20190403 - April's Specifications Committee Meeting

April Specifications Committee Meeting Agenda

Meeting Date
Wednesday, April 3, 2019 @ 9:00am
Building 5, Room 855

Approved Permanent Specification changes from last Committee meeting (2/6/19)

- **601.4.2-Contractor's Quality Control** Requires direct oversight of concrete batching operations by certified PCC Technician. It also requires any Agency tests Contractor QC cylinders to be certified for testing cylinders in accordance with ASTM C1077.
- **601.7-Mixing** Clarifies the 1-hour discharge time doesn't apply when mixes that use a hydration control stabilizing admixture are used. It also notes that if superplasticizer is used to adjust the slump of a mix at the jobsite, water can't be used after that to make further slump adjustments.

Approved Project Specific Special Provisions (SP) from last Committee meeting (2/6/19)

- None

Items removed from Committee Agenda

- SP601 - Embedded Galvanic Anode Protection
- SP601 - Epoxy Bonding Compound
- SP601 - Epoxy Injection
- SP601 - Shotcrete

Old Business - Provisions discussed at last Committee meeting

<table>
<thead>
<tr>
<th>Section</th>
<th>Provision</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>601</td>
<td>601.8.7-Removal of Forms and Construction of Superimposed Elements</td>
<td>3rd time to committee; discussed in December &amp; February. Proposed specification change to Section 601. It requires adjacent bridge deck placements within a pour sequence to be treated as superimposed elements in Table 601.8.7. No update to the proposed specification. A redline copy, showing the proposed changes/updates to the existing specification is included. Approval is expected in April.</td>
</tr>
<tr>
<td>603</td>
<td>SP 603 - Post Tensioning</td>
<td>3rd time to committee; discussed in December &amp; February. Project Specific Special Provision (SP) for furnishing, installing, stressing, and grouting of post tensioning tendons. Provision has been updated per comments at the last meeting. A redline copy, showing the latest changes/updates is included. Approval is expected in April.</td>
</tr>
<tr>
<td>604</td>
<td>SP 604 - Cured-in-place Pipe Liner</td>
<td>3rd time to committee; discussed in December &amp; February. Project Specific Special Provision (SP) for cured-In-Place pipe liner. Provision has been updated per comments at the last meeting. A redline copy, showing the latest changes/updates is included.</td>
</tr>
</tbody>
</table>
Approval is expected in April

<table>
<thead>
<tr>
<th>SECTION</th>
<th>TITLE</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>601</td>
<td>601.13.3-Concrete Protective Coating</td>
<td>This is an update to specification approved at the last meeting and included in 2019 Supplemental. 2nd time to Committee; discussed in February. Proposed specification change to Section 601. It updates the concrete protective coating subsection. The specification has been updated. Adding pay item for all surface prep &amp; separate pay item for coating. A redline copy, showing the proposed changes/updates to the 2019 supplemental specification is included.</td>
</tr>
<tr>
<td>711</td>
<td>711.1 through 711.23</td>
<td>The material requirements changes/updates related to the coatings are also included. 1. 711.1 through 711.23 No update to 711.1 - 711.23</td>
</tr>
<tr>
<td>604</td>
<td>SP604 - Pipe Lining</td>
<td>This is an update to previously approved SP's. 2nd time to committee; discussed in February. Project Specific provision for HDPE Pipe Liner. The update revises the appendix so that inside &amp; outside pipe diameters are listed. Provision has been updated per comments at the last meeting. It is a redline copy, showing the proposed changes/updates to the previously approved version.</td>
</tr>
<tr>
<td>616</td>
<td>SP616 - Predrilled Piling backfilled with Concrete</td>
<td>This is an update to previously approved SP's. 2nd time to committee; discussed in February. Project Specific provision for predrilled piling and backfilled with concrete. The update allows modified Class B. It is a redline copy, showing the proposed changes/updates.</td>
</tr>
<tr>
<td>108</td>
<td>108.7.1-Failure to Complete on Time and Liquidated Damages</td>
<td>2nd time to committee; discussed in February. Proposed specification change to Liquidated Damages table. The provision is a redline copy, showing the changes/updates to the existing specification is included.</td>
</tr>
<tr>
<td>492</td>
<td>SP 492 - Cold Central Plant Recycling</td>
<td>2nd time to committee; discussed in February. Project Specific Special Provision (SP) for cold central plant recycling. The provision is a redline copy, showing the latest changes is included.</td>
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</table>

**New Business - New Provisions for Spec Committee**

<table>
<thead>
<tr>
<th>SECTION</th>
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</tr>
</thead>
<tbody>
<tr>
<td>490</td>
<td>SP490-Nine Year Pavement Performance Criteria</td>
<td>This is an update to previously approved SP. 1st time to Committee. Project Specific Special Provision for long term warranty. The update would all use of the Division's in-place automated pavement condition data collection in evaluating warranty paving projects.</td>
</tr>
</tbody>
</table>
Two versions of the SP are attached. One is a redline copy, showing the proposed changes & the other is a clean copy.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>219</strong></td>
<td><strong>219.4.2-Testing</strong></td>
<td><strong>1st time to Committee.</strong> Proposed specification change to Section 219. It adds pH testing to controlled low-strength material (CLSM). A redline copy, showing the proposed changes/updates to specification is included.</td>
</tr>
<tr>
<td><strong>403</strong></td>
<td><strong>SP403 Hot-Applied Asphalt Mastic Treatment</strong></td>
<td><strong>1st time to Committee.</strong> Project Specific Special Provision for hot-applied asphalt mastic treatment. This is a maintenance item that is used to fill large cracks in asphalt pavement that are normally too big for standard crack seal, yet smaller than what would justify patching.</td>
</tr>
<tr>
<td><strong>501</strong></td>
<td><strong>501.1, 501.2, &amp; 501.3</strong></td>
<td><strong>1st time to Committee.</strong> Proposed specification changes for material name changes, so that they are in line with current terminology in the AASHTO standards. Those include changing: • “pozzolan” to “supplementary cementitious material (SCM)” • “ground granulated blast furnace slag (GGBFS)” to “slag cement” • “microsilica” to “silica fume” A redline copy, showing the proposed changes/updates to specification is included.</td>
</tr>
<tr>
<td><strong>514</strong></td>
<td><strong>514.1, 514.2. 514.3, 514.5, &amp; 514.8</strong></td>
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<tr>
<td><strong>601</strong></td>
<td><strong>601.2, 601.3, &amp; 601.6</strong></td>
<td></td>
</tr>
<tr>
<td><strong>603</strong></td>
<td><strong>603.2, 603.6.1.1, &amp; 603.6.3.1</strong></td>
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<tr>
<td><strong>604</strong></td>
<td><strong>604.2-Materials</strong></td>
<td><strong>1st time to Committee.</strong> Proposed specification change to Section 604. It corrects a couple invalid material references. A redline copy, showing the proposed changes/updates to specification is included.</td>
</tr>
<tr>
<td><strong>620</strong></td>
<td><strong>620.5.1.9</strong></td>
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<tr>
<td><strong>623</strong></td>
<td><strong>Section 623 - Pneumatically Applied Mortar or Concrete (Shotcrete)</strong></td>
<td><strong>1st time to Committee.</strong> Proposed specification change to Section 623. It is a complete section rewrite.</td>
</tr>
<tr>
<td><strong>679</strong></td>
<td><strong>679.1, 679.2, 679.3, &amp; 679.4</strong></td>
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<tr>
<td><strong>707</strong></td>
<td><strong>707.4</strong></td>
<td></td>
</tr>
<tr>
<td><strong>601</strong></td>
<td><strong>SP601 - Electrochemical Chloride Extraction</strong></td>
<td><strong>1st time to Committee.</strong> Project Specific provision for Electrochemical Chloride Extraction (ECE).</td>
</tr>
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<td><strong>604.2-Materials</strong></td>
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<td><strong>699</strong></td>
<td><strong>SP699-Just in Time Trainings</strong></td>
<td><strong>1st time to Committee.</strong> Project Specific provision for Just-in-Time Training. It would allow training</td>
</tr>
</tbody>
</table>
of project construction personnel responsible for the construction and inspection to attend, when added to contract.

| 705 | 705.5-Performance Graded Asphalt Binders | 1st time to Committee. Proposed specification change to Section 705. It adds elastic response to the PG64H-22 and updates the section to use new AASHTO procedure numbers. 2 version of the spec change are included. A redline copy, showing the proposed changes/updates to specification and clean copy. |
| 707 | 707.1  
707.13  
707.14  
707.15  
707.17 | 1st time to Committee. Proposed specification change to Concrete Admixtures. It updates the acceptance requirements; we will now be approving products through NTPEP. The provision is a redline copy, showing the changes/updates to the existing specification is included. |
| 715 | 715.39-Elastomeric Gasket and Sealing Material | 1st time to committee. Proposed specification change to Section 715. It updates an invalid ASTM reference. The provision is a redline copy, showing the changes/updates to the existing specification is included. |

**Comments**

Comments are requested on these Specification Changes and Project Specific Special Provisions. Please share your comments by April 1, 2019, they help in the decision making process. Please Send Comments to: DOHSpecifications@wv.gov

**Deadline for new items & updates to these provisions is May 8, 2019**

If you are the 'champion' of any specification changes and/or project specific special provisions currently in the Specification Committee, it is your responsibility to edit/update/modify them in a timely manner per comments and discussion in Spec Committee. *Failure to submit updates may result in removal of item and/or delays.*

**Next Meeting**

Wednesday, June 5, 2019 at 9am  
Building 5, Room 855: *(If Available. If not available a change in venue will be attached on the door)*

**2017 Standard Specifications Roads and Bridges & 2019 Supplemental Specifications**

**Electronic Copy (pdf):** The 2017 Standard Specifications Roads and Bridges & 2019 Supplemental Specifications can be viewed, printed, or downloaded from the Specifications Website. A link to the Specifications pages is here: http://transportation.wv.gov/highways/contractadmin/specifications

**Print Version:** Hard copies of the 2017 Standard Specifications Roads and Bridges & 2019 Supplemental Specifications are available thru Contract Administration. An order form for the book is on Specifications Website. A link to the pages is here: http://transportation.wv.gov/highways/contractadmin/specifications
2019 Specifications Committee
The Specification Committee typically meet every other month; on the first Wednesday. 2019 meetings will be held in February, April, June, August, October, and December. *Calendar subject to change, updates will be given, as needed.*

Specifications Committee Website
A copy of the meeting agenda can be found on the Specifications Committee Website http://transportation.wv.gov/highways/contractadmin/specifications/SpecComit

Material Procedures
Material Procedures (MPs) referenced in provisions are available upon request.

For questions regarding the Standard Specifications Roads and Bridges, Supplemental Specifications, Project Specific Special Provisions, or the Specifications Committee please e-mail DOHSpecifications@wv.gov

File Format Structure and Progression of items thru Specifications Committee
The purpose of the below protocol is to provide guidance on the file structure of Proposed Specification & Project Specific Special Provision as they progress thru Specification Committee. This procedure would facilitate a means of tracking changes from meeting to meeting; as the agendas & provisions are posted publicly online on the Spec Committee website.

TYPES OF PROVISIONS:
There are three standard types of provisions typically discussed in committee:
1. Specification Changes – These are permanent changes to the WVDOT Standard Specifications.
   • Unless inserted into a project proposal, these changes typically go into effect in January (of subsequent year) with the Supplemental Specifications.
2. Project Specific Special Provisions (SP) – Are applied to specifically designated projects.
3. Updates to previously approved SP – Changes/edits/updated to SP that have been approved by spec committee.

NEW BUSINESS ITEMS:
New items to should be setup & submitted in the following format:
1. Specification Changes – Shown as red-line copy (see note)
2. Project Specific Special Provisions (SP) – Will be shown in all black.
3. Updates to approved SP – Shown as red-line copy

Each item should also include a description with:
• Brief overview of item
• Background info and/or reason for change

NOTE: Red-line copy is a form of editing in which indicate removal or addition of text. You can redline a Microsoft Word document by using the built in “Track Changes” feature or you can manually redline document with font color changes & strike-through.

OLD BUSINESS ITEMS:
Updated provisions that were discussed at the last committee meeting should be setup in the following format:
• Redline copy from prior meeting would not be shown
• Redline copy of new changes/updates (from previous meeting)

PROGRESSION OF ITEMS THRU COMMITTEE AND APPROVAL:
Depending on how important the project and/or comments/discussion of item at previous meeting, then several things can happen in no particular order
• Few comments/discussion/minor changes ... will recommend approval of item at next meeting
• A lot of comments/discussion ... will not recommend approval at next meeting; item will be updated and reviewed again at next meeting.
• SP’s in committee may be used in advertised project. Hope to work to address comments & finish approving at subsequent meeting.
601.8-FORMS:
   601.8.7–Removal of Forms and Construction of Superimposed Elements:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

The forms for any portion of the structure shall not be removed until the concrete is strong enough to prevent damage. Methods of form removal likely to cause overstressing of the concrete shall not be used.

The minimum requirements for removal of forms or supports and the construction of superimposed elements shall be as specified in Table 601.8.7.

Due to continuity of reinforcement between placements and other issues, adjacent bridge deck placements shall be considered superimposed elements and must meet the minimum strength requirement in Table 601.8.7 before an adjacent placement in the sequence may be placed.

In lieu of field cured cylinders for the determination of compressive strength required for from removal and construction of superimposed elements, the Contractor may use the Maturity Method for the estimation of concrete strength as outlined in MP 601.04.21.

TABLE 601.8.7

<table>
<thead>
<tr>
<th>Structural Element</th>
<th>Removal of Forms</th>
<th>Placing Concrete In Superimposed Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compressive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strength-psi (Mpa)</td>
<td>Compressive Strength-psi (Mpa)</td>
</tr>
<tr>
<td>Bridge Decks</td>
<td>2000 (14.0)</td>
<td>3000 (21)</td>
</tr>
<tr>
<td>Columns</td>
<td>2000 (14.0)</td>
<td>2000 (14.0)</td>
</tr>
<tr>
<td>Walls &amp; Beams</td>
<td>2000 (14.0)</td>
<td>2000 (14.0)</td>
</tr>
<tr>
<td>Footings</td>
<td>500 (3.5)</td>
<td>2000 (14.0)</td>
</tr>
<tr>
<td>Components Supported By Falsework</td>
<td>3000 (21)</td>
<td>3000 (21)</td>
</tr>
<tr>
<td>Parapets</td>
<td>2000 (14.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(See 601.11)</td>
<td></td>
</tr>
</tbody>
</table>
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SPECIAL PROVISION

FOR

STATE PROJECT NUMBER: ________________________________
FEDERAL PROJECT NUMBER: ________________________________

SECTION 603
PRESTRESSED CONCRETE MEMBERS

ADD THE FOLLOWING TO SUBSECTION:

603.19-POST-TENSIONING:
The work under this section shall consist of furnishing, installing, stressing, and grouting of post-tensioning tendons in accordance with the details shown on the Plans, Section 603 of the Specifications, and this Special Provision.

603.19.1-Description:
Furnish and install all post-tensioning systems and any other pertinent items necessary for the prestressing system used, including but not limited to ducts, anchorage assemblies and supplementary reinforcement. Furnish all components of a post-tensioning system, including deviators for future post-tensioning, but not necessarily the prestressing steel, from a single supplier.

Install prestressing steel, which may be strands or bars, through ducts in the concrete. Stress to a predetermined load and anchor directly against the hardened concrete. Grout ducts to fill all voids and install protection at end anchorages.

Submit shop and working drawings and manuals in accordance with Section 603.19.1.2 of this Special Provision and Section 105 of the Specifications. The Contractor’s Specialty Engineer shall produce all shop drawings related to post-tensioning which shall bear the signature and seal of the responsible engineer.

603.19.1.1-Qualifications and Inspection:
Perform all post-tensioning field operations under the direct supervision (crew foreman) of a qualified post-tensioning and grouting technician. Provide project personnel, a crew foreman and crew members in accordance with Section 603.19.1.6 of this Special Provision. Conduct all stressing and grouting operations in the presence of the Engineer.
603.19.1.2-Shop Drawings: Prepare shop drawings to address all requirements stated in Section 105.2 of the Standard Specifications, contract plans and the requirements stated herein.

The Contractor will be required to submit checked detailed Shop Drawings, which include, but are not limited to, the following:

1. A complete description of all details covering each of the post-tensioning systems proposed for permanent tendons.
2. Prestressing details shall include method, sequence, and procedure of prestressing, securing tendons, release procedures and equipment.
3. Limitations of the selected post-tensioning system, tendon geometry and location of the tendons, specifics of the post-tensioning steel, anchorage devices, sheathing material, and accessory items to be used.
4. Anchorage system details, size and type of ducts for all post-tensioning tendons and their horizontal and vertical profiles. Duct supports and grout tubes, inlets, outlets, high point outlet inspection details, anchorage inspection details and permanent grout caps, protection system materials and application limits.
5. A table giving jacking sequence, jacking forces and initial elongation, and estimates of anchor sets of the tendons at each stage of erection for all post-tensioning.
6. Parameters to be used to calculate the typical tendon force such as expected friction coefficients, anchor set, and post-tensioning relaxation curves.
7. Certified copies of reports covering tests performed on post-tensioning steel and anchorages devices as required by Section 603.19.1.5 of this Special Provision.
8. The submittal shall also include information regarding the grout mix design, the method of mixing and placing the grout and the type and capacity of equipment to be used.
9. The details of the anchorage systems shall be shown including local zone reinforcement steel required to resist the concrete bursting stress in the vicinity of the anchorage assemblies.

603.19.1.3-Alternate Post-Tensioning Designs: Alternate designs using a post-tensioning scheme other than that shown on the plans may be submitted for the Engineer’s approval provided that the proposed alternate scheme fulfills the following requirements:

1. The prestress system is a type described in and meeting the requirements of this Special Provision.
2. The net compressive stress in the concrete after all losses is at least as large as that provided by the post-tensioning shown on the plans.
3. The distribution of individual tendons at each cross section generally conforms to the distribution shown on the plans.
4. The ultimate strength of the structure with the proposed post-tensioning scheme meets the requirements of the “AASHTO LRFD Bridge Design Specifications” Current Edition with all applicable interims and shall be
equivalent to or greater than the service and strength limit states provided by the original design.

(5) Stresses in the concrete and prestressing steel at all sections and at all stages of construction meet the requirements of the Design Criteria noted on the plans.

(6) All provisions of the Design Criteria noted on the plans shall be satisfied.

(7) The Contractor fully designs and details all the elements affected by the alternative post-tensioning system.

(8) The Contractor submits complete shop drawings including post-tensioning scheme and system, reinforcing steel, and concrete cover; and design calculations (including short and long term prestress losses) for the Engineer’s approval.

(9) Any alternate post-tensioning system approved by the Engineer, which results in a change in quantity from that shown on the Contract Documents, will be paid based on the quantity actually used and accepted or the plan quantity, whichever is less, and at the unit bid price. If approved alternate post-tensioning scheme or system is under a VECP (Value Engineering Change Proposal), the method of payment will be in compliance with the VECP agreement.

(10) Alternative post-tensioning shall be designed and sealed by the responsible Specialty Engineer.

