent cable abrasion during installation. No adjustable base cans shall be used for installations. Fixture base plate shall require no adapter rings to fit base can.

All base cans shall be Class I, Size B. Standard can depth shall be 24 inches with some areas in the contract requiring deeper base cans to accommodate thicker paving sections. See plans for additional information.

Fixture bolt types shall be as recommended by the manufacturer and torqued to manufacturer's requirements.

125-2.8 EXISTING BASE CANS. Existing base cans identified for installation of new RWSL fixtures or blank plates shall receive new fixture bolts for installation of fixture or blank plate. Bolt shall be torqued to manufacturer's requirements.

125-2.9 TEMPORARY PLYWOOD COVERS. All temporary plywood covers shall conform to the requirements of AC 150/5345-42. Plywood covers shall be used to protect the light base flange during construction.

125-2.10 COVER PLATES. All cover plates shall meet the requirements of AC 150/5345-42. Solid cover plates for existing L-868 bases shall be 3/4-inch thick minimum and provided by the Contractor. The top of bolts attaching cover plates to base cans shall be flush or 1/8-inch below the adjacent pavement. Contractor shall use spacer rings to adjust elevation of cover plates.

125-2.11 FLANGE RINGS, BEVEL RINGS AND SPACERS. All flange rings, bevel rings and spacers shall conform to the requirements of the most current AC 150/5345-42. A flange ring with mud dam shall be used on all in-pavement fixtures. Spacer rings shall be used for adjustment of fixture elevation.

125-2.12 SEALANT. Sealant shall conform to the requirements of FAA specifications for sealant and the details herein. Sealant for around fixture top flange and spacer rings in concrete shall be P-605, P-606, or approved equal. Contractor shall not employ the use of Gardox sealant products.
125-3.0 CONCRETE ENCASEMENT. Concrete for backfill and encasement shall conform to the requirements of Section 90, Structural Concrete (FAA P-610), using 1 inch maximum size coarse aggregate with a minimum 28 day compressive strength of 4,000 psi. Concrete shall be red when used to encase ducts. Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A 615 Grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

125-3.1 CONSTRUCTION METHODS

125-3.2 The installation and testing details for the systems shall be as specified in the applicable circulars.

125-3.3 INSTALLING BASE CANS. Base cans shall be installed as shown on the plans. Before trenching or excavating, base can locations shall be surveyed and set within the tolerances as indicated on the contract documents. The Contractor will be held responsible for the correct layout, leveling, adjustment and orientation of all base cans installed.

Conduits entering base cans shall extend 1-1/2" into the can to allow for thermal contraction and expansion.

125-3.4 INSTALLING LIGHT FIXTURES. The Contractor shall provide fixtures in locations indicated and in accordance with the Contract Documents.

The light fixtures shall be installed in accordance with the Contract Documents. The Contractor will be held responsible for the correct layout, leveling, adjustment and orientation of all lights installed. All lines upon completion shall be true to line and uniform as judged by the Engineer. Each light fixture shall be grounded to the internal ground lug of the base can with a 36-inch braided ground strap equal to the #6 AWG wire as shown on the plans.

All bolts used to connect the fixture to the base can shall be coated with an approved anti-seize coating and used with a 2-piece lock washer.

Final fixture installation shall be checked at night, and shall be to the satisfaction of the Engineer. All lines of light shall be continuous without breaks or blackout spots as viewed by the Engineer from a vehicle.

125-3.5 ISOLATING TRANSFORMERS. The isolation transformers shall be placed in the base can as shown on the Contract Drawings. The primary and secondary cable connections shall be made as shown on the plans.

Provide 3-foot minimum slack cable inside the base can to permit connections of both primary leads to the transformer outside the base can. Additional cable slack for base cans greater than 24-inches deep will be required. Cable slack shall be sufficient to allow the isolation transformer, ILC, and fixture to rest on the pavement surface, 1-foot outside of the base can, during maintenance.
125-3.6 **INDIVIDUAL LIGHTING CONTROLLER (ILC).** The Individual Lighting Controllers primary and secondary cable connections shall be installed as shown on the plans. Each ILC shall be grounded to the internal ground lug of the base can with a 36-inch braided ground strap equal to #6 AWG wire as shown on the plans.

125-3.7 **CORRECTIVE ACTION.** The Contractor shall be responsible for correcting any deficient condition (installed under this contract) identified during the testing. If retesting of corrected conditions can be completed within the originally scheduled field test period, and then retesting shall be performed to verify that any deficient condition has been successfully corrected.

125-3.8 **INSTALLATION OF EXISTING LIGHT ON NEW BASE CAN IN NEW OR EXISTING PAVEMENT.** The Contractor shall install the new base can as shown on the plans and reinstall the existing equipment including light fixture, individual lighting controller, and transformer as shown on the plans. The Contractor shall use new L-823 splice kits, ground and power cables, and bolting hardware to make all connections.

125-3.9 **INSTALLATION OF NEW LIGHT ON NEW BASE CAN IN NEW OR EXISTING PAVEMENT.** The Contractor shall install the new base can as shown on the plans and install new equipment including light fixture, individual lighting controller, and transformer as shown on the plans. The Contractor shall use new L-823 splice kits, ground and power cables, and bolting hardware to make all connections.

125-4.0 **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

The following items shall be measured and paid for as described in Project Requirements – 4 of these specifications:

1. #8, 5KV, Black or Red, Type L-824 Unshielded Cable, RWSL
2. #6, 600V, Insulated Green Ground Wire, Solid, RWSL
3. 1-2" RGS or PVC Concrete-Encased Conduit, RWSL
4. 2" RGS Conduit in Sawkerf, RWSL
5. Reinstall THL Light, Iso Xformer, ILC with Base Can in new PCC
6. Reinstall REL Light, Iso Xformer, ILC w/ Base Can in new PCC
7. New REL Light, Iso Xformer, ILC with Base Can in Existing PCC Pavement

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.
END OF SECTION 125
SECTION 130 – RWSL ELECTRICAL INSTALLATION TESTING

130-1.1 GENERAL. This section shall consist of performing all tasks necessary to prove proper performance of the Runway Status Lights installation consisting of Takeoff Hold Light (THL) circuits and Runway Entrance Light (REL) circuits.

This section describes the electrical quality control testing furnished by the Contractor. The Contractor shall provide all testing as required by this section, including retesting of failed items. All items furnished and/or installed by the Contractor shall be tested in accordance with this section.

The Contractor shall provide for all electrical testing to confirm that the installations associated with this project comply with the Contract Documents. Contractor shall engage an independent organization to perform the Hi-Pot Testing with the Contractor providing all testing assistance.

The Contractor shall furnish all equipment, labor, supervision, transportation, materials and appliances necessary or required for testing the airport lighting systems before and after installation. The Contractor shall perform all tests in the presence of the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the pay item for the respective item being tested.

Any system installation errors or discrepancies of installation not in conformance with the Contract Documents shall be corrected at no additional cost. Equipment, cables and other components which do not satisfy the test requirements of this Section shall be removed and replaced with new equipment, cables and other components which do satisfy the requirements of this item including any necessary retesting required to confirm that the discrepancy has been corrected.

Weather information necessary to complete the testing forms may be obtained from the listed website http://www.faa.gov/air_traffic/weather/asos/ by selecting on the respective state and airport ID.

130-1.2 DEFECTIVE WORK. Any work performed under this section which fails to meet the requirements stated herein will be considered defective and, unless another remedy is stated, shall be removed and replaced at the Contractor’s expense.

Section 113 – Underground Cable for Airports (FAA L-108)

Section 115 – Underground Conduit for Airports (FAA L-110)

Section 125 – Installation of Runway Status Light Systems

Other Sections, Tests, Specifications, and Standards referenced herein.

130-1.3 LIMITED ACCESS / NIGHT CONSTRUCTION. See PR-1, Scope of Work and Phasing Summary, and the construction phasing drawings for restrictions relative to construction in areas of limited or night-time construction.
130-2.0 EQUIPMENT AND MATERIALS

130-2.1 SUBMITTALS. Materials and equipment covered by this item shall be subject to acceptance through manufacturer’s certification of compliance with the applicable specification when requested by the Engineer. All equipment, materials, methods and record keeping procedures shall be submitted to the Engineer for review in accordance with PR-6, Submittal Procedures.

The submittal shall include a list of the proposed test and measurement equipment to be used, the test and measurement equipment serial number, the current calibration certificate for each piece of equipment and a written description of the proposed test. A copy of the test and measurement equipment manufacturer’s recommended test procedure is acceptable as a written description of the proposed test.