603.19.1.4-Material Storage: Store all materials in a weatherproof building, shed or container until time of use. Maintain storage environment at 65% Relative Humidity or less for all steel products in storage for more than 30 days.

603.19.1.5-Certification of Post-Tensioning System: The manufacturer of the post-tensioning system must submit test results to the Engineer and include certified test reports from an independent laboratory audited by AASHTO Materials Reference Laboratory (AMRL) Resource which shows the post-tensioning system meets the requirements specified herein. Plastic components shall be tested in a certified independent laboratory accredited through the accreditation program of the Geosynthetic Accreditation Institute (GAI) or the American Association for Laboratory Accreditation (AALA). Certification of test reports may be performed by an independent laboratory outside of the United States of America. This outside laboratory shall be approved by the Engineer prior to commencement of any work on the project. If any component of the post-tensioning system is modified or replaced, after the approval of the Engineer, the entire system must be retested in accordance with the directions stated herein and new certified test reports must be submitted and approved prior to the submission of Shop Drawings. Certification of test reports may be performed by an independent laboratory located outside of the U.S., if the independent laboratory is approved by the Materials Control, Soil and Testing Division.

Perform certification tests for the plastic components on a sample formed or cut from the finished product. Provide the Engineer with a certification that the plastic from the duct sample complies with all requirements of the specified cell class, stress crack rating and the specified amount of antioxidant. Certify to the Engineer that the post-tensioning system being furnished is in compliance with all requirements stated herein.
Ensure all components of a system are stamped with the supplier’s name, trademark, model number and size corresponding to catalog designation.

Prior to installing any post-tensioning hardware, the Contractor shall furnish the Engineer with a certification from the post-tensioning supplier that the system chosen for the project meets all of the requirements stated in this Special Provision, and is the system currently approved with the requirements of this Section. Upon completion of the post-tensioning installation, the contractor shall supply the Engineer a certification that the post-tensioning system supplied was installed without any modification and met the requirements of the contract documents.

Post-tensioning systems which have been tested and approved by the Florida Department of Transportation (FDOT) will be considered as an acceptable alternate to the required testing stated in this Special Provision. A certified copy of approval letter from FDOT including any details associated with the approval shall be submitted to the Engineer with the Shop Drawings prepared by the post-tensioning system supplier.

603.19.1.6-Project Personnel Qualifications:

603.19.1.6.1-General: Submit qualifications of supervisory personnel to the Engineer. The contractor will not begin construction until the qualifications of supervisory personnel, as set forth herein, have been approved by the Engineer.

603.19.1.6.2-Proof of License or Certification: Contractor personnel that are required to be registered as professional engineers as required herein, must submit a copy of the Professional Engineer license renewal notice/card issued by the licensing agency of the state from which they hold registration. The renewal notice/card must display the license number and must indicate that the license is in force and current. If not shown on the renewal notice/card, the telephone number and address of the licensing agency that issued the renewal notice shall be included with the copy of the renewal notice. Under certain circumstances a West Virginia registration may be required.

603.19.1.6.3-Experience Record: The Contractor shall provide for each project engineer, superintendent, manager, or foreman seeking approval as supervisors a notarized certificate attesting to the completeness and accuracy of the following information in order to substantiate their experience record:

1. Project owner’s name -such as the State of West Virginia- and telephone number of an owner’s representative, project identification number for the project as well as the following project location information: state, city, county, highway number and feature intersected.

2. Provide a detailed description of all bridge construction experience and the level of supervisory authority during that experience. Report the duration in weeks, as well as begin and end dates, for each experience period.

3. Provide the name, address and telephone number of an individual who can verify that the experience being reported is accurate. This individual should have been an immediate supervisor unless the supervisor cannot be contacted in which case another individual with direct knowledge of the experience is acceptable.
603.19.1.6.4-Concrete Post-Tensioning: The contractor shall ensure the following positions meet the requirements as follows:

603.19.1.6.4.1-Project Engineer: Ensure the Project Engineer is a registered Professional Engineer with a minimum of five (5) years of bridge construction experience. Ensure that a minimum of three (3) years of experience is in concrete post-tensioned box girder construction. Ensure that the three (3) years of experience includes, but is not limited to, erection, safe use of form traveler, design and stabilization of falsework required for concrete post-tensioned box girder construction, post-tensioning and grouting operations and a minimum of one (1) year as the Project Engineer in responsible charge of post-tensioning related operations.

603.19.1.6.4.2-Project Superintendent/Manager: Ensure the Project Superintendent/Manager has a minimum of ten (10) years of bridge construction experience or is a registered Professional Engineer with five (5) years of bridge construction experience. Ensure that the Project Superintendent/Manager has a minimum of three (3) years of supervisory experience in, but not limited to, erection, safe use of form traveler, design and stabilization of falsework required for concrete post-tensioned box girder construction, post-tensioning and grouting operations and a minimum of one (1) year as the Project Superintendent/Manager in responsible charge of post-tensioning related operations.

603.19.1.6.4.3-Foreman: Ensure the Foreman has a minimum of five (5) years of bridge construction experience with a minimum of two (2) years of experience in post-tensioning related construction and a minimum of one (1) year as the Foreman in responsible charge of post-tensioning related operations. Foreman shall be certified as PTI Level 2 Bonded PT Field Specialist.

603.19.1.6.4.4-Crews for Tendon Installations and Post-Tensioning: Perform all tendon installation and stressing of post-tensioning tendons under the supervision of the Crew Foreman. The Crew Foreman shall be certified as PTI Level 2 Bonded PT Field Specialist. In addition, the Crew Foreman shall have a minimum of three (3) years of job site experience in post-tensioning operations. In addition, the contractor shall provide a minimum of two (2) crew members who are certified PTI Level 2 Bonded PT Field Specialist, but need not necessarily have job-site experience. At least 25% of each crew shall be certified in PTI Level 1 Bonded PT – Field Installation.

603.19.1.6.4.5-Crews for Tendon Grouting: Perform all grouting operations after the stressing of tendons under the supervision of the Crew Foreman. The Crew Foreman shall be certified as PTI Level 2 Bonded PT Field Specialist and ASBI Certified Grouting Technician. In addition, the Crew Foreman shall have a minimum of three (3) years job-site experience in the grouting of post-tensioning tendons. In addition, the Contractor shall provide a minimum of two (2) crew members that shall be certified as PTI Level 2 Bonded PT Field Specialist and ASBI Certified Grouting Technician, but need not necessarily have job-site experience. At least 25% of each crew shall be certified in PTI Level 1 Bonded PT – Field Installation.
603.19.2-Terms Used:

**Anchorage Assembly:** An assembly of various hardware components that secures a tendon at its ends after it has been stressed imparting the tendon force into the concrete.

**Anchor Plate:** Any hardware of the anchorage assembly that bears directly on the concrete and transfers the tendon force directly into a structure.

**Anticipated Set:** The set assumed to occur in the design calculation of the post-tensioning forces at the time of load transfer.

**Bar:** Post-tensioning bars are high strength steel bars, normally available from 5/8 to 2 1/2 inch diameter and usually threaded with very coarse thread.

**Bleed:** The autogenous flow of mixing water within or that which emerges from newly placed grout caused by the settlement of the solid materials within the mass.

**Coupler:** A device used to transfer the prestressing force from one partial length prestressing tendon to another. (Strand couplers are not allowed.)

**Duct:** Material forming a conduit to accommodate prestressing steel installation and provide an annular space for the grout, which protects the prestressing steel.

**Family of Systems:** Group of post-tensioning tendon assemblies of various sizes, which use common anchorage devices and design. All components within the family of systems shall be furnished by a single supplier and shall have a common design with varying sizes.

**Fluidity:** A measure of time, expressed in seconds, necessary for a stated quantity of grout to pass through the orifice of a flow cone.

**Grout:** A mixture of cementitious materials and water, with or without mineral additives or admixtures, proportioned to produce a pumpable consistency without segregation of the constituents, when injected into the duct to fill the space around the prestressing steel.

**GUTS:** Guaranteed Ultimate Tensile Strength: This is the tensile strength of the material that can be assured by the manufacturer. GUTS should not be confused with "f PU" the specified ultimate tensile strength (AASHTO LRFD 5.4.4.1).

**Grout Cap:** A device that contains the grout and forms a protective cover sealing the post-tensioning steel at the anchorage.

**Inlet Vent:** Tubing or duct used for injection of the grout into the duct.

**Outlet Vent:** Tubing or duct to allow the escape of air, water, grout and bleed water from the duct.

**Post-tensioning:** A method of prestressing where tensioning of the tendons occurs after the concrete has reached a specified strength.

**Prestressing Steel:** The steel element of a post-tensioning tendon which is elongated and anchored to provide the necessary permanent prestressing force.

**Post-Tensioning Scheme or Layout:** The pattern, size and locations of post-tensioning tendons provided by the Designer on the Contract Plans.

**Post-tensioning System:** An assembly of specific models of hardware, including but not limited to anchorage assembly, local zone reinforcement, wedge plate, wedges, inlet and outlet vents, couplers, duct, duct connections and grout cap used to construct a tendon of a particular size and type. The entire assembly must meet the system pressure testing requirement.

**Pressure Rating:** The estimated maximum pressure that water in a duct or duct component can exert continuously with a high degree of certainty that failure of the duct or duct component will not occur (commonly referred to as working pressure).

**Set** (Also Anchor Set or Wedge Set): Set is the total movement of a point on the strand just behind the anchoring wedges during load transfer from the jack to the permanent
anchorages. Set movement is the sum of slippage of the wedges with respect to the anchorage head and the elastic deformation of the anchor components. For bars, set is the total movement of a point on the bar just behind the anchor nut at transfer and is the sum of slippage of the bar and the elastic deformation of the anchorage components.

Strand: An assembly of several high strength steel wires wound together. Strands usually have six outer wires helically wound around a single straight wire of a similar diameter.

Tendon: A single or group of prestressing steel elements and their anchorage assemblies imparting prestress forces to a structural member. Also included are ducts, grouting attachments, grout and corrosion protection filler materials or coatings.

Tendon Size: The number of individual strands of a certain strand diameter or the diameter of a bar.

Tendon Type: The relative location of the tendon to the concrete shape, either internal or external.

Thixotropic: The property of a material that enables it to stiffen in a short time while at rest, but also to acquire a lower viscosity when mechanically agitated.

Wedge Plate: The hardware that holds the wedges of a multi-strand tendon and transfers the tendon force to the anchorage assembly (commonly referred to as anchor head).

Wedge: A conically shaped device that anchors the strand in the wedge plate.

603.19.3-Materials: Meet the requirements of the following:

<table>
<thead>
<tr>
<th>Material</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire Strand</td>
<td>AASHTO M203</td>
</tr>
<tr>
<td>Bar</td>
<td>AASHTO M275</td>
</tr>
<tr>
<td>Water</td>
<td>Section 715, Subsection 715.7</td>
</tr>
</tbody>
</table>

603.19.3.1-Prestressing Material:

603.19.3.1.1-Prestressing Steel:

Strand: Unless otherwise noted on the Plans, strand shall be uncoated, Grade 270 (1860 MPa), low relaxation 7-wire strand conforming to the requirements of AASHTO M203.

Bar: Unless otherwise noted on the Plans, bar shall be uncoated, Grade 150 (1035 MPa), high strength, coarse thread bar conforming to the requirements of AASHTO M275, TYPE II.

603.19.3.2-Post-Tensioning System: Use only the approved post-tensioning system as stated in Section 603.19.1.5 of this Special Provision, and of the proper size and type to construct tendons as shown on the Contract Documents. The use of bar couplers on the project is subject to written approval by the Engineer. Substitution of components of an approved post-tensioning system is not allowed. Use only post-tensioning systems that utilize tendons fully encapsulated in anchorages and ducts. Systems that transfer prestress force by bonding the prestress steel strand directly to concrete are not allowed. Embedded anchors for bars are permitted. Systems utilizing formed, ungrouted voids or “diablos” will be permitted for future post-tensioning only. Strand or tendon couplers are not permitted. Use bar couplers meeting the requirements of AASHTO LRFD Bridge Design and Bridge Construction Specifications. Test and provide certification that the couplers meet or exceed the testing requirements in the AASHTO LRFD Bridge Construction Specifications.
603.19.3.1.3-Post-Tensioning Anchorages:  The Contractor shall ensure that the anchorages develop at least 95% of the actual ultimate tensile strength of the prestressing steel, when tested in an unbonded state, without exceeding the anticipated set.

Anchorages shall be designed so that the average concrete bearing stress and local zone reinforcement complies with the “AASHTO LRFD Bridge Design Specifications”, Current Edition with all applicable Interims. Test and provide written certification that anchorages meet or exceed the testing requirements in the AASHTO LRFD Bridge Construction Specifications. The design and furnishing of local zone reinforcement, in addition to the reinforcement shown in the plans, shall be the responsibility of the Contractor with no additional compensation.

The body of all future post-tensioning anchorages shall be galvanized in accordance with AASHTO M111. Other components of the anchorage including wedges, wedge plate and local zone reinforcement are not required to be galvanized. Construct the bearing surface and wedge plate from ferrous metal. Equip all anchorages with a permanent grout cap that is vented and bolted to the anchorage.

Extreme care shall be taken so that bends in deviators/diabolos conform to the radii shown on the plans and that the deviators/diabolos are properly positioned. The Contractor shall demonstrate to the Engineer that deviators/diabolos are correctly positioned after concrete placement is complete by stringing lines along future tendon paths between anchorages and deviators. Improperly bent or positioned deviators/diabolos shall be rejected and shall be repaired or replaced by the Contractor.

Provide wedge plates with centering lugs or shoulders to facilitate alignment with the bearing plate.

Place anchorages with grout outlets suitable for inspection from either the top or front of the anchorage. The grout outlet will serve a dual function of grout outlet and post-grouting inspection access. The geometry of the grout outlets must facilitate being drilled using a 3/8” diameter straight bit to facilitate endoscope inspection directly behind the anchor plate. Anchorages may be fabricated to facilitate both inspection locations or may be two separate anchorages of the same type each providing singular inspection entry locations.

Trumpets associated with anchorages will be made of either ferrous metal or polypropylene plastic material conforming to the requirements stated in Section 603.19.3.1.6.4. The thickness of the trumpet at the transition location (choke point) will not be less than the thickness of the duct as established in Section 603.19.3.1.6.4. Alternately, the trumpet material may be a polyethylene or polyolefin containing antioxidant(s) with a minimum Oxidative Induction Time (OIT) according to ASTM D3895 of not less than 20 minutes. Test the remolded finished polyolefin material for stress crack resistance using ASTM F2136 at an applied stress of 348 psi resulting in a minimum failure time of 3 hours.

603.19.3.1.4-Inlets, Outlets, Valves and Plugs:  Provide permanent grout inlets, outlets, and threaded plugs made of ASTM A240, Type 316 stainless steel, nylon or polyolefin materials. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). Products made from polyolefin shall contain antioxidant(s) with a minimum Oxidation Induction Time (OIT) according to
ASTM D3895 of not less than 20 minutes. Test the remolded finished polyolefin material for stress crack resistance using ASTM F2136 at an applied stress of 348 psi resulting in a minimum failure time of 3 hours. All inlets and outlets will be equipped with pressure rated mechanical shut-off valves or plugs. Inlets, outlets, valves and plugs will be rated for a minimum pressure rating of 150 psi. Use inlets and outlets with a minimum inside diameter of 3/4 inch (20 mm) for tendons of five or more strands and 3/8 inch (10 mm) for single bar tendons and four-strand tendons.

Provide dual mechanical shutoff valves when performing vertical grouting. Specifically designate temporary items, not part of the permanent structure, on the PT System drawings. Temporary items may be made of any suitable material.

603.19.3.1.5-Permanent Grout Caps: Use permanent grout caps made from fiber reinforced polymer or ASTM A240 Type 316L stainless steel. The resins used in the fiber-reinforced polymer shall be either nylon, Acrylonitrile Butadiene Styrene (ABS) or polyester. For products made from nylon, the cell class of the nylon according to ASTM D5989 shall be S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). Seal the cap with O-ring seals or precision fitted flat gaskets placed against the bearing plate. Place a grout vent on the top of the cap. Grout caps must be rated for a minimum pressure rating of 150 psi. Use ASTM A240 Type 316L stainless steel bolts to attach the cap to the anchorage. When stainless steel grout caps are supplied, provide certified test reports documenting the chemical analysis of the steel.

603.19.3.1.6-Duct and Pipe:

603.19.3.1.6.1-General: Use only corrugated plastic duct for all internal tendons. Ensure that all connectors, connections and components of post-tensioning system hardware are air and water tight and pass the pressure test requirements herein. The use of diablos is allowed for future post-tensioning only. The Contractor shall provide connectors for the future tendon’s ducts at the diablos located at anchorages for future tendons.

Ducts and pipes shall be sufficiently rigid to withstand placement of concrete, grouting, and construction loads without damage or excessive deformation, and shall be air and watertight. Ducts shall bend without crimping or flattening and shall have sufficient strength to maintain their shape and correct alignment during concrete placement. Also, ducts and all connections shall be capable of withstanding the pressure required for pre-grouting air pressure test.

603.19.3.1.6.2-Duct and Pipe Minimum Diameter: For prestressing bars, provide ducts with a minimum internal diameter of at least 1/2 inch larger than the outside diameter of the bar, measured across the deformations.

For multi-strand tendons, provide ducts with a minimum cross-sectional area 2 1/2 times the cross-sectional area of the prestressing steel.

603.19.3.1.6.3-Steel Pipes: Use galvanized schedule 40 steel pipes conforming to ASTM A-53, Grade B where shown in the plans. Ensure that steel pipes used in the tendon anchorage zones are equipped with shear transfer devices. Test and provide written certification that the shear transfer mechanism can resist at least 68% of the tendon GUTS in a shear transfer pull-out test described below:
Shear Transfer Mechanism Pullout Test Procedure:

1. Cast anchorage, shear transfer mechanism and duct in a test block of concrete with minimum dimensions of 2’-6” x 2’-6” x Required Diaphragm Length (6 ft. min.)
2. Stress tendon to 80% GUTS. Grout tendon.
3. Transfer force from wedge plate to shear transfer mechanism. Alternative procedures to safely obtain the required resistance force for the shear transfer mechanism may be used.
4. Measure tendon release force. (Must be greater than 68% of tendon GUTS)
5. Remove shim plates from behind anchor head and transfer tendon force through grout/shear transfer mechanism into test block.
6. Record lowest transfer force measured over a sustained period of one hour. Use tested shear transfer devices.

**603.19.3.1.6.4-Corrugated Plastic Duct:** Do not use ducts manufactured from recycled material. Use seamless fabrication methods to manufacture ducts.