The Contractor shall submit the qualifications of the organization performing the Hi-Pot testing. The submittal shall include:

A. The organizations name and address.
B. References for the organization from five previous air carrier airports with similar jobs to include names and phone numbers.
C. A complete list of all test, measurement equipment and all accessories proposed for use including the serial numbers of the equipment and a copy of the respective calibration certificates.
D. Test procedures and safety precautions required during testing.
E. Qualifications and experience of persons performing the testing.
F. References for the person designated to perform the testing from five previous similar jobs to include names and phone numbers.

Submit a proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits. The Contractor shall submit a complete list of required tests and a proposed schedule and duration of the tests. The schedule shall be integrated with the overall project schedule. The Contractor shall update the testing schedule on a monthly basis for the duration of the project.

All test results shall be submitted in a bound report no later than two weeks after the completion of all testing.

130-2.2 SAFETY. Dangerous voltages are present during the system testing. The Contractor is solely responsible for the safety of all personnel involved in the testing activities and shall ensure that all testing areas are secured to prevent the entry of unqualified personnel.

Observe all safety instructions or precautions recommended by testing equipment manufacturer.

The Contractor shall perform a “Hazard/Risk Evaluation” of each test site and procedure. The Contractor shall provide a job briefing and install the necessary barriers and barricades at the respective approach boundaries prior to starting the testing.
The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

In addition to compliance with the Contractor's safety program, the Contractor shall comply with the following documents/programs:

- OSHA, 29CFR1910 Occupational Safety and Health Standards
- OSHA 29CFR1926 Safety and Health regulations for Construction
- NFPA 70B Recommended Practice for Electrical Equipment Maintenance
- NFPA 70E Standard for Electrical Safety in the Workplace
- AC 150/5340-26 Maintenance of Airport Visual Aid Facilities
- Airport’s safety program.

130-2.3 QUALIFICATIONS. Each person performing testing shall have a minimum of 5 years of successful experience on similar projects. At least 3 of these years of experience shall have occurred in the last 5 years on projects of comparable size and complexity. Persons performing the testing shall have passed a proctored Journeyman Electrician’s exam with 75% grade or better and be a commercial licensed Journeyman Electrician. Equivalent training and experience may be considered by the Engineer. Documentation demonstrating compliance with these requirements shall be submitted to the Engineer for verification and review before starting the testing. Experience records shall include references (names and phone numbers) from airports where the test procedures have been performed in a satisfactory manner. Only persons whose experience records have been confirmed by the Engineer shall perform testing.

The person performing the tests shall be a “qualified person” as defined in NFPA 70E.

The person performing the tests shall be thoroughly familiar with the test equipment used in the test performed and shall be sufficiently experienced to detect equipment abnormalities or questionable data obtained during the test procedure.

Each piece of test and measurement equipment utilized to demonstrate compliance with the Contract Documents shall be calibrated. The level of calibration shall be “NIST traceable, Z540 Calibration with Data”. The test and measurement equipment calibration shall be valid for one year. At any time the Engineer may require the Contractor to have a piece of test equipment recalibrated. Should the Engineer have any reason to doubt the accuracy of a piece of test equipment, even within current calibration, the test and measurement equipment shall be removed from the project. The Engineer shall determine which tests shall be redone due to the malfunctioning equipment.

The test and measurement equipment calibration lab as a minimum shall meet the requirements of ANSI/NCSL Z-540 and shall be A2LA accredited.

The High Potential (Hi-Pot) tests shall be performed by an independent agency certified by the National Electrical Testing Association (NETA) with certified technicians using properly calibrated equipment and standard procedures.
130-2.4 TESTING COORDINATION. After installation of all required components and before final acceptance, in accordance with project phasing and schedule make required tests to determine proper function of all circuits.

Ten days prior to any testing the Contractor shall notify the Engineer of the tentative start of testing. Together, a mutually agreed upon schedule of testing will be developed. All requirements under this item shall be coordinated with the Engineer.

The Contractor shall perform the necessary inspection and tests for some items concurrently with the installation because of subsequent inaccessibility of some components.

The Contractor shall ensure that all test and measurement equipment, accessories and qualified personnel are available prior to scheduling tests.

All test results shall be recorded by the Contractor and witnessed by the Engineer or designated representative, unless the Engineer has provided written instruction to proceed in the Engineer’s absence. Test results shall be submitted in a bound report after the specified testing is completed.