Use corrugated duct manufactured from non-colored, unfilled polypropylene meeting the requirements of ASTM D4101 “Standard Specification for Polypropylene Injection and Extrusion Materials” with a cell classification range of PP0340B44544 to PP0340B65884. The duct shall be white in color containing antioxidant(s) with a minimum Oxidative Induction Time (OIT) according to ASTM D3895 of 20 minutes and containing a non-yellowing light stabilizer. Furnish duct with a minimum thickness as defined in the following table:

<table>
<thead>
<tr>
<th>Duct Shape</th>
<th>Duct Diameter</th>
<th>Duct Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>any size</td>
<td>0.08 inches (2.0 mm)</td>
</tr>
<tr>
<td>Round</td>
<td>3.0 inches (76 mm)</td>
<td>0.10 inches (2.5 mm)</td>
</tr>
<tr>
<td>Round</td>
<td>4.0 inches (100 mm)</td>
<td>0.12 inches (3.0 mm)</td>
</tr>
<tr>
<td>Round</td>
<td>1 5/8 inches (47 mm)</td>
<td>0.12 inches (3.0 mm)</td>
</tr>
</tbody>
</table>

**603.19.3.1.6.4.1-Testing Requirements for Corrugated Plastic Duct:** Ensure that the duct system components and accessories meet the requirements of Chapter 4, Articles 4.1 through 4.1.8 of International Federation of Structural Concrete (FIB) Technical Report, Bulletin 7, titled “Corrugated Plastic Duct for Internal Bonded Post-Tensioning” as modified herein.

The requirements in FIB Technical Report, Bulletin 7, are modified as follows:

(a) Conduct the lateral load resistance test (FIB 4.1.4), without the use of a duct stiffener plate, using a load of 150 lbs. (667 N) for all sizes.

(b) Wear resistance of duct (FIB 4.1.7) must not be less than 0.06 in (1.5 mm) for duct up to 3.35 inches in diameter and not less than 0.08 inch (2 mm) for duct greater than 3.35 inches in diameter.

(c) Bond length test (FIB 4.1.8) must achieve 40 % GUTS in a maximum length of 16 duct diameters.
603.19.3.1.6.4.2-Minimum Bending Radius for Corrugated Plastic Duct: In addition to the component testing stated herein, the manufacturer shall establish, through testing, the minimum bending radius for the duct. The test consists of a modified duct wear test as described in Chapter 4, Article 4.1.7 of FIB Technical Report, Bulletin 7, titled “Corrugated Plastic Duct for Internal Bonded Post-Tensioning”. The test apparatus shall be identical to the wear test apparatus with the same clamping force as a function of the number of strands in the duct; however, modify the procedure as follows: do not move the sample along the strand to simulate wear; the test duration will be 7 days. Upon completion of the test duration, remove the duct. The minimum wall thickness along the strand path must not be less than 0.06 inch for duct up to 3.35 inches diameter and not less than 0.08 inch for duct greater than 3.35 inches in diameter.

603.19.3.1.6.4.3-Corrugated Duct Connections and Fittings: Make all splices, joints, couplings and connections to anchorages with devices or methods (i.e. mechanical couplers, plastic sleeves in conjunction with shrink sleeve) producing a smooth interior alignment with no lips or kinks. Design all connections and fittings to be airtight. Duct tape is not permitted to join or repair duct connections. Construct connections and fittings from polyolefin materials containing antioxidant stabilizer(s) meeting the requirements established in Section 603.19.3.1.4 or 603.19.3.1.6.4.

603.19.3.1.6.5-Corrugated Ferrous Metal Duct: Do not use corrugated ferrous metal ducts in any location.

603.19.3.1.6.6-Epoxy Coated Metal Duct: Do not use epoxy coated metal ducts in any location.

603.19.3.1.6.7-Shipping and Storage of Ducts: Furnish ducts with end caps to seal the duct interior from contamination. Ship in bundles which are capped and covered during shipping and storage. Protect ducts against ultraviolet degradation, crushing, excessive bending, dirt contamination and corrosive elements during transportation, storage and handling. Do not remove end caps supplied with the duct until the duct is incorporated into the bridge component. Store ducts in a location that is dry and protected from the sun. Storage must be on a raised platform and completely covered to prevent contamination. If necessary, wash only the outside surface of the duct before use to remove any contamination.

603.19.3.1.7-Internal Duct Mechanical Couplers, O-Ring Assemblies and Heat Shrink Sleeve Requirements:

603.19.3.1.7.1-Mechanical Couplers: Construct mechanical internal duct couplers with stainless steel, plastic or a combination of these materials. Use plastic resins meeting the requirements of Sections 603.19.3.1.4 or 603.19.3.1.6.4 to construct plastic couplers. Use ASTM A240 Type 316L stainless steel to make metallic components.

603.19.3.1.7.2-O-Rings: O-ring duct coupling shall be made from plastic resins meeting the requirements of Section 603.19.3.1.4 or 603.19.3.1.6.4.
All O-ring materials (diameter < or = 0.25 inch) shall conform to the following requirements:

**Mechanical Properties**
- Shore hardness, A (ASTM D2240): 50-75
- Ultimate elongation %, (ASTM D412) > 250%
- Tension strength, (ASTM D412) > 1400 psi.

**Accelerated Testing**
- Thermal Deterioration 70 hours @ 257º F (ASTM D573)
- Change in tensile strength + or – 30%
- Change of elongation - 50%
- Change of hardness + or - 15 points
- Compression Set Method B 22 hours @ 257º F (ASTM D395) 50%
- Volume change due to absorption of H2O, Method D, for 70 hours @ 212º F, ASTM D471 +10%

**Environmental Resistance**
- Ozone Resistance Exposure Method B, ASTM D1171: Pass
- Low Temp. Non-brittle after 3 Min. @ -40º F (ASTM D2137): Pass

Furnish segment seal assemblies for large diameter compression seals, used to couple ducts at segment joints, which conform with the requirements stated above with the following additions and changes:

**Mechanical Properties**
- Shore hardness, A (ASTM D2240): 30-40
- Tensile strength, (ASTM D412): > 600 psi
- Compression Set Method B 22 hours @ 257º F, (ASTM D395): 60%

**Compression Force** – The maximum force to compress the O-ring to its final compressed position shall not be greater than 25 psi times the area encircled by the O-ring.

**Voided Area** – The seal shall be designed to accommodate the material flow within its own cross sectional area by using a hollow or voided design.

**Mounting Assemblies** – Assemblies holding the O-ring must mount to the form bulkhead and provide for duct alignment.

**603.19.3.1.7.3-Heat Shrink Sleeves:** Furnish and install heat shrink sleeves having a uni-directional circumferential recovery manufactured specifically for the size of the duct being coupled consisting of an irradiated and linear-density polyethylene for internal applications. Furnish adhesive having the same value to steel polyolefin applications. Ensure the heat shrink sleeves have an adhesive layer that will withstand 150º F operating temperature and meet the requirements of the following table:
Property | Test Method | Minimum Requirements
--- | --- | ---
Minimum Fully Recovered Thickness |  | 92 to 126 mils
Peel Strength | ASTM D 1000 | 29 pli
Softening Point | ASTM E 28 | 162°F
Lap Shear | DIN 30 672M | 87 psi
Tensile Strength | ASTM D 638 | 2,900 to 3,480 psi
Hardness | ASTM D 2240 | 46 to 48 Shore D
Water Absorption | ASTM D 570 | Less than 0.05%
Color |  | Yellow or Black
Minimum Recovery | Heat Recovery Test | 33% to 58%
Operating Temperature |  | 125°F

Install heat shrink sleeves using procedures and methods in accordance with the manufacturer’s recommendations.

**603.19.3.1.8-System Test Requirements:** For each family of post-tensioning systems, assemble systems and perform the pressure test defined herein. For each family of post-tensioning systems, test two assemblies (largest and smallest) from the family. The post-tensioning assembly includes at least one of each component required to make a tendon from grout cap to grout cap.

**603.19.3.1.8.1-Grouting Component Assembly Pressure Test:** Assemble anchorage and grout cap with all required grouting attachments (grout tube, plugs, etc.). Seal the opening in the anchorage where the duct connects. Condition the assembly by maintaining a pressure of 150 psi in the system for 3 hours. After conditioning, the assembly must sustain a 150 psi internal pressure for five (5) minutes with no more than 15 psi reduction in pressure. For systems using the same anchorages, grout caps and grouting attachments as previously approved system, the Grouting Component Assembly Pressure Test may include documentation from a previous submittal with written certification that the same components are being utilized in both anchorages.

**603.19.3.1.8.2-Internal Duct Systems:** Perform a system test for the assembly for compliance with the requirements of Chapter 4, Article 4.2 Stage 1 and Stage 2 Testing contained in FIB Technical Report, Bulletin 7, titled “Corrugated Plastic Duct for Internal Bonded Post-Tensioning.” For bar systems, modify the system test length to 15 feet.

Test the coupler for proper function by casting the coupler into a two part concrete test block using match cast techniques. Use blocks that are 12 inch x 12 inch x 12 inch (300 mm x 300 mm x 300 mm). After the concrete has hardened, pull the blocks apart and clean the surface of any bond breaker materials. Using an external apparatus, clamp the block together and maintain 40 psi pressure on the block cross-section during the pressure test. Do not apply epoxy between the blocks for this portion of the test. Pressurize the duct within the test block to 1.5 psi and lock off the outside air source. The assembly must sustain a 1.5 psi internal pressure for five (5) minutes with no more than 0.15 psi reduction in pressure. Separate the duct coupler blocks from the duct system, remove the clamping
device, place a 1/16 inch layer of epoxy on the face of both blocks, and clamp the blocks together and maintain a pressure of 40 psi on the block cross-section for 24 hours. Upon removal of the clamping force, demolish the blocks. The coupler and attached ducts should be intact and free of epoxy, and properly attached without crushing, tearing or other signs of failure. This test will not be required if the Engineer approves prior test results performed for the same system submitted by the Contractor.

The grout cap to anchorage seal and the duct to pipe assembly must comply with the following test. Condition the assembly by maintaining a pressure of 150 psi in the system for 3 hours. After conditioning, the assembly must sustain a 150 psi internal pressure for five minutes with no more than 15 psi reduction in pressure. The length of the test pipe assembly for this test is 15 feet.

Acceptance of the “duct system test data” will be a prerequisite for shop drawing submission of the duct system.

603.19.4-Grout:
A. Grouts shall be prebagged in plastic lined or coated bags. Stamp grout bags with date of manufacture, lot number, shelf life, and mixing instructions. Any change of materials or material sources requires retesting and certification of the conformance of the grout with the physical properties requirements. A copy of the Quality Control Data Sheet for each lot number and shipment sent to the job site shall be provided to the Contractor by the grout supplier and furnished to the Engineer.
B. Materials with a total time from manufacture to usage in excess of six months shall be retested and certified by the supplier before use or shall be removed and replaced.
C. Manufacturers of post-tensioning grout seeking evaluation of their product shall submit material to the WVDOT Materials Laboratory for testing and shall provide certified test reports from an audited and independent Cement and Concrete Reference Laboratory (CCRL), which shows the material meets all the requirements specified herein.
D. Grout shall be stored in a location that is waterproof and convenient to the work. Storage in the open must be on a raised platform and with an adequate waterproofing. On-site storage of grout is limited to a maximum period of one month.
E. The grout material shall be mixed in accordance with the manufacturer’s recommendations.
F. Grouts shall achieve a non-bleeding characteristic and shall maintain grout fluidity in strict compliance with the manufacturer’s recommendations.
G. Grouts shall contain no aluminum powder.
H. The water content shall be the minimum necessary for proper placement, and shall not exceed a water-cement ratio of 0.45.
I. Grouts and temporary corrosion protection methods shall not involve toxic substance.
J. Grout shall meet or exceed the specified physical properties stated herein as determined by the following standard and modified ASTM test methods.
<table>
<thead>
<tr>
<th>Property</th>
<th>Test Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Chloride Ions</td>
<td>Max. 0.08% by weight of cementitious material</td>
<td>ASTM C 1152</td>
</tr>
<tr>
<td>Volume Change</td>
<td>0.0% to +0.1% expansion at 24 hours and 0.0% to +0.2% expansion at 28 days</td>
<td>ASTM C 1090*</td>
</tr>
<tr>
<td>Expansion</td>
<td>&lt;= 2.0% for up to 3 hours</td>
<td>ASTM C 940</td>
</tr>
<tr>
<td>Fine Aggregate (if utilized)</td>
<td>99% passing the No. 50 Sieve (300 micron)</td>
<td>ASTM C 136**</td>
</tr>
<tr>
<td>Wet Density – Laboratory</td>
<td>Report maximum and minimum obtained test value lb/ft³</td>
<td>ASTM C 185</td>
</tr>
<tr>
<td>Wet Density – Field</td>
<td>Report maximum and minimum obtained test value lb/ft³</td>
<td>ASTM C 138</td>
</tr>
<tr>
<td>Compressive Strength @ 28 days (Average of 3 cubes)</td>
<td>&gt;= 7,000 psi</td>
<td>ASTM C 942</td>
</tr>
<tr>
<td>Initial Set of Grout</td>
<td>Min. 3 hours, Max. 12 hours</td>
<td>ASTM C 953</td>
</tr>
<tr>
<td>Fluidity Test ***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efflux Time from Flow Cone</td>
<td>(a) Immediately after mixing Min. 9 sec., Max. 20 sec.</td>
<td>ASTM C 939 ****</td>
</tr>
<tr>
<td>(b) 30 minutes after mixing with remixing for 30 sec.</td>
<td>Max. 30 sec.</td>
<td>ASTM C 939 ****</td>
</tr>
<tr>
<td>Bleeding @ 3 hours</td>
<td>Max. 0.0%</td>
<td>ASTM C 940 ****</td>
</tr>
<tr>
<td>Permeability @ 28 days</td>
<td>Max. 2500 coulombs At 30 V for 6 hours</td>
<td>ASTM C 1202</td>
</tr>
<tr>
<td>API Mud Balance Test</td>
<td>Value &gt;= 1.9 Report maximum and minimum obtained test value</td>
<td></td>
</tr>
</tbody>
</table>

* Modify ASTM C 1090 to include verification at both 24 hours and 28 days.
** Use ASTM C117 procedure modified to use #50 sieve. Determine the percent passing the #50 sieve after washing the sieve.
*** Adjustments to flow rates will be achieved by strict compliance with the manufacturer’s recommendations. The time efflux is the time to fill a one liter container placed directly under the flow cone.
**** Modify the ASTM C 939 test by filling the cone to the top instead of the standard level. The efflux time is the time to fill a one quart (one liter) container placed directly under the flow cone.
***** Modify ASTM C 940 to conform with the wick induced bleed test as follows:
  (a) Use a wick made of a 20 inch length of AASHTO M203, Grade 270, seven wire 0.6 inch diameter strand. Wrap the strand with 2 inch wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut. Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning.
  (b) Condition dry ingredients, mixing water, prestressing strand and test apparatus overnight at 65 to 75°F.
(c) Mix the conditioned dry ingredients with conditioned mixing water and place 800 ml of the resulting grout into the 1,000 ml graduate cylinder. Measure and record the level of the top of the grout.

(d) Completely insert the strand into graduated cylinder. Center and fasten the strand so it remains essentially parallel to the vertical axis of the cylinder. Measure and record the level of the top of the grout.

(e) Store the mixed grout at the temperature range listed above in (b).

(f) Measure the level of the bleed water every 15 minutes for the first hour and hourly for two successive readings thereafter.

(g) Calculate the bleed water, if any, at the end of the three hour test period and the resulting expansion per the procedures outlined in ASTM C 940, with the quantity of bleed water expressed as a percent of the initial grout volume. Note if the bleed water remains above or below the top of the original grout height. Note if any of bleed water is absorbed into the specimen during the test.

***** API (American Petroleum Institute) Recommended Practice 13B-1, Standard Procedure for Testing Water-based Drilling Fluids. The mud balance apparatus is to be non-reactive with the grout. Report maximum and minimum values, when compared to water, obtained when using maximum w/c ratios as specified by the grout manufacturer.

603.19.5-Samples for Testing and Identification:

603.19.5.1-General: Testing shall conform to the applicable AASHTO/ASTM Specifications for the prestressing material used. All material samples for testing shall be furnished by the Contractor at no cost to the Division. Consider job site or site referred to herein as the location where the prestressing steel is to be installed.

603.19.5.2-Testing of Prestressing Steel: Furnish samples for testing as described below for each manufacturer of prestressing strand or bar to be used on the project.

With each sample of prestressing steel strand or bar furnished for testing, submit a certification stating the manufacturer’s minimum guaranteed ultimate tensile strength of the sample furnished.

The Engineer will sample the following materials, at the plant, from the prestressing steel used for post-tensioning operations:

(a) For strand: three randomly selected samples, 5 feet long, per manufacturer, per size of strand, per shipment, with minimum of one sample for every ten reels delivered.

(b) For bars: three randomly selected samples, 5 feet long, per manufacturer, per size of bar, per heat of steel, with minimum of one sample per shipment.

One of each of the samples furnished to represent a lot, will be tested. The remaining sample(s), properly identified and tagged, will be stored by the Engineer for future testing. In the event of loss or failure of the component, the stored sample will be utilized to evaluate for minimum strength requirements. For acceptance of the lot represented, test results must show 100% of guaranteed ultimate tensile strength (GUTS).

603.19.5.3-Lots and Identification: A lot is that parcel of components as described herein. All bars, of each size from each mill heat of steel, and all strand from each manufactured reel to be shipped to the site, must be assigned an individual lot number and must be tagged in such a manner that each such lot can be accurately identified at the job site. Submit records to the Engineer identifying assigned lot numbers with the heat or reel of material represented. All unidentified prestressing steel, or bars received at the site will
be rejected. In addition, loss of positive identification of these items at any time will be cause for rejection.

603.19.5.4-Testing of Grout: The Contractor shall provide the current certified mill test reports for each lot of grout received from the manufacturer showing compliance with the requirements in Section 603.19.4. Any change of materials or material sources requires retesting and certification of the conformance of the grout with the physical properties requirements. A copy of the Quality Control Data Sheet for each lot number and shipment sent to the job site shall be provided to the Contractor by the grout supplier and furnished to the Engineer.

Materials with a total time from manufacture to usage in excess of either six months, or the stated shelf-life, shall be re-tested and certified by the supplier before use, or shall be removed and replaced. Materials stored at the job site more than one month will be rejected and the Contractor shall remove them from the job site.

603.19.5.5-Approval of Materials: The approval of any material by the Engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

603.19.6-Testing by the Contractor:

603.19.6.1-Tendon Modulus of Elasticity Test: For this project, the Contractor shall perform a tendon modulus of elasticity test in accordance with the following procedure.

For the purpose of accurately determining the tendon elongations while stressing, bench test two (2) samples of each size of tendon to determine the modulus of elasticity prior to stressing the initial tendon.

For the purpose of this test, the bench length between anchorages must be at least 40 feet and the tendon duct at least 2 inches clear of the tendon all around. The test procedure must consist of stressing the tendon at the anchor assembly with a load cell at the dead end. Tension the test specimen to 80% of ultimate in ten equal increments and the detension from 80% of ultimate to zero in ten equal decrements. For each increment and decrement, record the gauge pressure, elongation and load cell force. Note elongations of the tendon for both ends and the central 30 feet, measured to accuracy of ± 1/32 inch. Correct the elongations for the actual anchorage set of the dead end.

Calculate the modulus as follows:

\[ E = \frac{PL}{Adl} \]

Where:

- \( P \) = force in tendon
- \( L \) = distance between pulling wedges and dead wedges or exact length in center 30 feet of the tendon.
- \( A \) = cross sectional area of the tendon based on nominal area.
- \( dl \) = strand elongation for load \( P \).

If the bench test result varies from the modulus of elasticity used for shop drawings by more than 1%, submit revisions to the theoretical elongations to the Engineer for approval.
When the observed elongations of the tendon in the erected structure fall outside the acceptable tolerances, or to otherwise settle disputes, additional Tendon Modulus of Elasticity Tests may be required to the satisfaction of the Engineer.

If the source of the prestressing steel changes during the course of the project, additional test series or substantiations from previous projects, not to exceed two per source, will be required.

The apparatus and methods used to perform the test must be submitted to the Engineer for approval. Test must be conducted in the Engineer’s presence.

603.19.6.2-In-Place Friction Test: This test is intended to demonstrate that the friction characteristics, losses, and resulting tendon forces are in agreement with the design assumptions. This test is only required if authorized by the Engineer in order to resolve discrepancies between actual and theoretical elongations in excess of ± 5% percent.

The test procedure shall consist of stressing the tendon at an anchor assembly with a load cell at the dead end. The test specimen shall be tensioned to 80 percent of ultimate tendon tensile strength in eight equal increments and de-tensioned in eight equal decrements. For each increment and decrement, the gauge pressure, elongations, and load cell force shall be recorded. Account shall be taken of any wedge seating in both the live end (i.e., back of jack) and the dead end (i.e., back of load cell) and of any friction within the anchorages, wedge plates, and jack as a result of slight deviations of the strands through these assemblies. For long tendons requiring multiple jack pulls with intermediate temporary anchoring, care shall be taken to keep an accurate account of the elongation at the jacking end allowing for intermediate wedge seating and slip of the jack’s wedges.

When friction is to be reduced, only graphite is to be used as a lubricant subject to the approval of the Engineer. The ducts shall be blown dry with oil free air to remove any excess graphite.

If the elongation falls outside the ± 5% range compared to the anticipated elongations, investigate the reason and make detailed calculations confirming the final tendon forces are in agreement with the approved Plans.

Significant shortfall in elongations is indicative of poor duct alignments and/or obstructions. Correct or compensate for such elongations in a manner proposed by the Contractor and reviewed and approved by the Engineer at no additional cost to the Department.

If, for the Contractor’s expected friction coefficients, the elongations fall outside the plus or minus 5 percent range, the Contractor shall investigate the reason and make revisions to his post-tensioning operations such that the final tendon forces are in agreement with the Plans.

The apparatus and methods used to perform the test must be submitted to the Engineer for approval. Tests must be conducted in the Engineer’s presence.

603.19.6.3-Grout Fluidity: Contractor shall perform a grout fluidity test in accordance with Section 603.19.4, prior to the beginning of the injection process and after grouting each tendon. The test shall be performed on a sample taken from the end of the pump hose before grouting and at the outlet end of the tendon after the tendon has been properly grouted. The testing shall be repeated for each two hours of grouting operations.
The efflux time shall be within 5 seconds of the values established during laboratory testing.

603.19.6.4-Tests Reports Required: Submit two copies of the “Tendon Modulus of Elasticity Test” reports to the Engineer at least 30 days prior to installing the tendons.

Submit two copies of the “In Place Friction Test” reports to the Engineer within two (2) weeks after successful installation of the tested tendon.

Two copies of the grout fluidity test per tendon shall be submitted to the Engineer within three days after performing the test.

603.19.6.5-Payment for Testing: Testing by the Contractor will not be paid for separately but shall be incidental to the price paid for the post-tensioning.

603.19.6.6-Application of Test Results: Re-evaluate the theoretical elongation shown on the post-tensioning shop drawing or working drawings using the results for the Tendon Modulus of Elasticity Test and In Place Friction Test as appropriate and correct as necessary. Submit revisions to the theoretical elongations to the Engineer for approval. No work shall proceed on grouting the tendons until the Engineer has reviewed and approved the revisions to the theoretical elongations.

603.19.7-Protection of Prestressing Steel:

603.19.7.1-Shipping, Handling, and Storage: Protect all prestressing steel against physical damage and corrosion at all times, from manufacture to final grouting or encasing in the concrete. The Engineer will reject prestressing steel that has sustained physical damage. Carefully inspect any reel that is found to contain broken wires during use. Remove and discard lengths of strand containing broken wires. The wire must be bright and uniformly colored when installed, having no foreign matter or pitting on its surface.

Prestressing steel shall be packaged in containers or shipping forms for protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor, which prevents rust or other results of corrosion, shall be placed in the package or form, or shall be incorporated in a corrosion inhibitor carrier type packaging material, or when permitted by the Engineer, may be applied directly to the steel. The corrosion inhibitor shall have no deleterious effect on the steel, concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material shall conform to the provisions of Federal Specification MIL-P-3420. Packaging or forms damaged by any cause shall be immediately replaced or restored to the original condition.

The shipping package or form shall be clearly marked with a statement that the package contains high-strength prestressing steel, the care to be used in handling, and the type, kind, and amount of corrosion inhibitor used, including the date when placed, safety orders, and instructions for use. Low relaxation (stabilized) strand shall be specifically designated per requirements of AASHTO M203. All such strand not so designated shall be rejected.

603.19.7.2-During Installation in the Structure: The time between the first installation of the post-tensioning steel in the duct and the completion of the stressing and grouting operations shall not exceed twenty (20) calendar days unless the use of corrosion inhibitor is approved by the Engineer. The corrosion inhibitor shall not reduce the bond between the post-tensioning steel and the grout or the grout and the ducts, and the removal
of the corrosion inhibitor shall not introduce remnant moisture into the ducts or annular spaces between the wires of the post-tensioning strand. Any light surface corrosion forming during this period will not be cause for rejection of the post-tensioning steel. These twenty calendar days shall also apply to the post-tensioning steel used for the In-Place Friction Test, if it is to be used as a production tendon.

Flushing of grout is not permitted and vacuum grouting is required to repair all voids as defined in Section 603.19.12.6.7. Flushing of ducts is only permitted as defined in Section 603.19.10. When flushing is permitted, use flush water containing slack lime (calcium hydroxide) or quicklime (calcium oxide) in the amount of 0.17 lb/gal.

Except when approved by the Engineer in writing, failure to grout tendons within sixty (60) calendar days will result in stoppage of the affected work.

603.19.8-Fabrication of Post-Tensioning Ducts and Anchorages in the Final Structure:

603.19.8.1-General: Accurately and securely fasten all post-tensioning anchorages, ducts, inlet and outlet pipes, miscellaneous hardware, reinforcing bars, and other embedded items at the locations shown on the plans or on the approved Shop or Working Drawings or as otherwise approved by the Engineer. Construct tendons using the minimum number of duct splices possible.

603.19.8.2-Ducts: Accurately align and position ducts at the locations shown on the Plans, according to the approved Shop or Working Drawings, or as otherwise approved by the Engineer. Securely fasten all internal ducts in position at regular intervals not exceeding two feet (0.6 meter) for round plastic ducts, and one foot (0.3 meter) for flat ducts to prevent movement, displacement, or damage from concrete placement and consolidation operations. Show the method and spacing of duct supports on appropriate Shop Drawings.

Ensure all alignments, including curves and straight portions, are smooth and continuous with no lips, kinks, or dents.

Carefully check all ducts and repair as necessary before the placing of any concrete commences. The tolerance on the location of the ducts for the tendons shall be as specified below in Section 603.19.8.5.

After installing the ducts and until grouting is complete, ensure that all ends of ducts, connections to anchorages, splices, inlets and outlets are sealed at all times. Provide an absolute seal of anchorage and duct termination locations by using plumber’s plugs or equal. Grout inlets and outlets will be installed with plugs or valves in the closed position. Leave low point outlets open. The use of duct tape is not permitted.

603.19.8.3-Splices and Joints: All splices, joint couplings, and connections (inlet and outlet) and valves shall be part of the approved post-tensioning system. Approved shrink sleeve material may be used to repair duct. The use of any tape to repair or seal the duct is not permitted.

603.19.8.4-Location of Grout Inlets and Outlets: Place grout inlets and outlets at locations as shown on the plans or approved shop drawings. Equip all grout inlets and
outlets with positive shut-off devices. At a minimum, grout inlets and outlets will be placed in the following positions:

(a) Top of the tendon anchorage,
(b) Top of the grout cap,
(c) At the high points of the duct when the vertical distance between the highest and lowest point is more than 20 inches;
(d) At a location 3 feet past high points of the duct on the down stream side opposite the direction of grouting,
(e) At all low-points,
(f) At major changes in the cross section of the duct,
(g) At intermediate point(s) for tendons longer than 150 feet,
(h) At other locations required by the Engineer.

Extend grout tubes a sufficient distance out of the concrete member to allow for proper closing of the valves.

All grout caps used must be installed to prevent entrapment of air or water voids and must provide 100 percent coverage of all tendons, wedges and wedge plates in the anchorage.

603.19.8.5-Tolerances: Position post-tensioning ducts within the tolerances given below:

<table>
<thead>
<tr>
<th>Tolerances in Inches For:</th>
<th>Vertical Position</th>
<th>Lateral Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Deck Tendons in Slab</td>
<td>± ¼</td>
<td>± ½</td>
</tr>
<tr>
<td>Longitudinal Tendons</td>
<td>± ¼</td>
<td>± ½</td>
</tr>
<tr>
<td>All Other Cases or in Cases of Doubt</td>
<td>± ¼</td>
<td>± ¼</td>
</tr>
</tbody>
</table>

In all other cases, ensure that tendons are not out of position by more than ± 1/4 inch in any direction.

Ensure entrance and exit angles of tendon paths at anchorages and/or at faces of concrete are within ± 3 degrees [± 5%] of desired angle measured in any direction and any deviations in the alignment are accomplished with smooth transitions without any kinks.

Angle changes at duct joints must not be greater than ± 3 degrees [± 5%] in any direction and must be accomplished with smooth transitions without any kinks.

Locate anchorages within ± 1/4 inch of desired position laterally and ± 1 inch along the tendon except that minimum cover requirements must be maintained.

Position anchorage confinement reinforcement in the form of spirals, multiple U shaped bars or links, properly centered around the duct and start within 1/2 inch of the back of the main anchor plate.

If conflicts exist between the reinforcement and post-tensioning duct, the position of the post-tensioning duct shall prevail and the reinforcement shall be adjusted locally with the Engineer’s approval.

603.19.8.6-Internal Duct Pressure Test: Pressure test all internal ducts, before casting concrete. Seal the tendon at the anchorage duct at the termini and test with compressed air to determine if the duct connections require repair. In the presence of the
Engineer, pressurize the duct to 1.5 psi and lock-off the outside air source. Record the pressure loss over one (1) minute. If the pressure loss exceeds 0.15 psi, repair the leaks in the duct using methods approved by the Engineer. Upon completion of repairs approved by the engineer, the duct shall be retested to the requirements specified above.

603.19.8.7-Post-Tensioning System Field Certification: Post-Tensioning System supplier shall furnish the engineer with a certification that the post-tensioning system chosen for this project has been installed without modification as indicated in the approved shop drawings.

603.19.9 Placing Concrete

603.19.9.1-Precautions: The Contractor shall exercise great care when placing and consolidating concrete so as not to displace or damage any of the post-tensioning ducts, anchorage assemblies, splices and connections, reinforcement, or other embeddings. Fabricate all duct splices to prevent duct kinks during concrete placement. Use mandrels at joints as needed to maintain duct alignment and shape.

The Contractor shall ensure that ducts located within mass concrete pours have the capacity to withstand the concrete temperature expected according to the thermal control plan as per Section 601.12.4.1 of the Special Provisions. For mass concrete pours, the contractor may propose to use galvanize rigid steel pipe ducts for Engineer’s approval, at no additional cost to the Division.

603.19.9.2-Proving of Post-Tensioning Ducts: Upon completion of concrete placement, prove that the post-tensioning ducts are free and clear of any obstructions or damage and are able to accept the intended post-tensioning tendons by passing a torpedo through the new joints in the ducts. Use a torpedo having the same cross-sectional shape as the duct and that is a 1/4 inch smaller all around than the clear, nominal inside dimensions of the duct. Make no deductions to the torpedo section dimensions for tolerances allowed in the manufacture or fixing of the ducts. For straight ducts, use a torpedo at least 2 feet long. For curved ducts, determine the length so that when both ends touch the outermost wall of the duct, the torpedo is 1/4 inch clear of the innermost wall. If the torpedo will not travel completely through the duct, the Engineer will reject the member, unless a workable repair can be made to clear the duct. The torpedo must pass through the duct easily, by hand, without resorting to excessive effort or mechanical assistance.

603.19.9.3-Problems and Remedies: The Engineer will reject ducts or any part of the work found to be deficient. Perform no remedial or repair work without the Engineer’s approval. Any remedial work will be completed at no additional cost to the Division.

603.19.10-Installing Tendons: For tendons subjected to contamination with chlorides, flush the duct before placing the prestressing strands, with lime treated potable water and test for presence of chlorides and oils. Chlorides in the water must be less than 600 ppm. If chloride levels are in excess of 600 ppm, continue to flush the duct until the chloride level is below 250 ppm. Blow oil-free compressed air through the duct to remove any excess water in the duct.
Post-tensioning strands may be pushed or pulled through the ducts to make up a tendon using methods which will not snag on any lips or joints or damage the duct. Strands which are pushed shall be rounded off at the end of the strand or fitted with a smooth protective cap. During the installation of the post-tensioning strand in to the duct, the strand shall not be intentionally rotated by any mechanical device.

Alternatively, strands may be assembled into the tendon, which then may be pulled through the duct together using a special steel wire sock (“Chinese finger”) or other device attached to the end. If the ends of the strands are welded or brazed, they shall be cut back 18 inches from the weld or braze. Round the end of the pre-assembled tendon for smooth passage through the duct. Cutting shall be done with an abrasive saw or equal. Flame cutting shall not be allowed.

In accordance with this Special Provision, the time requirements for corrosion protection shall commence from the time the strands were first placed in the ducts and not from the time of concrete placement. Do not install permanent tendons before the completion of testing as required by this Special Provision and plans. As a sole exception, the tendon to be tested in the “In Place Friction Test” may be installed for the test.

603.19.11-Post-Tensioning Operations:

603.19.11.1-General: Do not apply post-tensioning forces unless the concrete has attained the specified compressive strength as determined by cylinder tests. The stressing of post-tensioning tendons shall be under the immediate supervision of the qualified project personnel as described in Section 603.19.1.7. In addition, a qualified representative of the post-tensioning Specialty Contractor, who shall exercise rigid control of the operations as necessary for full compliance with all requirements stated in this Section (603.19.11) shall be present. As a minimum, the representative shall be present at the beginning of each different type of post-tensioning operation. If the representative determines that the Contractor’s crew is thoroughly familiar with one type of operation, he shall deliver a signed statement of competence for the crew to the Engineer for review. Upon approval by the Engineer of the statement of competence, the presence of the representative shall not be required again until a different type of post-tensioning operation occurs. The statement shall list the names of the Contractor’s crew and crew leader who will be responsible for the post-tensioning operations. The stressing operations shall be overseen by the Contractor’s crew leader who shall demonstrate competence in supervising the stressing operations and performing elongation measurements and calculations; this crew leader shall preferably be an Engineer. No stressing operations shall be performed without direct supervision of the representative or the Contractor’s approved project personnel.

603.19.11.2-Stressing Tendons: All post-tensioning steel shall be tensioned by means of hydraulic jacks so that the post-tensioning force shall not be less than that required by the Plans, or by approved Shop Drawings, or as otherwise required or approved by the Engineer. Do not utilize monostrand jacks to stress tendons with five or more strands. Monostrand jacks will be allowed for stressing tendons only when specifically approved by the Engineer, or when strand tendons are housed in flat ducts that preclude intertwining of strands. Monostrand jacking is permitted provided the elongation of individual strands is kept within a tolerance of +10% of the calculated value. In addition, the average elongation of the group of strands in the duct shall be within +5% of the calculated elongation.
The maximum temporary stress (jacking stress) in the post-tensioning steel shall not exceed 80 percent of its specified minimum ultimate tensile strength. Tendons shall not be overstressed to achieve the expected elongation.

The post-tensioning steel shall be anchored at initial stresses that will result in the long term retention of permanent stresses or forces of not less than those shown on the Plans or the approved Shop Drawings. Unless otherwise approved by the Engineer, the initial stress after anchor set shall not exceed 70 percent of the specified ultimate tensile strength of the post-tensioning steel.

Permanent stress and permanent force are the stress and force remaining in the post-tensioning steel after all losses, including long term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in the post-tensioning steel from the sequence of stressing, friction and unintentional wobble of the ducts, anchor set, friction in the anchorages, and all other losses peculiar to the post-tensioning system.

603.19.11.3-Stressing Sequence: The Contractor shall follow the sequence, the phase and the end from which tendons must be stressed shown in the plans or required by the Engineer. The Contractor shall not modify the stressing sequence shown on the Plans or the approved Construction Manual without approval from the Engineer.

603.19.11.4-Stressing Equipment: Only use equipment furnished by the supplier of the post-tensioning system (tendons, hardware, anchorages, etc.).

603.19.11.4.1-Stressing Jacks and Gauges: Each jack must be equipped with a pressure gauge for determining the jacking pressure. The pressure gauge must have an accurate reading gage with a dial at least 6 inches in diameter.

603.19.11.4.2-Calibration of Jacks and Gauges: Calibrate each jack and its gauge(s) as a unit. The calibration must consist of three test cycles with the cylinder extension of the jack in various positions (i.e. 2-inch, 4 inch, 8 inch stroke). At each pressure increment, average the forces from each test cycle to obtain an average force. Perform the calibration with the equipment (jack, pump, hoses, etc.) setup in the same configuration that is intended to be used at the job site. The post-tensioning supplier or an independent laboratory shall perform initial calibration of jacks and gauge(s). Use load cells calibrated within the past 12 months to calibrate stressing equipment. For each jack and gauge unit used on the project, furnish certified calibration charts and curves to the Engineer prior to stressing. Supply documentation denoting the load cell(s) calibration date and tracability to NIST (National Institute of Standards and Technology) along with the jack/gauge calibration.

Provide the Engineer with certified calibration charts and curves prior to the start of the work and every six months thereafter, or as requested by the Engineer. Calibrations subsequent to the initial calibration with a load cell may be accomplished by the use of a master gauge. Supply the master gauge to the Engineer in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. Provide a quick-attach hydraulic manifold to enable quick and easy installation of the master gauge to verify the permanent gauge readings. The master gauge will be calibrated
and provided to the Engineer. The master gauge will remain in the possession of the Engineer for the duration of the project.

Any jack repair, such as replacing seals or changing the length of the hydraulic lines, is cause for recalibration using a load cell.

No extra compensation will be allowed for the initial or subsequent calibrations or for the use and required calibrations of the master gauge.

**603.19.11.5-Elongations and Agreement with Forces:** Ensure that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times.