The Contractor is reminded that due to phasing constraints, any outside testing agencies utilized may have multiple mobilizations required to test airfield lighting systems as each area is completed. For projects completed in phases, the respective required testing must be completed by phase.

130-2.5 TEST AND MEASUREMENT EQUIPMENT. Electrical test and measurement equipment shall be an off the shelf item, not a one of a kind prototype. The test and measurement equipment shall be manufactured by a firm regularly engaged in the manufacture of precision electrical test and measurement equipment for the industrial, commercial and utility marketplace. Typical accuracy for test equipment shall be + 2% of instrument reading and shall be TRUE RMS.

The Engineer shall confirm that the test and measurement equipment proposed for use by the Contractor is suitable for the intended use. The Engineer shall have sole discretion to determine if the test and measurement equipment is suitable for the intended use.

The ground point for the cable test equipment shall be the shelter ground bus. The shelter ground bus, shelter ground system, and airfield guard wire system shall be complete prior to cable testing.

130-3.0 CONSTRUCTION METHODS

130-3.1 GUARD WIRE AND EARTH ELECTRODE SYSTEM TESTING. Continuity of guard wire and Earth Electrode Systems (EES) shall be checked by visual inspection as construction progresses, prior to work being covered up. Verification of guard wire system continuity shall also be checked by visual inspection at accessible locations during normal inspections.

Should the guard wire or earth electrode system conductors be damaged or are suspected to be damaged by construction activities (in the opinion of the Engineer) the Contractor shall test the conductors for continuity with a micro-ohmmeter. The conductors shall be isolated such that
there is no parallel path. Alternatively the Contractor may conduct tests and through mathematical computations prove the continuity of the conductors.

Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

Verification of the adequacy of the guard wire and earth electrode systems shall be by taking earth resistance measurements as detailed below. Earth resistance measurements shall be made in normally dry conditions not less than 48 hours after the last rainfall.

Initially the Contractor shall test each ground rod in accordance with the following instructions. The horizontal distance between the Ground Electrode under Test (Electrode X) and the Auxiliary Current Electrode (Electrode Z) shall be 4 times the depth (length) of the ground electrode under test.

The three electrodes shall be installed in a straight line in a direction away from other underground metallic items. The test leads shall be separated.

The first test shall be conducted with the Auxiliary Potential Electrode (Electrode Y) at 45% of the distance between the X and Z electrodes. The earth resistance shall be measured and recorded at the 45% position. The Y electrode will then be moved 5% closer to the Z electrode to the 50% position and the earth resistance shall be measured and recorded. The previous steps will be repeated at 5% distance intervals through the 80% position. Graph the resultant points on the form provided at the end of this item.

The above test method shall be utilized at each new ground rod installation until otherwise determined by the Engineer. The Engineer will use the acquired data to establish a revised distance ratio between the X and Z electrode.

Once the new electrode distance ratio is set by the Engineer, the Contractor may perform the tests with a single test position for electrode Y.

Earth resistance tests shall be performed as each ground rod is installed. Earth resistance tests shall be conducted prior to the connection of any grounded, earth electrode system or guard wire conductors. Ground rods not in compliance with the not to exceed maximum earth resistance shall have an additional 10’ section(s) added until the required earth resistance is achieved.

The Earth Electrode System and Guard Wire Systems shall be tested individually. After satisfactory testing is completed on each system, the EES and Guard Wire System shall be terminated together.
130.3.2 **RWSL Circuit Continuity Testing.** After new cable installation and before the Hi-pot test or power applied, the airfield lighting series circuit cable system shall be given a circuit internal resistance (continuity) test.

This test shall be conducted at the high voltage output cabinet where the L-824C cables enter the facility used to house the Constant Current Regulator (CCR) and shall be used to prove continuity of the entire circuit. All L-824C cables are to be disconnected from the surge arrester assemblies inside the high voltage output box and all circuits not being tested shall be grounded to the EES. The Contract Documents shall be reviewed to confirm proper circuit routing, connection and installation of necessary components prior to testing.

The cable, connectors, isolation transformers, ILCs and fixtures shall be in their final configurations ready for connection to the constant current regulator (CCR).

The EES and Guard Wire System shall be terminated together.

Observe all OSHA required safety precautions.