- Measure tendon elongations to the nearest 1/16 inch.
- For the required tendon force, the observed elongation must agree within 5% of the theoretical elongation or the entire operation must be checked and the source of error determined and remedied to the satisfaction of the Engineer before proceeding further. Do not overstress the tendon to achieve the theoretical elongation.
- In the event that agreement between the observed and theoretical elongations at the required force falls outside the acceptable tolerances, the Engineer may, at his discretion and without additional compensation to the Contractor, require additional tests for “In-Place Friction” in accordance with Section 603.19.6.2.

**603.19.11.6-Friction:** The Contract Plans were prepared based on the assumed friction and wobble coefficients and anchor set noted on the Plans. The Contractor shall submit calculations and show a typical tendon force diagram, after friction, wobble, and anchor set losses on the Shop Drawings based upon the expected actual coefficients and values for the post-tensioning system to be used. These coefficients and values shall be given on the Shop Drawings.

- If, in the opinion of the Engineer, the actual friction significantly varies from the expected friction, the Contractor shall revise his post-tensioning operation such that the final tendon force is in agreement with the Plans.
- When friction is to be reduced, only graphite is to be used as a lubricant subject to the approval of the Engineer. The ducts shall be blown dry with oil free air to remove any excess graphite.

**603.19.11.7-Wire Failures in Post-Tensioning Tendons:** Multi-strand post-tensioning tendons having wires, which failed by breaking or slippage during stressing, may be accepted provided the following conditions are met:

- The completed structure shall have a final post-tensioning force of at least 98 percent of the design total post-tensioning force.
- Any single tendon shall have no more than a five percent reduction in cross-sectional area of post-tensioning steel due to wire failure.

As an exception, any of the above conditions may be waived as approved by the Engineer when conditions permit the Contractor to propose acceptable alternative means of restoring the post-tensioning force lost due to wire failure.
603.19.11.8 Cutting of Post-Tensioning Steel: Post-tensioning steel shall be cut by an abrasive saw within ¾ to 1½ inches away from the anchoring device. Flame cutting of post-tensioning steel is not allowed.

603.19.11.9-Record of Stressing Operations: The Contractor shall keep a record of the following post-tensioning operations for each tendon installed:

(a) Project name, number.
(b) Contractor and/or subcontractor.
(c) Tendon location, size, and type.
(d) Date tendon was first installed in ducts.
(e) Reel number for strands and heat number for bars.
(f) Nominal and minimum cross-sectional area.
(g) Assumed Modulus of elasticity.
(h) Date Stressed.
(i) Jack and Gauge serial numbers per stressing operation.
(j) Required jacking force.
(k) Gauge pressures.
(l) Elongations (anticipated and actual).
(m) Anchor sets (anticipated and actual).
(n) Stressing sequence.
(o) Stressing mode (one end/ two ends/ simultaneous).
(p) Witnesses to stressing operation (Contractor and inspector).
(q) Date grouted, days from stressing to grouting, grouting pressure applied, and injection end.

Any other relevant information, including but not limited to the application of approved corrosion inhibitors onto the tendon, shall also be recorded. The Contractor shall provide the Engineer with a complete copy of all stressing and grouting operations.

603.19.11.10-Duct Pressure Field Test: After stressing and before grouting internal tendons, install all grout caps, inlets and outlets and test the tendon with compressed air to determine if duct connections require repair. In the presence of the Engineer, pressurize the tendon to 50 psi and lock-off the outside air source. Record the pressure loss for one minute. A pressure loss of 25 psi is acceptable. If the pressure loss exceeds 25 psi, repair leaking connections using methods approved by the Engineer. Upon completion of repairs approved by the engineer, retest the duct to the requirements specified above.

603.19.11.11-Tendon Protection: Within four hours after stressing, the ends of the tendon shall be cut and the tendon shall be protected against corrosion or harmful effects of debris by temporarily plugging or sealing all openings and vents until the tendon is grouted. Grout caps shall be placed over the tendon end and anchorage plate. If tendon contamination occurs, remove and replace the tendon.

603.19.12-Grouting Operations:

603.19.12.1-General: Prior to grouting, clean ducts with oil-free compressed air to remove water that may interfere with the grout injection. The flushing of ducts with water
during grouting operation will not be permitted. Check all inlets and outlets to ensure they are capable of accepting injection of the grout by blowing through the system and proving that each inlet and outlet is free and capable of accepting the grout.

Either install an approved corrosion inhibitor or grout ducts within twenty (20) calendar days from the date of the post-tensioning steel installation except when the Engineer approves in writing.

Grouting operations shall be supervised and conducted by qualified crew members, technician(s) and/or engineer(s) in accordance with Section 603.19.1.7, Project Personnel Qualifications.

Grouting shall be injected from the lowest point on the tendon profile. The location of all grout injection locations must clearly be shown on the Shop Drawings.

603.19.12.2-Grouting Operations Plan: Submit a grouting operations plan for approval at least thirty (30) working days in advance of any scheduled grouting operations. Written approval of the grouting operations plan by the Engineer is required prior to commencement of grouting of the permanent structure. At a minimum, the plan will address and provide procedures for the following items:

1. Names and proof of experience and training for the grouting crew and the crew supervisor in conformance with Section 603.19.1.7 of this Special Provision;
2. Type, quantity, and brand of materials used in grouting including all certifications required;
3. Type of equipment furnished, including capacity in relation to demand and working condition, as well as back-up equipment and spare parts;
4. General grouting procedure;
5. Duct pressure test and repair procedures;
6. Proposed method to control the rate of flow within ducts;
7. Theoretical grout volume calculations;
8. Mixing and pumping procedures;
9. Direction of grouting;
10. Sequence of use of the inlets and outlet pipes;
11. Procedures for handling blockages;
13. The Contractor shall provide additional temporary corrosion protection measures to be used when tendons are left ungrouted for more than twenty (20) calendar days, including methods by which to expel moisture or to remove any contamination if induced as a part of the corrosion protective measures.

A joint meeting of the Contractor, grouting crew and the Engineer will be required five (5) working days prior to the commencement of grouting operations. At the meeting the grouting operation plan, required testing, corrective procedures and any other relevant issues shall be discussed.
603.19.12.3-Grout Inlets and Outlets: Ensure the connections from the grout pump hose to inlets are free of dirt and are airtight. Inspect valves to be sure that they can be opened and closed properly.

603.19.12.4-Supplies: Before grouting operations start, provide an adequate supply of water and compressed air for clearing and testing the ducts, mixing and pumping the grout. Where public water supply is not available, provide a water storage tank of sufficient capacity.

603.19.12.5-Equipment:
603.19.12.5.1-General: Provide grouting equipment consisting of measuring devices for water, a high-speed shear colloidal mixer, a storage hopper (holding reservoir) and a pump with all the necessary connecting hoses, valves, and pressure gauge. Provide pumping equipment with sufficient capacity to ensure that the post-tensioning ducts to be grouted can be filled and vented without interruption at the required rate of injection in not more than 30 minutes. Any material not placed within 30 minutes shall be retested for conformance with Section 603.19.4. Grout failing to meet these requirements shall be rejected.

Provide an air compressor and hoses with sufficient output to perform the required functions.

Provide vacuum grouting equipment (volumetric measuring type) prior to the start of grouting operations and retain the equipment on the job during the duration of tendon grouting operations.

603.19.12.5.2-Mixer, Storage Hopper: Provide a high speed shear colloidal mixer capable of continuous mechanical mixing producing a homogeneous and stable grout free of lumps and undispersed cement. The colloidal grout machinery will have a charging tank for blending and a holding tank. The blending tank must be equipped with a high shear colloidal mixer. The holding tank must be kept agitated and at least partially full at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.

Add water during the initial mixing by use of a flow meter or calibrated water reservoir with a measuring accuracy equal to one percent of the total water volume.

603.19.12.5.3-Grout Pumping Equipment: Provide pumping equipment capable of continuous operation which will include a system for circulating the grout when actual grouting is not in progress.

The equipment shall be capable of maintaining pressure when ducts are completely grouted and have a valve that can be closed off without loss of pressure in the duct.

Grout pumps shall be positive displacement type, capable of providing a continuous grout flow and maintaining a discharge pressure of at least 145 psi.

Pumps shall be constructed to have seals adequate to prevent oil, air or other foreign substances from entering the grout and to prevent loss of grout or water. The capacity will be such that an optimal rate of grouting can be achieved.

A pressure gauge having a full scale reading of no more than 300 psi will be placed at the duct inlet. If long hoses (in excess of 100 ft) are used, place two gauges, one at the
pump and one at the inlet. The diameter and rated pressure capacity of the grout hoses must be compatible with the pump output.

**603.19.12.5.4-Vacuum Grouting Equipment:** Provide vacuum grouting equipment for backup at the job site, concurrently with all pressure grouting operations, consisting of the following:

(a) Volumeter for the measurement of void volume.
(b) Vacuum pump with a minimum capacity of 10 cfm (0.283 cmm) and equipped with flow-meter capable of measuring amount of grout being injected.
(c) Manual colloidal mixers and/or dissolvers (manual high speed shear mixers), for voids less than 20 liters in volume.
(d) Standard colloidal mixers, for voids 20 liters and greater in volume.

**603.19.12.5.5-Stand-by Equipment:** During grouting operations, provide a stand-by grout mixer and pump.

**603.19.12.6-Grouting:**

**603.19.12.6.1-General:** Perform test to confirm the accuracy of the volume-measuring component of the vacuum grouting equipment each day before performing any vacuum grouting operation. Use either water or grout for testing using standard testing devices with volumes of 0.5 gal and 6.5 gal and an accuracy of equal to or less than 4 ounces. Perform one test with each device. The results must verify the accuracy of the void volume-measuring component of the vacuum grouting equipment within 1% of the test device volume and must verify the accuracy of the grout volume component of the vacuum grouting equipment within 5% of the test device volume. Ensure the Engineer is present when any test is performed.

Grout tendons in accordance with the procedures set forth in the approved grouting operation plan. Grout all empty ducts.

**603.19.12.6.2-Temperature Considerations:** Maximum grout temperature must not exceed 90°F at the grout inlet. Use chilled water and/or pre-cooling of the bagged material to maintain mixed grout temperature below the maximum allowed temperature. Grouting operations are prohibited when the ambient temperature is below 40°F or is 40°F and falling.

**603.19.12.6.3-Mixing and Pumping:** Mix the grout with a metered amount of water. The materials will be mixed to produce a homogeneous grout. Continuously agitate the grout until grouting is complete.

**603.19.12.6.4-Grout Production Test:** During grouting operations the fluidity of the grout must be strictly maintained within the limits established by the grout manufacturer. A target fluidity rate will be established by the manufacturer’s representative, based on ambient weather conditions. The manufacturer’s representative shall be on-site at all times during this testing. Determine grout fluidity by use of either test method found in Section
603.19.4. Perform fluidity test for each tendon to be grouted and maintain the correct water to cementitious ratio. Do not use grout which tests outside the allowable flow rates.

Prior to grouting empty ducts, condition the grout materials as required to limit the grout temperature at the inlet end of the grout hose to 90°F. Prior to performing repair grouting operations, condition the grout materials to limit the grout temperature at the inlet end of the grout hose to 85°F. Check the temperature of the grout at the inlet end of the grout hose hourly.

At the beginning of each day’s grouting operation, perform a Shupack Pressure Bleed Test in accordance with Section 603.19.4. If zero bleed is not achieved at the end of the required time period, do not begin grouting of any new or additional tendons until the grouting operations have been adjusted and further testing shows the grout meets the specified requirements.

603.19.12.6.5-Grout Operations: Open all grout outlets before starting the grouting operation. Grout tendons in accordance with the Grouting Operations Plan. Unless approved otherwise by the Engineer, pump grout at a rate of 16 feet to 50 feet of duct per minute. Conduct normal grouting operations at a pressure range of 10 psi to 50 psi measured at the grout inlet. Do not exceed the maximum pumping pressure of 145 psi at the grout inlet.

Use grout pumping methods which will ensure complete filling of the ducts and complete encasement of the steel. Grout must flow from the first and subsequent outlets until any residual water or entrapped air has been removed prior to closing the outlet.

Pump grout through the duct and continuously discharge it at the anchorage and grout cap outlets until all free water and air are discharged and the consistency of the grout is equivalent to that of the grout being pumped into the inlet. Close the anchorage outlet and discharge a minimum of 2 gallons of grout from the grout cap outlet into a clean receptacle. Close the grout cap outlet.

For each tendon, immediately after uncontaminated uniform discharge begins, perform a fluidity test using the flow cone on the grout discharged from all grout outlets. Discharge a minimum of one gallon of grout for the fluidity test. The measured grout efflux time will not be less than the efflux time measured at the pump or minimum acceptable efflux time as established in Section 603.19.4. Perform fluidity test for each tendon to be grouted and maintain the correct water to cement ratio. Alternately, check the grout fluidity using the Wet Density method contained in Section 603.19.4. The measured density must fall within the values established in Section 603.19.4. The density at the final outlet must not be less than the grout density at the inlet. If the grout fluidity is not acceptable, discharge additional grout from the anchorage outlet and test the grout fluidity.

Continue this cycle until an acceptable grout fluidity is achieved. Discard grout used for testing fluidity. After all outlets have been bled and sealed, elevate the grout pressure to 75 psi, seal the inlet valve and wait two minutes to determine if any leaks exist. If leaks are present, fix the leaks using methods approved by the Engineer. Repeat the above stated process until no leaks are present. If no leaks are present, bleed the pressure to 5 psi and wait a minimum of ten minutes for any entrapped air to flow to the high points. After the minimum ten minute period has expired, increase the pressure as needed and discharge grout at each high point outlet to eliminate any entrapped air or water. Complete the process by locking a pressure of 30 psi into the tendon.
If the actual grouting pressure exceeds the maximum allowed, the inlet will be closed and the grout will be pumped at the next outlet, which has just been, or is ready to be closed, as long as a one-way flow is maintained. Grout will not be pumped into a succeeding outlet from which grout has not yet flowed. If this procedure is used, the outlet/inlet, which is to be used for pumping will be fitted with a positive shut-off and pressure gage.

When complete grouting of the tendon cannot be achieved by the steps stated herein, stop the grouting operation. After waiting 48 hours, fill the tendon with grout in accordance with the procedure outlined in 603.19.12.6.8.

603.19.12.6.6-Construction Traffic and Operations Causing Vibrations: During grouting and for a period of 4 hours upon completion of grouting, eliminate vibrations from all sources of construction activities such as moving construction vehicles, jackhammers, compressors, generators, pile driving operations, soil compaction, etc., that are operating within 300 feet down-station and 300 feet up-station of the ends of the span in which grouting is taking place.

603.19.12.6.7-Post-Grouting Operations and Inspection: Do not remove or open inlets and outlets until the grout has cured for 24 to 48 hours. Perform inspections within one hour after the removal of the inlet/outlet. After the grout has cured, remove all outlets located at anchorages and high points along the tendon to facilitate inspection. Inspect all high points along the tendon as well as the inlets or outlets located at the anchorages. Depending on the geometry of the grout inlets, drilling may be required to penetrate to the inner surface of the trumpet or duct. Use drilling equipment that will automatically shut-off when steel is encountered. Unless grout caps are determined to have voids by sounding, do not drill into the cap. Perform inspections in the presence of the Engineer using endoscopes or probes. Within four hours of completion of the inspections, fill all duct and anchorage voids using the volumetric measuring vacuum grouting process.

Seal and repair all anchorage and inlet/outlet voids that are produced by drilling for inspection purposes as specified in Section 603.19.13.2. Remove the inlet/outlet to a minimum depth of 2 inches. Use an injection tube to extend to the bottom of the drilled holes for backfilling with epoxy.

Post grouting inspection of tendons having a length of less than 150 feet may utilize the following statistical frequency for inspection:

1. For the first 20 tendons, inspect all outlets located at anchors and tendon high points by drilling and probing with an endoscope or probe. If one or more of the inspection locations are found to contain a defect (void), continue testing all tendons until 20 consecutive tendons have been inspected and no voids have been found.
2. When no defects are detected as defined in No. 1 above, the frequency of inspection can be reduced to inspect every other tendon (50%). If a defect is located, inspect the last five tendons grouted. Return to step 1 above and renew the cycle of 100% tendon inspection.

If tendon grouting operations were prematurely terminated prior to completely filling the tendon, drill into the duct and explore the voided areas with an endoscope. Probing is
not allowed. Determine the location and extent of all voided areas. Install grout inlets as needed and fill the voids using volumetric measuring vacuum grouting equipment.

**603.19.12.6.8-Vacuum Grouting:** If vacuum grouting is required to repair voids in ducts, the following procedure shall be used:

1. Pressurize void and check for leaks
2. Seal leaks by a method approved by the Engineer
3. Measure the volume of the void to determine the necessary amount of grout
4. Mix sufficient amount of grout for use and for testing, record quantity of mixed grout
5. Test the grout using the flow-cone or the modified flow-cone method in accordance with Subsection 603.19.4
6. Evacuate air from the voids
7. Switch valve and inject grout into voids under pressure
8. Record quantity of grout remaining and calculate the amount injected
9. Seal all grout injection inlets
10. Clean equipment, area of operations on structure and properly discard unused grout
11. Record and report all vacuum grouting operations

**603.19.12.6.9-Grouting Report:** Provide a grouting report signed by the Contractor and/or the Subcontractor within 72 hours of each grouting operation for review by the Engineer.

Report the theoretical quantity of grout anticipated as compared to the actual quantity of grout used to fill the duct. Notify the Engineer immediately of shortages or overages.

Information to be noted in the records must include but not necessarily be limited to the following: identification of the tendon; date grouted; number of days from tendon installation to grouting; type of grout; injection end and applied grouting pressure, ratio of actual to theoretical grout quantity; summary of any problems encountered and corrective action taken.

**603.19.13-Forming and Repairs of Holes and Block-Outs:**

603.19.13.1-Repair of Holes and Block-Outs: Repair all holes and block-outs by filling with a non-shrink epoxy grout used to protect the post-tensioning anchorages. This non-shrink epoxy grout may be Embeco, Chem-Comp, Five Star or approved equal.

603.19.13.2-Repair of Grout Inlets and Outlets: Place threaded plastic caps in all intermediate grout inlet and outlet pipes and threaded plastic plugs to be installed at anchorages and grout caps shown on the Shop Drawings. Repair all intermediate grout inlets and outlet pipes shown on the Shop Drawings using a non-shrink epoxy grout (fluid or gel type) approved by the Engineer. Prepare the surface to receive the non-shrink epoxy grout in strict compliance with the manufacturer’s recommendations.

603.19.14-Protection of Post-Tensioning Anchorages: Within seven days upon completion of the grouting, protect the anchorage of post-tensioning bars and strands as indicated here. Clean all exposed surfaces of laitance, grease, curing compounds, surface...
treatments, misplaced mortar, grout, coating and oils by grit blasting or water blasting. After cleaning of all surfaces and acceptance by the Engineer, place a heavy unbroken coating of an epoxy bonding compound to all such surfaces. The epoxy bonding compound shall conform to AASHTO M 235, Type III.

Immediately upon the completion of the epoxy bonding compound application, install tight fitting forms securely against the previously placed concrete. Mix and place and fill forms with non-shrink epoxy grout in accordance with the manufacturer’s current standard technical guidelines. The non-shrink epoxy grout shall be placed within the “tack time” period of the epoxy bonding compound. Construct all pour-backs in leak proof forms creating neat lines. The non-shrink epoxy grout may require pumping for proper installation. Construct forms to maintain a liquid head to insure intimate contact with the concrete surface. Use vents as needed to provide for the escape of air to insure complete filling of the forms.

After anchorage material has properly cured in accordance with the manufacturer’s recommendations, the forms may be removed. After the pour-backs are a minimum of 28 days old, clean the surface of laitance, grease, curing compounds, surface treatments, oils and coatings, if any, by methods approved by the Engineer. Apply to all surfaces of pour-backs a coating in accordance with the Section 601.13 of the Supplemental Specifications.

603.19.15-Method of Measurement: The quantity of post-tensioning tendons to be paid for under this Section shall be the computed weight, in pounds (kilograms), of permanent post-tensioning steel tendons entered into the completed structure and accepted. Measurement shall be the theoretical plan length measured from anchor plate bearing face to anchor plate bearing face with no allowance made for waste or extension past the anchor plate faces. No measurement will be made for temporary post-tensioning, which shall be considered incidental to the item "Post Tensioning Strands" and the item "Post Tensioning Bars".

For quantity determination the following unit weights shall be used:

<table>
<thead>
<tr>
<th>Prestressing System</th>
<th>Weight per Unit Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50 inch diameter seven wire strand</td>
<td>0.521 plf</td>
</tr>
<tr>
<td>0.60 inch diameter seven wire strand</td>
<td>0.740 plf</td>
</tr>
<tr>
<td>1 inch high strength deformed bar</td>
<td>3.010 plf</td>
</tr>
<tr>
<td>1-1/4 inch high strength deformed bar</td>
<td>4.395 plf</td>
</tr>
<tr>
<td>1-3/8 inch high strength deformed bar</td>
<td>5.564 plf</td>
</tr>
</tbody>
</table>

603.19.16-Basis of Payment: Post-tensioning tendons will be paid for at the contract unit price per pound of steel strand and per pound of steel bar, complete and in place. Payment shall be full compensation for furnishing, installing, stressing, grouting all post-tensioning tendons, and probing and inspecting grouted anchorages. Payment shall also include anchorage assemblies and post-tensioning system hardware which is not embedded in concrete, grout and grouting, all testing, anchorage protection systems, and all labor, materials, tools, equipment, and incidentals necessary for completing the work in accordance with these Special Provisions and the plans. This payment shall also include lubricant in the tendon ducts for friction control. No separate measurement and payment will be made for anchorage components, including anchorages and diablos for future tendons and spare ducts, local anchorage zone reinforcement supplied as an integral part of a proprietary anchorage system,
nor ducts for similar post-tensioning system hardware. Anchorage components, ducts, and similar items of post-tensioning system hardware, which are embedded within the cast-in-place concrete, shall be deemed to be included in the cost of the cast-in-place concrete.

In the event that the Contractor constructs the structure with an accepted alternative not detailed on the Plans, the payment shall be based on the unit price bid extended by either the quantities shown on the Plans or the actual quantities used and accepted, whichever is less.

### 603.19.17-Pay Items:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>603003-001</td>
<td>Post Tensioning Strands</td>
<td>pound (kilogram)</td>
</tr>
<tr>
<td>603004-001</td>
<td>Post Tensioning Bars</td>
<td>pound (kilogram)</td>
</tr>
</tbody>
</table>
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL PROVISION
FOR
STATE PROJECT NUMBER: ____________________________
FEDERAL PROJECT NUMBER: ____________________________

SECTION 604
PIPE CULVERTS

604.1-DESCRIPTION:

ADD THE FOLLOWING TO THE SECTION:

604.1.1-Cured-In-Place Pipe Liner: The purpose of this special provision is to describe the work and material required to line an existing pipe with a new cured-in-place (CIP) pipe liner.

604.2-MATERIALS:

ADD THE FOLLOWING TO THE SECTION:

604.2.5-Materials: The CIP pipe liner must be a continuous system (jointless) and must provide for complete structural integrity, independent of the load bearing capacity of the existing host pipe. The CIP pipe liner shall conform to ASTM D5813 and be designed according to ASTM F1216 as a fully deteriorated gravity pipe. Design the structural spray liner rehabilitation system to support the dead load and live load. Use the following AASHTO HL-93 live loads for calculations:

<table>
<thead>
<tr>
<th>Cover</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ft.</td>
<td>30.8 psi</td>
</tr>
<tr>
<td>2 ft.</td>
<td>13.4 psi</td>
</tr>
<tr>
<td>3 ft.</td>
<td>7.3 psi</td>
</tr>
<tr>
<td>4 ft</td>
<td>4.6 psi</td>
</tr>
<tr>
<td>5 ft</td>
<td>3.1 psi</td>
</tr>
<tr>
<td>6 ft.</td>
<td>2.2 psi</td>
</tr>
<tr>
<td>7 ft.</td>
<td>1.6 psi</td>
</tr>
<tr>
<td>8 ft.</td>
<td>1.2 psi</td>
</tr>
<tr>
<td>9 ft&gt;</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Use the following minimum design parameters:
1. ground water level will be top of the existing pipe unless site conditions indicate a higher value
2. soil density of 120 pcf
3. soil modulus of reaction of 2000 psi
4. factor of safety of 2

604.6-LAYING AND JOINING:

ADD THE FOLLOWING TO THE SECTION:

604.6.4-Cured-In-Place Pipe Liner: Installation of the CIP pipe liner shall meet the following requirements.

604.6.4.1-Installation: The Contractor shall provide a CIP pipe liner that is able to mold itself or fit tightly to the shape of the existing pipe. The CIP pipe liner must be capable of conforming to the pipeline bends in the existing pipe without splitting, rupturing, or wrinkling of the CIP pipe liner material. The CIP pipe liner must provide a flow capacity equal to, or greater than, that of the existing pipe prior to rehabilitation. Submit a written installation plan for the conduit renewal to the Engineer for acceptance at least ten days before beginning work. Provide design calculations performed and stamped by a Professional Engineer registered in West Virginia.

Installation shall be per ASTM F1216, ASTM F1743, ASTM F2019 and per the manufacturer’s recommendations. All process water and condensate from steam used in the installation and curing process shall be managed per 107.21 through 107.24, inclusive, as a liquid waste.

The work covered under this section includes furnishing all labor, materials and equipment required for installing a new CIP pipe liner system within an existing pipe. Minor work may be required to prepare the existing pipe for installation of the new CIP pipe liner and to complete the installation of the CIP pipe liner. Inspect the existing pipe using experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television or man entry before and after installation of the CIP pipe liner. Clean, remove debris, and repair conduit walls and joints prior to installing the CIP pipe liner. Restore active service connections after installation of the pipe liner.

604.14-PAY ITEMS:

ADD THE FOLLOWING TO THE TABLE:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>604125-*</td>
<td>“size”, Cured-In-Place Pipe Liner</td>
<td>Linear Foot (Meter)</td>
</tr>
</tbody>
</table>

“size”—Normal
* Sequence Number
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 601
STRUCTURAL CONCRETE

601.13-PROTECTIVE SURFACE TREATMENT:

601.13.3-Concrete Protective Coating:

DELETE ENTIRE SUBSECTION 601.13.3 AND REPLACE WITH THE FOLLOWING:

601.13.3-Field Application of Concrete Protective Coatings: This section covers requirements for materials to be used as surface finishes for designated surfaces of concrete structures. The concrete masonry coatings must hide form marks, patches, and other minor irregularities and prevent deterioration, spalling, and other damage to the concrete due to the action of the weather and deicing chemicals. The Engineer will inspect all concrete surfaces to be coated as stated in the plans and/or contract documents. The field painting (coating) of concrete structures shall follow the provided requirements set forth in this specification unless otherwise noted in the Contract. This specification shall apply to surface preparation, coating application, contractor responsibilities, environmental and worker protection, and waste handling/disposal. All structures shall be pre-cleaned and washed in accordance with Section 685 of the Standard Specifications. The Engineer will ensure a satisfactory ordinary surface finish prior to coating operations. This section shall apply only when the pay item for concrete protective coating is included in the plans.

601.13.3.1-Physical Requirements of Coating: Physical requirements shall conform to Section 711.5.2.

601.13.3.2-Concrete Surface Preparation: All concrete surfaces to receive a protective coating shall be prepared in accordance with SSPC-SP 13, Surface Preparation of Concrete, SSPC-The Fundamentals of Cleaning and Coating Concrete, ASTM D4258-Standard Practice for Surface Cleaning Concrete for Coating. All surfaces to receive a protective coating shall be thoroughly cleaned and kept free of oil, form oil, grease, dust, dirt, mud, curing compound, release agents, loose patching mortar, or any other substances that may prevent bonding.
601.13.3.3-Coating Paint Application Requirements: When specified in the plans, the following concrete surfaces requirements shall be coated, including all beveled edges:

1) Bridge Abutments and Wingwalls – Every exposed surface above a point six inches below ground or fill line. Exclude where epoxy coating is applied.
2) Bridge Pier Caps – The tops (including exposed surfaces of pads, pedestals, and keys), sides and ends. Do not apply the coating to bearing areas. Exclude where epoxy coating is applied.
3) Bridge Superstructure – The tops, inside and outside faces, and ends of all barrier walls, parapets, curbs, and points that will be exposed. Do not apply the coating to the riding surface of the bridge deck.
4) Exposed Surfaces of Substructure and the Superstructure – all surfaces identified in 1), 2), and 3) above and the underneath surfaces of slab overhangs that are outside of exterior girders and the exterior side and bottom of exterior beams or girders, the interior windows of barriers, and all exposed surfaces of piers and abutments. Extend the concrete coating from a point six inches below ground line to the top of the exposed surface.
5) Any other area as designated within the contract plans not mentioned above.

601.13.3.3.1-Weather Conditions: Coating application shall not be performed while the ambient temperature is below 40° F (5° C) or above 100° F (38° C), or the relative humidity above 90 percent. Coating application shall only be permitted between the dates of April 15th through October 15th. There will be no painting permitted to occur in a heated containment. Heated containment shall not be permitted.

601.13.3.3.2-Coating Paint Storage: Coatings shall be stored in a temperature controlled environment between 40° F – 100° F (5° C – 38° C) in accordance to coating manufacturers recommendations. At no time will the coatings be used beyond the manufacturer’s shelf life.

601.13.3.3.3-Coating Paint Application: The coating shall be applied by spray, brush or roller methods. Brushes or rollers, when used, shall have sufficient body and length of bristle or roller nap to spread a uniform coat. Small touch-up areas may be brushed or rolled, if approved by the Engineer.

Use of an agitated pot shall be mandatory in spray application. The agitator or stirring rod shall reach within 1 inch (25 mm), of the bottom of the pot and shall remain in motion at all times during coating application. Coatings shall be mixed in strict accordance with the coating manufacturer’s written instructions. Under certain conditions, it may be necessary to thin or adjust the solvent balance of the paint. The type and amount of solvent to be used shall be that listed on the coating manufacturer’s product data sheet for that material. Upon thinning, the dry film thickness requirement shall still be met by appropriately increasing the wet film thickness.

Application requirements and drying times between coats shall be in accordance with the coating manufacturer’s recommendations.
Spray guns must be equipped with the recommended size tip for the coating material being applied and shall be held perpendicular (90 degrees) to, and at, the proper distance from the receiving surface. Complete protection shall be provided by the contractor against spatter, spillage, overspray, wind-blown paint, or similar releases. Appropriate containment shall be placed around the work area to protect public and private property. Staging must be adequate to provide access to all areas being coated. Violation of these requirements causing excessive paint waste will be justification for the WVDOH Engineer to order the Contractor to cease all work on the project until corrective action has been taken. The method of cleaning and/or replacement shall be submitted to the Engineer in advance for approval.

Coating application shall be suspended any time the ambient temperature or the temperature of the concrete does not comply with the coating manufacturer’s recommendations.

Prior to application of the materials, the contractor shall furnish the Engineer with copies of the coating material manufacturer’s brochures, or booklets, and product data sheets. Apply protective coating materials in strict conformity with the coating manufacturer’s written instructions and apply the material at a uniform rate of at least 50±10 ft²/gal (1.75±0.35 m²/L).

Satisfactorily repair or remove any portions of the coating that are not clean, uniform in color, texture, thickness, tightly bonded, or that are damaged before final acceptance of the project and replace them with an acceptable finish and coating.

Provide a neat uniform appearance, and prevent the coating from being dripped, sprayed, or otherwise deposited upon concrete and surfaces not designated to receive the coating. Remove any objectionable deposits or material and repair the surfaces to the Engineer’s satisfaction.

601.13.3.4-Environmental, Worker Protection, And Waste Handling:

601.13.3.4.1-General: Environmental protection shall be used when cleaning, coating, painting, welding or cutting an existing bridge concrete. The containment class, emission assessment methods and levels as defined by the current revision of SSPC Guide 6 shall be as stated in the contract documents. The specific pollution control system which is proposed for the complete capture, containment, collection, and disposal of the “spent material” generated by the work shall be included in the plan.

601.13.3.4.2-“Spent Material”: This shall include material generated by surface preparation operations, and shall be disposed of in accordance with Section 7 of SSPC SP-13. The Contractor shall, at the Contractor’s expense, select a laboratory that will sample and analyze the “spent materials”. The laboratory must be certified by the WVDEP, EPA or by another state’s DEP-equivalent. Certification will be provided to the Engineer prior to the beginning of work. The waste transporter for both hazardous and non-hazardous waste will be listed on the Contractor’s Containment/Disposal Control Plan.

601.13.3.4.3-Permits for Disposal of “Spent Material”: Shall be in accordance with Section 107.2, Permits, Licenses, and Taxes or any other applicable sections of Section 107. The “spent material” shall not be disposed of until authorized by the Engineer and in
no case shall “spent material” be allowed to accumulate longer than 90 days prior to transport.

601.13.3.4.4-Additional requirements for all classes of containment: Contractor will provide ground covers beneath the containment area and all equipment where spills are possible to capture inadvertent spills or leaks of debris. Extend the covers a minimum of 5 feet beyond the area to be covered. Debris shall be removed from the covers at least once per shift, or as directed by the Engineer. If the ground beneath the structure serves as the base of the containment, install and maintain air and dust impenetrable materials such as solid plywood panels or flexible materials such as tarpaulins. Provide explosion-proof lighting inside containment for all paint application. Maintain a minimum of 10 foot-candles for surface.

601.13.3.5-Contractor Responsibilities:

601.13.3.5.1-Concrete Protective Coating Materials: Select concrete masonry coatings from the Department’s List of Approved Materials. Use a material that is readily recognizable by its name, trademark, container, or other feature. All materials shall conform to 711.5.3.

601.13.3.6-Inspection Requirements:

601.13.3.6.1-Inspection of Applied Coating Paint: If in the opinion of the Engineer the coating has flaws other than deficiencies in the prescribed dry film thickness, the material shall be repaired or shall be removed and replaced. Defects in the film, including but not limited to runs, sags, mud-cracking, or lifting, overspray, and dry spray, shall be corrected until a continuous uniform film has been applied. Excessive film thickness shall be reduced and insufficient film thickness shall be increased. If the thickness of the finish coat is reduced, a thin coat of the finish shall be reapplied to seal the surface and to blend the area into the surrounding coating. Depending on the defect, total removal and replacement of the effected coating may be required. Dry film thickness readings shall be in accordance with the coating manufacturer recommendations. No unsightly runs or sags shall be visible. All "mud-cracking" and/or "dry overspray" in the paint film coating shall be removed. Calibration of the ultrasonic thickness gage shall be in accordance with ASTM D6132 and dry film thickness measurements shall be in accordance with MP-708.40.00SSPC PA-9.

601.13.3.6.2-Access for Inspection: The Contractor shall furnish suitable safe access and shall provide a time mutually agreed to for inspecting the structural concrete prior to and after each coating. The Division’s inspector shall approve all repairs. When providing suitable safe access, rubber rollers or other protective devices shall be used. Metal rollers or clamps and other types of fastenings that will mar or damage freshly coated surfaces shall not be used. No temporary attachments, supports for access, or forms, shall damage the coating system. Any damage that occurs from such devices shall be repaired to the satisfaction of the Engineer at the Contractors expense.

601.13.3.6.3-Repair Procedures for Field Paint Coating Deficiencies: All field repairs to the coating shall be made in strict accordance with the coating manufacturer's
recommendations, except where the requirements listed in this specification are more stringent. Any products used during repairs to the coating deficiencies shall be from the same manufacturer as the coating being repaired. Surfaces that will be inaccessible for coating after erection shall be repaired and/or recoated prior to erection. The Engineer is to review and accept a repair plan before deficient areas are repaired. The requirements specified herein for provisions for inspection, mixing, thinning, temperature and humidity, and application shall govern the coating of the repaired areas. In order to avoid abrupt changes in paint coating thickness, the area adjacent to repair areas shall transition from zero paint film thickness to full system film thickness within not less than 3 inches (75 mm) of the repair area. By means of sanding the transition area. The requirements for the dry film thickness of the repair coats are the same as those specified for the coating paint system.

601.13.3.7-Submittals: Submittals shall be forwarded through the Prime Contractor and be accepted by the Engineer prior to commencement of the subject work. This is the responsibility of both the Fabricator and the Field Contractor. Electronic submittals will be accepted.

601.13.3.7.1-Quality Control Plan for Painting: Minimum requirements and document form are set forth in MP 688.02.20.

601.13.3.7.2-Containment/Disposal Environmental Control Plan for Existing Concrete Structures: Minimum requirements and document form are set forth in MP 688.03.20.

601.14-METHOD OF MEASUREMENT:

DELETE THE LAST PARAGRAPH AND REPLACE WITH THE FOLLOWING:

The quantity of work done under line items 603.13.3 will include preparation and application of concrete protective coating to all exposed surfaces of special bridge railing, outside face of exterior prestressed girders, exposed portion of abutments, wingwalls and piers. The area to be coated will be measured on a square foot (square meter) basis.

The measurement of payment for Concrete Protective Coating, will be based on the actual surface area in square feet as determined from the lines and dimensions shown on the plans, subject to field verification. Payment shall include all applications of concrete protective coatings and means required to place the material.

The unit of measure for Surface preparation of Concrete Protective Coating shall be lump sum. The price and payment shall be full compensation for all concrete surface preparation work required prior to placement of coating.

601.16-PAY ITEMS:

ADD THE FOLLOWING ITEMS TO THE TABLE
<table>
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<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
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</thead>
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<td>601019-001</td>
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<td>Square Foot</td>
</tr>
<tr>
<td>601019-005</td>
<td>Surface Preparation of Concrete Protective Coating</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SUPPLEMENTAL SPECIFICATION

FOR

SECTION 711
PAINTS, COATING, OILS, AND INKS

DELETE THE INTRODUCTION AND SUBSECTIONS 711.1 THROUGH 711.22
AND REPLACE WITH THE FOLLOWING:

All shall consist of pigments and vehicles conforming to the general requirements of these
specifications, proportioned and treated to produce materials possessing the detailed composition
and physical properties.