The circuit’s internal resistance (continuity) test shall be performed using an ohmmeter with sufficient output to measure the circuit’s internal resistance. The expected internal circuit resistance should be within 20 percent of calculated value shown in calculations shown under “Calculations” Section of these Specifications.

Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

Upon successful completion of circuit’s internal resistance (continuity) test, record the measured circuits internal resistance on the cable test form included at the end of this Section.
130-3.3 RWSL CIRCUIT INSULATION RESISTANCE TESTING. [The circuit insulation resistance test (megger test) may be used to verify the continuity of a L-824C cable or circuit during construction of each phase or lighting array.]

The RWSL circuit insulation resistance test shall be performed with a megohmmeter providing a test voltage of 1,000 volts DC. The output of the megohmmeter shall be direct reading in megohms and shall have an upper range limit of at least 10 gigohms or greater.

Observe all OSHA required safety precautions such as safety glasses (or face shield), hot gloves, fireproof clothing, etc..

Ground all other conductors within the conduits or ducts containing the conductor under test.

Connect the test instrument in accordance with the manufacturer’s recommendations. Record data at the required intervals on the form provided at the end of this Item. The insulation resistance measurement results shall be corrected to 20 degree Centigrade (68 degrees Fahrenheit).

The expected insulation resistance for the completed circuit should be in excess of 50 megohms.

Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

Upon successful completion of circuit’s insulation resistance test, record the measured circuits internal resistance on the cable test form included at the end of this item.

130-3.4 RWSL CIRCUIT HIGH POTENTIAL TESTING: Prior to performing the Hi-pot test, the circuit continuity test must be completed and any discrepancies in the circuit corrected.

This test shall be conducted at the high voltage output cabinet where the L-824C cables enter the facility used to house the Constant Current Regulator (CCR). All L-824C cables are to be disconnected from the surge arrester assemblies inside the high voltage output box and any cables not being tested must be grounded to the EES.

The cable, connectors, isolation transformers, ILCs and fixtures shall be in their final configuration, ready for connection to the constant current regulator (CCR).

Warning, this test is being conducted with 10kV; observe all OSHA required safety precautions.

In damp conditions, humidity, condensation and actual precipitation on the surface of a cable termination can increase the leakage current by several orders of magnitude. Humidity also increases the corona current, which indication is included in the total leakage current. The Contractor shall evaluate the conditions and determine if the safety requirements are being met.

The airfield lighting circuit Hi-Pot test shall be performed with a calibrated high voltage test set which has steady, filtered direct current output voltage. The high voltage test set shall include an accurate voltmeter and microammeter for reading the voltage applied to the circuit and resultant insulation leakage current.

Ground all other conductors within the high voltage output cabinet containing the conductor under test.

Clean and dry the cable under test for a distance of 1 foot from the ends.

Connect one lead of the Hi-Pot test instrument to the cable and the other lead to the EES.
At the end of each test, discharge the cable with a hot stick to the EES. The Hi-Pot test shall be conducted for ten (10) minutes. Step the voltage up, hold and down in accordance with the test form included at the end of this item. Record data at the required intervals on the form provided at the end of this Item. The insulation resistance measurement results shall be corrected to 20 degree Centigrade (68 degree Fahrenheit).

Insulation leakage current shall be measured and recorded for each circuit after a 1 minute application of the test voltage. If leakage current exceeds values specified below, the circuit shall be sectionalized and retested and the defective parts shall be repaired or replaced. Leakage current limits include allowances for the normal number of connectors and splices for each circuit as follows:

A. Three microamperes for each (300 m) 1000 feet of cable.
B. Two microamperes for each 5,000-volt series transformer.

If the measured value of insulation leakage current exceeds calculated value, the circuit shall be sectionalized and tested as specified for each section. Defective components shall be corrected or replaced until repeated tests indicate an acceptable value of leakage current for the entire circuit.

Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

Upon successful completion of the high potential test on all L-824C circuits within the facility terminate L-824C cables to the surge assemblies.

**130-4.0 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.**

No separate measurement or payment for RWSL System Testing will be made. The cost associated with this work shall be applied to the associated bid items for the Runway Status Light System.