711.1-711.4: BLANK

711.5-CONCRETE PROTECTIVE COATINGS AND STAIN:

711.5.1-General: This specification provides the requirements for concrete protective
coatings and stains. Concrete coatings and stain may be used as surface finishes for designated
surfaces of cement concrete structures. The protective coatings and stains must hide form
marks, patches, and other minor irregularities and prevent deterioration, spalling, and other
damage to the concrete due to the action of the weather and deicing chemicals. These materials
must have protective and corrosion resistance properties. The storage life will be based on
manufacturer recommendations.

711.5.2-Physical Requirements: An independent testing laboratory acceptable to the
Division shall perform the tests described herein on representative samples of the material.
Tests listed herein are the minimum testing requirements to be met. When requested in writing,
the Engineer may accept materials based on conformance to the same type of test but differing
on minor procedural points. Attach copies of test procedures which differ from those stated
herein.

i. Freeze-Thaw Test: Cast and cure 3 concrete specimens no less than 4 by 6 by 6 inches
(100 by 150 by 150 mm). Moist cure specimens for 14 days and then dry in room air
at 60° to 80° F (15° to 27° C) for 24 hours before applying protective coating. Ensure
that there is no excessive oil on specimen forms. Coat sides of specimens (brush
permitted) according to the manufacturer’s directions at a rate of 50± 10ft2/gal (1.75±
0.35 m2/L) and cure at room temperature for 48 hours, after which:

1. Immerse in water at room temperature 60° to 80° F (15° to 27° C) for 3 hours
and remove.
2. Place in cold storage at 5° F (-15° C) for one hour and remove.
3. Thaw at room temperature, 60° to 80° F (15° to 27° C) for one hour.
4. Repeat steps 1), 2) and 3) to complete a total of 50 cycles. At the end of 50 cycles of the Freeze/Thaw Test, ensure that the coated specimens show no visible defects.

ii. **Salt Fog:** Apply the masonry coating to concrete at a rate of 50± 10ft2/gal (1.75± 0.35 m2/L) and test the coating according to ASTM B 117. Expose the coating to a 5 percent sodium (salt) solution for 300 hours and maintain it at 194° ± 4° F (90± 2° C) during the period of exposure. Ensure that it shows no loss of adhesion or deterioration at the end of the 300 hours.

iii. **Fungus Growth:** Ensure that like protective coatings passes a fungus resistance test as described by federal specifications TT-P-29. After a minimum incubation period of 21 days, ensure that no growth is exhibited on the coatings.

iv. **Color**—The color choices permissible shall conform to SAE International AMS-STD-595 A. The color difference, ΔE, of the acceptance samples shall not be more than five units from the Standard Numbers 37925, 36650, 37925, 36622

711.5.3-Approval: For approval, the manufacturer shall submit copies of certified test reports to Materials Control, Soils and Testing (MCS&T) Division for review and approval. An independent testing laboratory acceptable to the Division shall perform the tests described herein on representative samples of the material. Tests listed herein are the minimum testing requirements to be met. Attach copies of test procedures which differ from those stated herein. In addition, provide brochures or booklets containing detailed instructions and explanatory remarks about surface preparation, application procedures, and other pertinent operations. The Division may also choose approved products from the National Transportation Product Evaluation Program (NTPEP) and/or the North East Protective Coating Committee (NEPCOAT) tested materials.

711.6-ZINC PRIMERS:

711.6.1-ORGANIC ZINC PRIMER:

711.6.1.1-General: This specification provides the requirements for an organic zinc rich primer. The Organic Zinc Primer may be used in the shop on new steel or in the field on existing steel. The steel shall be capable of being blast cleaned to a near-white finish, meeting SSPC-SP-10 requirements for new steel, and SSPC-SP-6, for existing steel. When used as a shop primer, the material shall have a minimum slip coefficient of 0.50 (Class B) when tested in accordance with “Test Method to Determine the Slip Coefficient for Coatings used in Bolted Joints” as adapted by the Research Council on Structural Connections. Acceptance for field painting will be based on batch testing of materials that do not meet the minimum of 0.50 (Class B) slip coefficient. Initial approval of all materials may be based on complete Division testing, or may be chosen from the National Transportation Product Evaluation Program (NTPEP) and/or the North East Protective Coating Committee (NEPCOAT) tested materials to assure specification compliance. The primer may be top coated with materials meeting the requirements of Subsections 711.22.3 and 711.22.4. The dry film thickness requirement will be based on manufacturer recommendations. The paint storage life will be based on manufacturer recommendations.
711.6.1.2-Physical Requirements: Shall be as per SSPC Paint 20, Type II with the following exceptions:

i. The VOC shall not exceed 3.5 lbs /gal (420 g / l).

ii. Viscosity of the mixed paint shall be in accordance with ASTM D 562. Variance shall be within ±10 Krebs Units of the viscosity of the previously qualified paint.

iii. Weight per gallon of the mixed paint shall be in accordance with ASTM D 1475. Variance shall be within ±0.5 pounds (225 g) of the weight per gallon of the previously qualified paint.

711.6.2-Inorganic Zinc Primer:

711.6.2.1-General: This specification provides the requirements for an inorganic zinc rich primer. The Inorganic Zinc Primer shall be shop applied only, over a near white blasted surface, meeting SSPC – SP-10 requirements. The primer shall have a minimum slip coefficient of 0.50 (Class B) when tested in accordance with "Test Method to Determine the Slip Coefficient for Coatings used in Bolted Joints" as adapted by the Research Council on Structural Connections. The paint storage life will be based on manufacturer recommendations.

711.6.2.2-Physical Requirements: This primer shall meet the requirements set forth in AASHTO M 300 with the following exceptions:

i. The VOC shall not exceed 3.5 lbs /gal (420 g / l).

ii. The adhesion shall be a minimum of 4B when tested in accordance with ASTM D3359, Method B.

iii. Viscosity of the mixed paint shall be in accordance with ASTM D 562. Variance shall be within ±10 Krebs Units of the viscosity of the previously qualified paint.

iv. Weight per gallon of the mixed paint shall be in accordance with ASTM D1475. Variance shall be within ±0.5 pounds (225 g) of the weight per gallon of the previously qualified paint.

711.7-711.11: BLANK

711.12-EPOXY COATINGS:

711.12.1-General: This specification provides the requirements for a two component, modified epoxy coating for use as a spot primer or a one coat system for use on poorly prepared surfaces on most existing structures. The coating may be used as a primer over steel that has been cleaned to a minimum of SSPC-SP-2. If it is used as a primer, it may then be coated with the manufacturer’s recommended intermediate and/or top coat from the Division’s approved list of Zinc Rich Low VOC Systems (711.22). This coating shall also be suitable for use over zinc rich primers. All ingredients are not specified; however, the finished product shall comply with the requirements prescribed. The paint storage life will be based on manufacturer recommendations.
711.12.2-Composition: The pigment shall not react with the vehicle or interfere with the cure. The pigment may be aluminum flake powder or paste. The metallic aluminum pigment may be replaced by other pigments and coloring agents necessary to provide the specified color. The vehicle shall be modified epoxy resin and curing agent. The vehicle shall be formulated to permit trouble free application during normal humidity conditions.
   i. Color – The color choices permissible shall conform to SAE International AMS-STD-595A. The color difference, ΔE, of the acceptance samples shall not be more than five units from the Standard Numbers- 20062, 26373
   ii. Gloss @ 60° shall be 30-50 for semi-gloss and 51 or greater for gloss finishes.
   iii. Flat finishes shall have a gloss of 29 or less.

711.12.3-Physical Requirements: Steel panels shall meet the requirements of ASTM D609, Type III. Steel panels shall be sandblasted to a white metal blast finish in accordance with SSPC-SP-5, exposed to the atmosphere for 30 days so uniform rusting occurs, and then hand cleaned with a wire brush in accordance with SSPC-SP-2. The panel shall then be spray applied with epoxy maintenance coating according to manufacturers’ recommendations.
   i. Dry to touch @ 5 mils, (125 μm) dry, 24 Hours Maximum
   ii. Dry hard @ 5 mils, (125 μm) dry, 72 Hours Maximum
   iii. Weight per gallon, 10.5 Lbs. Minimum
   iv. Accelerated Weathering: Panels shall be tested in accordance with ASTM G 154. After 1,000 hours exposure, the coating shall show no rusting, blistering, or loss of adhesion to the test panel.
   v. Salt Fog: Panels shall be scribed to the base metal with an X of at least two inch (50 mm) legs. The test panels shall then be tested in accordance with ASTM B 117. After 1,000 hours of continuous exposure, the coating shall show no loss of bond, nor shall it show rusting or blistering beyond 1/16 inch (2 mm) from the center of the scribe mark.

711.12.4-Application Properties: The mixed paint, when thinned in accordance with manufacturer's recommendations, shall be capable of being sprayed in one coat at a wet film thickness of 10 mils (250 μm) without runs or sags. The properly thinned paint shall be capable of brush and roller application. The manufacturer's current printed instructions for application of the epoxy maintenance coating shall be submitted to the Division for review and approval prior to application. The paint storage life will be based on manufacturer recommendations.

714.13 through 711.20: BLANK

711.21-REPAIR OF DAMAGED GALVANIZED SURFACES:
   Repair of damaged galvanized surfaces will be done using a primer meeting the requirements Section 711.6.

711.22-ZINC RICH LOW VOC SYSTEM:
   711.22.1-General: Initial approval of the system will may be based on testing of the complete system by the Division for specification compliance or chosen from the NTPEP or NEPCOAT tested materials for specification compliance. Each product in the system shall be from the same paint manufacturer. Each coat shall be a contrasting color to the one previously
applied. The use of the intermediate coat meeting 711.22.3, shall be at the option of the paint manufacturer. In either case, the adhesion of the system shall be a minimum of 4A when tested in accordance with ASTM D3359, Method A. The adhesion test shall be conducted approximately 14 days after application of the top coat. All products shall have a maximum VOC of 2.8 lbs / gallon (336 g/l) with exception of the primer, which shall have a maximum VOC of 3.5 lbs / gallon (420 g/l). The paint storage life will be based on manufacturer recommendations. The prime fabricator is responsible for choosing the paint system when shop applied.

711.22.2-Primer: The primer shall meet the requirements of 711.6.

711.22.3-Intermediate Coat: This material shall meet the manufacturer's specification and shall be compatible with a primer (711.6) and the top coat (711.22.4).

711.22.4-Top Coat: This material shall meet the manufacturer’s specification and shall meet the requirements of 711.22.4.1. After system approval, all topcoat material shall be batch tested for color and dry time.

711.22.4.1-Physical Requirements:
   i. Dry Hard-24 Hours Maximum
   ii. Color–The color choices permissible shall conform to SAE International AMS-STD-595 A. The color difference, ΔE, of the acceptance samples shall not be more than five units from the Standards Numbers- 20062, 26373
   iii. Gloss @ 60° shall be 30-50 for semi-gloss and 51 or greater for gloss finishes. Flat finishes shall have a gloss of 29 or less.

711.22.5-System: The system shall be composed of a primer and topcoat. Application and dry film thickness shall be based on the manufacturer recommendations. The use of the intermediate coat shall be at the option of the paint manufacturer.

711.22.5.1-System Requirements:
   i. Intercoat Adhesion-The adhesion of the system shall be a minimum of 4B when tested in accordance with ASTM D3359, Method B.
   ii. Accelerated Weathering-After cycling 1000 hours there shall be no evidence of checking, cracking, rusting, or blistering. The degree of chalking shall not be less than No. 6 when tested according to ASTM G 154. The color difference after 1000 hours shall be no more than five ΔE units.
   iii. Salt Fog-Testing shall be in accordance with ASTM B117. After 1000 hours of continuous exposure, there shall be no evidence of checking, cracking, rusting, or blistering.
711.23- SAMPLE SUBMISSION AND APPROVAL:

711.23.1: All samples for approval testing and all supporting documentation shall be shipped to the address provided below:

West Virginia Division of Highways
Materials Control, Soils and Testing
Paint Laboratory
190 Dry Branch Drive
Charleston, West Virginia, 25306

711.23.2: Paints and coatings submitted for approval testing shall be furnished to the MCS&T Division in appropriate containers not holding more than one gallon (3.79 liters) of material. Each component shall be labeled appropriately, and the following information shall be provided with the sample.

i. Name and address of Manufacturer
ii. Trade Name or Trade Mark
iii. Type of Paint
iv. Lot or Batch number
v. Date of manufacturing
vi. All SDS/PDS information pertaining to the material
vii. Reference to the Division’s Standard Specifications

711.23.3: Acceptance Procedure: The Division will develop an approved list of products meeting this specification. This list will be placed on the Division’s website. The list shall be based upon testing performed by the Division, or the Division may choose materials from the National Transportation Product Evaluation Program (NTPEP) and/or the North East Protective Coating Committee (NEPCOAT) tested materials. Upon approval by the Division, further testing will not be required unless random samples tested by the Division show non-compliance with any of the specification requirements. The manufacturer shall supply the MCS&T Division the following for each product:

i. One, one gallon kit of the product
ii. One gallon thinner
iii. Instructions for mixing, thinning and application
iv. Materials Safety Data Sheet for both the paint and thinner
v. Product data sheet
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL PROVISION
FOR

STATE PROJECT NUMBER: ____________________________
FEDERAL PROJECT NUMBER: ____________________________

SECTION 604
PIPE CULVERTS

604.1–DESCRIPTION:

ADD THE FOLLOWING TO THE SUBSECTION:

604.1.1–High Density Polyethylene (HDPE) Pipe Liner: The purpose of this special provision is to describe the work and material required to line an existing pipe with a new high density polyethylene (HDPE) pipe liner.

604.2–MATERIALS:

ADD THE FOLLOWING TO THE SUBSECTION:

604.2.5–Materials: The liner pipe shall be solid wall HDPE in accordance with AASHTO M 326 having a Standard Dimension Ratio (SDR) of 32.5 or structural profile wall polyethylene pipe in accordance with ASTM F894 having a minimum ring stiffness constant (RSC) of 100.

604.6 – LAYING AND JOINING:

ADD THE FOLLOWING TO THE SUBSECTION:

604.6.4–High Density Polyethylene Pipe Liner: Installation of high density polyethylene (HDPE) pipe liner shall meet the following requirements.
604.6.4.1–Installation: The Contractor shall verify that the “Lining Pipe Culvert” will fit inside the culvert being lined prior to ordering materials. The Contractor shall adhere to the manufacturer and ASTM F585 installation requirements. The work covered under this section includes furnishing all labor, materials and equipment required for installing a new HDPE liner within an existing pipe. Minor work may be required to prepare the existing pipe for insertion of the new HDPE liner pipe. Remove all objects from the existing pipe that could damage the new pipe or obstruct the flow of grout within the annular space between the existing and new pipes. Blocking may be required to prevent the lining pipe from floating during grouting stage.

604.14–PAY ITEMS:

ADD THE FOLLOWING TO THE TABLE:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>604055-*</td>
<td>“size”, Lining Pipe Culverts</td>
<td>Linear Foot (Meter)</td>
</tr>
</tbody>
</table>

“size” — Nominal Size of Pipe
* Sequence number

Unless otherwise noted on the plans, the inside diameter of pipe. See Figure 604A.
## APPENDIX 604A

<table>
<thead>
<tr>
<th>Lining Pipe Culvert Nominal Size</th>
<th>Equivalent Pipe Sizes</th>
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<th></th>
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<tbody>
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<td></td>
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<td>ASTM-F894 Inside Diameter Pipe</td>
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<td>Inches</td>
<td>Inches</td>
<td>Inches</td>
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### APPENDIX 604A

<table>
<thead>
<tr>
<th>Lining Pipe Size</th>
<th>Inches</th>
<th>Approximate Equivalent Pipe Size (See Note)</th>
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<tr>
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<td>AASHTO M326</td>
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<tr>
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</tbody>
</table>

**NOTE:**
1. This information is provided for informational purposes only.
2. Pipe manufacturer wall and joint dimensions vary. Contractor shall obtain actual pipe material specifications for the specific pipe product installed.
3. Contractor should verify pipe liner will fit accordance with 604.6.4.1.

### FIGURE 604A

[Diagram of pipe dimensions]
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL PROVISION

FOR

STATE PROJECT NUMBER: ___________________________
FEDERAL PROJECT NUMBER: _________________________

FOR

SECTION 616
PILING

616.1–DESCRIPTION:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

This work shall consist of furnishing steel bearing piles of the kind and dimensions designated in the plans to the required bearing or penetration in accordance with this Special Provision and in reasonably close conformity with the lines and spacing shown on the Plans or established by the Engineer.

All piles shall be predrilled into rock and backfilled with concrete. Pile Driving is prohibited, unless called for in the Plans.

616.3–PREPARATION FOR DRIVING:

DELETE THE ENTIRE CONTENTS OF THE SUBSECTION

616.4–EQUIPMENT FOR DRIVING:

DELETE THE ENTIRE CONTENTS OF THE SUBSECTION
616.12–PREDRILLED PILING:

DELETE THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

The piles shall be predrilled into bedrock and concrete tremied around the piles to the top of rock socket elevation as indicated in the plans.

The bottom of the drilled boreholes shall be cleaned to the satisfaction of the Engineer prior to placement of concrete. Mini-Sid Inspection and CSL testing are waived.

Pile alignment shall meet the criteria as defined in Section 616.6.

Temporary Casing shall be used to keep the drill hole open during pile installation. The temporary casing shall be installed to the top of bedrock. The Rock Socket for the pile shall be a minimum diameter of three (3) feet. Shear studs, when required in the plans, shall be welded onto all piles.

The boreholes shall be drilled to the elevation specified in the plans and concrete shall be tremied in the annular space around the pile to the elevation specified in the plans from the bottom of the hole. The annular space around the piles shall be backfilled with Class DC Concrete (4,500 psi) or modified Class B (w/ 4,500 psi strength). The Concrete shall be tremied according to Section 625 – Drilled Caisson Foundations.

The zone above the top of concrete shall be as specified in the plans and backfilled with clean, dry sand to the bottom of the pile cap elevation.

616.15–BASIS OF PAYMENT:

ADD THE FOLLOWING TO THE END OF THE SECTION:

“Steel Piling, Predrilled and Backfilled with Concrete” of the size specified shall be paid for the actual length of piles remaining in the finished structure. The cost of temporary casing, concrete and sand for backfilling, and incidentals necessary to complete the work will be included in the bid price for piling.

616.16–PAY ITEMS:

ADD THE FOLLOWING ITEM TO THE TABLE:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>616001-001</td>
<td>Steel Piling, Predrilled and Backfilled with Concrete, “size”</td>
<td>Linear Foot (Meter)</td>
</tr>
</tbody>
</table>

“size” = Piling Size
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 108
PROSECUTION AND PROGRESS

108.7-COMPLETION DATES:
108.7.1-Failure to Complete on Time and Liquidated Damages:

DELETE THE CONTENTS OF SUBSECTION 108.7.1 AND REPLACE THE FOLLOWING:

Time is an essential element of the Contract, and it is important that the work be completed within the time specified. The cost to the Division for the administration of the Contract, including engineering, inspection, and supervision, will increase as the time required to complete the work is increased.