No separate payment will be made for constructing performing the item work under construction sequencing restrictions, including limited access or nighttime work areas.
Earth Resistance Test

Instrument Mfg: ____________________  Test Date ________________
Model ____________________  Operator Name ____________________
Serial Number ____________________  Test Location ____________________

### Test Conditions

<table>
<thead>
<tr>
<th>Soil Condition</th>
<th>Moist</th>
<th>Dry</th>
<th>Temperature °F °C</th>
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<table>
<thead>
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<th>Soil Type</th>
<th>Clay</th>
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<td>Slate</td>
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### Weather Conditions

- Relative Humidity: _____________
- Precipitation Accumulation: _____________
- Sky Conditions: _____________

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<th>Grounding System</th>
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<td>Rod Depth _______ ft</td>
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### Voltage Electrode

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Comments: ____________________
HIGH POTENTIAL TEST REPORT

Date: _____________________________ Start Time: _______ / Stop Time: __________

Circuit Designation: __________________________

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<tr>
<th>Circuit Designation:</th>
<th>Circuit Description:</th>
<th>Circuit Length:</th>
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<table>
<thead>
<tr>
<th>Circuit Operating Voltage:</th>
<th>Circuit Isolation Transformers Qty/Size:</th>
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Associated equipment included in test:

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<tr>
<th>Circuit Continuity:</th>
<th>Test Voltage:</th>
<th>Cable Manufacturer:</th>
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VISUAL/MECHANICAL INSPECTION

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<td>ACCEPTABLE BENDING RADIUS</td>
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<td>TIGHTNESS CABLE CONNECTION</td>
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ELECTRICAL TESTS

MEGGER @ 2500 VDC (1 MINUTE) = > 50KMO

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<th>LEAKAGE CURRENT (MICRO-AMPS)</th>
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<td>DECAYING VOLTAGE</td>
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*CONDITION: A=ACCEPTABLE, R=NEEDS REPAIR/REPLACEMENT OR ADJUSTMENTS, C=CORRECTED, NA=NOT APPLICABLE

Engineer: __________  Witness: ________________  Tested By: ________________
Test sheet:__________

<table>
<thead>
<tr>
<th>TIME</th>
<th>Hi-Pot</th>
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<tbody>
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<tr>
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<td>15 sec</td>
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<td>60 sec</td>
<td>1.3</td>
</tr>
<tr>
<td>1 min</td>
<td>1.2</td>
</tr>
<tr>
<td>30 sec</td>
<td>1.1</td>
</tr>
<tr>
<td>45 sec</td>
<td>1.0</td>
</tr>
<tr>
<td>60 sec</td>
<td>0.9</td>
</tr>
<tr>
<td>1 min</td>
<td>0.8</td>
</tr>
<tr>
<td>30 sec</td>
<td>0.7</td>
</tr>
<tr>
<td>45 sec</td>
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</tr>
<tr>
<td>60 sec</td>
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</tr>
<tr>
<td>1 min</td>
<td>0.4</td>
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</tr>
<tr>
<td>45 sec</td>
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<tr>
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<tr>
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**Suggested Hi-Pot Test Process**

1) Apply the DC Voltage up to the prescribed maximum test voltage of 10 kV in 4 Equal steps
2) Raise the voltage at an even rate obtain each required step in not less than 10 seconds
3) Hold the voltage at each step for 60 seconds.
4) Read and Record the leakage current at the end of each hold project.
5) Hold the maximum test voltage of 10kV for approximately 10 minutes
6) Read and record the leakage current at 15 second intervals during the first two minutes and then every minute thereafter for the remainder of the test.
7) Bring the test voltage control quickly and smoothly to zero
8) Discharge cable to EES with hot stick
### Airfield Lighting Circuit Continuity and Insulation Resistance Testing

**Date:**

**Start Time:** __________ / **Stop Time:** __________

<table>
<thead>
<tr>
<th>Circuit Designation</th>
<th>Circuit Description</th>
<th>Circuit Length</th>
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<table>
<thead>
<tr>
<th>Circuit Operating Voltage</th>
<th>Circuit Isolation Transformers Qty/Size</th>
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<table>
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<tr>
<th>Hazard Risk Evaluation Performed?</th>
<th>Ambient Temperature</th>
<th>Relative Humidity</th>
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<tbody>
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<th>Serial #</th>
<th>Upper Range Limit</th>
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Associated Equipment included in test:

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<tr>
<th>Circuit Continuity</th>
<th>Test Voltage:</th>
<th>Cable Manufacturer:</th>
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**Tested by:**

**Witness:**

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<th>10.0</th>
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Comments: ____________________________________________
END OF SECTION 130