Therefore, for each calendar day the project is deemed not to be Substantially Complete after the Contract Time specified for completion of the work, subject to such extensions of contract time required or permitted in 108.6, the Division will assess liquidated damages against the Contractor. Daily charges will be deducted for each calendar day, as defined in 101.2, on all contracts, except daily charges will not be deducted between November 30 and April 1. The total amount of daily charges will be deducted from any monies due the Contractor, not as a penalty but as liquidated damages. Unless specified elsewhere in the Contract, the amount of the daily charge will be calculated from the table posted at the WVDOH Contract Administration’s Specifications and Documents website: http://www.transportation.wv.gov/highways/contractadmin/specifications/Pages/LiquidDatedDamages.aspx. Table 108.7.1 on the date the project is first advertised.

<table>
<thead>
<tr>
<th>Original Contract Amount</th>
<th>Daily Charges Per Calendar Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>For More Than $0 To and Including $500,000</td>
<td>$300</td>
</tr>
<tr>
<td>$500,000 To and Including $2,000,000</td>
<td>$600</td>
</tr>
<tr>
<td>$2,000,000 To and Including $10,000,000</td>
<td>$1,500</td>
</tr>
<tr>
<td>$10,000,000 To and Including $25,000,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>$25,000,000 To and Including</td>
<td>$4,000</td>
</tr>
</tbody>
</table>
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL PROVISION
FOR

STATE PROJECT NUMBER: ___________________________
FEDERAL PROJECT NUMBER: ___________________________

SECTION 492
COLD CENTRAL PLANT RECYCLING, CCPR

492.1-DESCRIPTION:
This work shall consist of a mixture of sized Reclaimed Asphalt Pavement, RAP, millings
from existing asphalt pavement or existing stockpiles, asphalt emulsion, water and other additives.
The mixture shall be produced at a nearby location, then placed and compacted to produce a recycled
asphalt layer to the approved design properties in accordance with 105.03.

492.2-JUST-IN-TIME TRAINING, JITT:
The Engineer and Contractor are required to attend a just-in-time training, JITT, course
regarding CCPR and both shall mutually agree on the course instructor, course content and training
site. The training class shall be conducted at a project field location convenient for all project
construction personnel responsible for CCPR operations and inspection to attend.
The JITT course shall be held during normal working hours and be completed not more than
14 days prior to the start of CCPR operations.
The Contractor shall provide a JITT instructor experienced in the construction methods,
materials and test methods associated with asphalt emulsion stabilized CCPR. A copy of the course
syllabus, handouts and presentation materials shall be submitted to the Engineer at least five working
days before the course is to be taught.

492.3-QUALITY CONTROL:
A quality control plan, QCP, shall be submitted to the Engineer a minimum of five calendar
days prior to the JITT. The QCP shall include the proposed CCPR mix design, a start to finish process
description to include discussion on corrective action measures, a list of proposed equipment, a list of
proposed QC tests and testing frequencies, and the curing methods and procedures applied to the
CCPR. All QC test results shall be maintained during the duration of the contract and made available
to the Engineer upon request, within 2 business days.
The following table provides the type and minimum frequency for tests:
### TABLE 492.3.2
Quality Control Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Frequency¹,²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of Laydown</td>
<td>1 per 500 linear feet</td>
</tr>
<tr>
<td>Pulverized Material Gradation</td>
<td>1 per 1,000 tons of production</td>
</tr>
<tr>
<td>Pulverized Material Moisture Content</td>
<td>1 per 500 tons of production</td>
</tr>
<tr>
<td>Asphalt Emulsion Content</td>
<td>1 per 500 tons of production</td>
</tr>
<tr>
<td>Water Content</td>
<td>1 per 500 tons of production</td>
</tr>
<tr>
<td>Compacted In-Place Field Density</td>
<td>1 per 1,000 linear feet</td>
</tr>
<tr>
<td>Field Moisture Content for Curing</td>
<td>1 per each day of production</td>
</tr>
</tbody>
</table>

Note 1: The Contractor shall perform all quality control tests within the first 500 ft after startup and after any change in the mix design.

Note 2: Testing frequency is based upon either linear foot of CCPR laydown or tons of CCPR mixture processing.

Note 3: Asphalt emulsion content and water content shall be taken from the readings of the control settings of the mixing unit.

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### 492.4-MATERIALS:

CCPR shall consist of a homogenous blend of RAP combined with asphalt emulsion, water, and when required, recycling additives such as corrective aggregate or cement. RAP shall be the product resulting from the cold milling or crushing of existing asphalt pavement and processed so that 100% passes the 1 ¼ in. (31.5 mm) sieve. Cement recycling additives used in asphalt emulsion stabilized CCPR may be dry powder or slurry with a minimum dry solids content of 60%. The actual materials used are dependent on the CCPR mix design and project requirements. Cement—All materials used must be supplied from an approved source.

#### 492.4.1—Asphalt Emulsion: Materials for use in CCPR shall be in accordance with the following:

Asphalt Emulsion shall be selected for the project by the asphalt emulsion supplier based on the Contractor’s mix design. The penetration of the supplied asphalt emulsion shall be within ±25 dmm of the penetration of the design asphalt emulsion. The asphalt emulsion shall be received on the job site at a temperature no greater than 120°F. See Table 492.4.1

Corrective Aggregate to adjust gradation or supplement material volume:

1. Coarse or Dense Graded Aggregate, Class C or Higher
2. Fine Aggregate
3. RAP shall be the product resulting from the cold milling or crushing of existing asphalt pavement and processed so that 100% passes the 1 ¼ in. (31.5 mm) sieve.

Portland Cement, Type I

Water

---

### TABLE 492.4.1

<table>
<thead>
<tr>
<th>Test</th>
<th>Procedure</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, Saybolt Furol, @ 77°F (25°C), SFS</td>
<td>AASHTO T 59</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>
Sieve Test, No. 20 (850 µm), retained on sieve, %  
Storage Stability Test, 24 hr, %  
Distillation Test, Residue by distillation, %  
Oil Distillate by volume, %  
Penetration, 77°F (25°C), 100 g, 5 s, dmm  

<table>
<thead>
<tr>
<th>Test</th>
<th>Procedure</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Abrasion Value, % loss</td>
<td>AASHTO T 96</td>
<td>40% max</td>
</tr>
<tr>
<td>Sand Equivalent, %</td>
<td>AASHTO T 176</td>
<td>60 min</td>
</tr>
<tr>
<td>Washed Gradation</td>
<td>AASHTO T 11 &amp; T 27</td>
<td>As required</td>
</tr>
</tbody>
</table>

The asphalt emulsion shall be selected for the project by the asphalt emulsion supplier based on the Contractor’s mixture design. The penetration of the supplied asphalt emulsion shall be within ±25 dmm of the penetration of the design asphalt emulsion. The asphalt emulsion shall be received on the job site at a temperature no greater than 120°F. 

Modified AASHTO T 59 – distillation temperature of 350 ± 9°F (177 ± 5°C) with a 20-minute hold.

Type A certification shall be required to be furnished by the asphalt emulsion supplier.

492.4.2-Corrective Aggregate: Corrective Aggregate may be required to supplement the RAP gradation in order to meet performance requirements of the mix. When required by the mix design, corrective aggregate shall meet the requirements of Table 492.4.2.

<table>
<thead>
<tr>
<th>Test</th>
<th>Procedure</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Abrasion Value, % loss</td>
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<tr>
<td>Washed Gradation</td>
<td>AASHTO T 11 &amp; T 27</td>
<td>As required</td>
</tr>
</tbody>
</table>

492.4.3-Water: Water may be added to the RAP in the mixing apparatus to achieve uniform mixing and to lubricate the mix to facilitate compaction. Water added to the RAP shall be free from deleterious concentrations of acids, alkalis, salts, sugars and other organics, chemical or deleterious substances. The water shall not cause an adverse effect on either the recycling agent or the recycled pavement mixture. If the Engineer deems the water is of questionable quality it shall be tested in accordance with ASTM C1602.

492.4.4-Cement: Cement, in either dry or slurry form, may be added to the CCPR mixture as determined by the mix design. Slurry made from cement shall contain a minimum of 60% dry solids content. Cement shall comply with the latest specifications for Type I or Type II cement (AASHTO M 85, AASHTO M 240). The ratio of residual asphalt in the bituminous recycling agent to dry cement shall be at least 3:1. In addition, the cement shall be limited to a maximum of 1.0 percent by dry weight of RAP. The Contractor shall submit the type of process for incorporating cement into the recycling process with the Mix Design.

492.5-MIX DESIGN:

CCPR mix designs shall be in accordance with Materials Procedure (MP) xxx.05.04 XXX.XX.XX and comprised of existing RAP, asphalt emulsion and recycling additives, if necessary. The mix design and all associated testing shall be performed using samples of each proposed material. RAP samples shall either be collected from the existing pavement at the project site representing the milling depth or from the RAP stockpile to be used during construction. The mix design shall be completed by a design laboratory that is AASHTO Resource accredited in asphalt mixtures and asphalt emulsion. Additional mix designs shall be performed when the proposed material changes significantly in order to establish representative mixes for the entire job. The
Contractor shall be responsible for obtaining all samples required to develop the mix design. One sample per lane mile of planned CCPR shall be the minimum sampling frequency for mix design preparation.

The Contractor shall provide a mix design or designs for approval at least five calendar days prior to the JITT. The mix design shall include all test results performed. If new materials are added, a new mix design, including the updated test results, shall be submitted at least one day prior to implementation.

CONSTRUCTION REQUIREMENTS

492.6-ROADWAY PREPARATION:

1. Snowplowable raised pavement markers shall be removed in accordance with 808.11(e) prior to CCPR operations.
2. Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the pulverized asphalt material during milling operation.
3. All areas of soft or yielding subgrade shall be corrected prior to CCPR operations.
4. If the CCPR mix is to be placed on a prepared subgrade or aggregate base, ensure the subgrade soils and base have been properly prepared, moisture treated and compacted to the minimum density according to plans or specifications, immediately prior to placement of the CCPR mix, so as to create an evenly graded, unyielding surface.

492.7-PAVEMENT REMOVAL:

The existing asphalt pavement shall be milled in accordance with Section 415 to the length, depth and width as shown on the plans or specifications. The RAP shall be free of contamination of dirt, base, concrete or other deleterious materials such as silt and clay.

When a paving fabric is encountered during pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the CCPR does not affect the performance parameters or inhibit placement or compaction of the CCPR. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments or operations so that the shredded fabric in the recycled material is no more than 5 sq. in. No fabric piece shall have a dimension exceeding a length of 4 in.

Rubberized crack filler, durable pavement markings, loop wires and other non-pavement materials shall be removed as observed from the roadway. Residual materials that cannot be completely removed may be incorporated into the mixture if the Contractor can demonstrate that those added materials will not adversely affect performance.

Any such materials retained in the mix shall be appropriately sized and blended so as not to adversely affect the strength of the recycled pavement.

492.8-EQUIPMENT:

The equipment shall consist of the following major components:

492.8.1-Milling Machine/Pavement Cold Planer: Milling equipment shall be in accordance with Section 415.2.2.4. The equipment shall be capable of pulverizing the existing asphalt material in a single pass to the depth shown on the plans. The machine shall have automatic depth controls to maintain the cutting depth to within ± ¼ in. of that shown on the plans.
The milling operation shall not disturb or damage the underlying material. The use of a heating device to soften the pavement will not be allowed.

**492.8.2-Additive Slurry Storage and Supply Equipment:** Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. Additive slurry storage and supply equipment shall have agitators or similar equipment to keep the slurry in suspension when held in the slurry batch or storage tanks. Slurry shall be kept in suspension during transport using agitator equipment.

**492.8.3-Sizing Equipment:** A material sizing unit shall be capable of sizing using a scalping screen or crushing capabilities to reduce RAP to a maximum size of 1 ¼ in. (31.5 mm) or to the maximum size requirements specified prior to mixing with the asphalt emulsion.

**492.8.4-Mixing and Proportioning Equipment:** The equipment shall be capable of processing sized RAP, asphalt emulsion, water and any additives stipulated in the mix design to a homogenous and uniformly coated CCPR mixture.

The mixing plant shall be of sufficient capacity and coordination to adequately handle the proposed Cold Mix Asphalt (CMA) construction. The mixing unit shall be a twin shaft pugmill or other approved mixer, including the drum type capable of producing a consistent uniform mixture. The outlet of the mixer shall be such that it prevents segregation of the material when discharged.

A HMA mixing plant in accordance with Section 401 may be utilized as a CMA mixing plant. The equipment/plant shall display automatic digital readings shall be displayed for flow rate of both the RAP and asphalt emulsion in appropriate units of weight and time.

The mixing apparatus shall have cold feed hopper equipped with vibrators on the hopper’s walls to assist the free flow of materials to a variable speed belt conveyor. Control of the RAP shall be by mechanically adjustable gate valves at the point of discharge or a RAP belt scale for the continuous weighing of the RAP. The variable speed belt conveyor or RAP belt scale shall be interlocked to the asphalt emulsion metering device.

The asphalt emulsion metering device shall be capable of automatically adjusting the flow of asphalt emulsion to compensate for any variation of RAP introduced into the mixing apparatus. Asphalt emulsion shall be metered by weight of RAP using a calibrated meter that will accurately measure the amount of asphalt emulsion to within a tolerance of ± 2.0% of the specified rate.

**492.8.5-Hauling Equipment:** Hauling equipment shall be in accordance with Section 401.9.7.

**492.8.6-Laydown Equipment:** Laydown equipment shall be in accordance with 401.9.9.

The paver screed shall be controlled by electronic grade and cross-slope control. Heating of the screed shall not be allowed.

CCPR material shall either be loaded directly into the paver hopper from transport trucks or loaded into a materials transfer vehicle. If utilizing a materials transfer device, a hopper insert shall be used and heating of the mixture shall not be allowed.
492.8.7-Compaction Equipment: Compaction equipment shall be in accordance with 401.9.10. The number, weight, and types of rollers shall be necessary to obtain required compaction. At a minimum, the following rollers shall be used:

1. At least one pneumatic tired roller in accordance with 401.9.10 with a minimum weight of not less than 20 tons.
2. At least one double drum vibratory roller in accordance with 401.9.10 with a minimum weight of not less than 10 tons.

492.9-WEATHER RESTRICTIONS:
CCPR operations shall be performed when the RAP temperature, or pavement surface temperature, is above 50°F with ambient temperatures above 35°F for seven days. The Engineer may restrict work when the heat index is greater than 100°F. The CCPR shall not be performed before May 1st or after October 1st.

492.10-MATERIAL SIZING AND STOCKPILING:
The gradation of the RAP shall have 100% passing the 1 ¼ in. (31.5 mm) sieve, or to be sized to meet specific contract requirements.

RAP that has been crushed and screened shall be stockpiled and maintained to prevent reconsolidation. Water may be added to RAP as it is screened and crushed to abate dust and mitigate reconsolidation.

Corrective aggregate, if required, shall either be mixed with RAP to create a homogenous mixture during stockpiling or fed into the mixing apparatus at the rate determined by the mix design.

492.11-PROCESSING AND MIXING OPERATION:
The sized RAP shall be processed through a mixing unit capable of combining the sized RAP, asphalt emulsion, and any additives to produce a homogenous recycled mixture.

An additive used in asphalt emulsion stabilized CCPR may be dry powder or slurry and the Contractor shall address the application methods and fugitive dust control procedures in the QCP when dry powder materials are used.

The asphalt emulsion shall be injected into the CCPR materials at the initial rate determined by the mix design and approved by the Engineer. Sampling and mix design may determine different levels of asphalt emulsion at various portions of the project.

The asphalt emulsion shall have an application tolerance determined by adding ± 0.25% to the percent total asphalt emulsion content.

The Contractor can request the asphalt emulsion percentage to exceed the upper tolerance provided the mix design requirements are satisfied at the requested percentage. The request will be subject to approval by the Engineer.

492.12- PLACEMENT:
The depth of CCPR shall be as indicated on the plans.

The hauling equipment shall deliver the blended CCPR material into the paver within one hour of mixing or before the asphalt emulsion begins to break and set.

CCPR single lift thickness shall be a minimum compacted depth of 3 in. and not exceed a maximum compacted depth of 6 in. A minimum lift thickness of 2 in. can be utilized if the crushed RAP has a maximum size of 3/4 in.
492.13-CONTROL STRIP AND COMPACTION:
A minimum 500 ft long control strip shall be conducted on the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:

1. Demonstrate the equipment, materials and processes proposed to produce a CCPR layer in accordance with specification requirements
2. Determine the optimal rates for the asphalt emulsion, water and any additives recommended for the material
3. Determine the sequence and manner of rolling necessary to obtain specified density requirements in one uniformly compacted layer.

The CCPR density shall be achieved with the same equipment, materials, construction methods and density requirements used on the accepted control strip. A new control strip shall be constructed if changes are made outside of the tolerances of the original mix design, equipment or construction methods.

A rolling pattern that produces the maximum obtainable density, or optimum field density, shall be determined during the control strip. The Contractor shall provide a sequence and manner of rolling by establishing a roller pass versus density chart that shows the progress of densification from initial lay down through optimum field density using a properly calibrated nuclear gauge in accordance to AASHTO T 310-355. Production may continue after approval of the control strip.

The Contractor shall perform compaction testing in accordance with AASHTO T 310-355 during production to ensure compaction is between 97% and 102% of the optimum field density established during the control strip. If two successive tests indicate compaction is over 102% or below 97% of the optimum field density, a new rolling pattern and roller pass versus density chart shall be established.

The QC technician shall be on site, observing all compaction efforts and approving areas as they reach minimum relative compaction. Care shall be taken not to over compact the mat.

Any type of rolling effort that causes cracking, displacement or other type of pavement distress shall be discontinued until such time as the problem can be resolved and approved by the Engineer.

Rollers shall not be started or stopped on recycled material unless when changing direction during the compaction process.

All tests shall be conducted at the stated QC testing frequencies throughout CCPR operations.

492.14-OPENING TO TRAFFIC:
Opening to traffic shall occur after sufficient cure time has been applied to the CCPR so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by a rotary power broom in accordance with Section 405.

After opening to traffic, the surface of the recycled pavement shall be maintained in a condition suitable for the safe movement of traffic.

492.15-MAINTENANCE:
The Contractor shall maintain the recycled pavement in a manner satisfactory to the Engineer until the surface course has been constructed.

Any damage to the completed recycled material shall be repaired by the Contractor prior to the placement of new asphalt concrete or final surface sealing. Patching shall be in accordance with the WV DOH Maintenance Manual. The excavated patch areas shall be filled and compacted with HMA.
or CCPR material as directed by the Engineer. No direct payment will be made for damage repair unless approved by the Engineer.

492.16-CURING:
Before placing the final surfacing, the recycled surface shall remain in-place for a minimum of three days and meet one of the following conditions:
1. There is less than 3.0% moisture remaining in the mixture, or;
2. The material has remained in-place for a minimum of 10 days without rainfall.

The planned method and duration of curing of CCPR shall be in accordance with the QCP. The specified surface course shall be placed within two weeks of the CCPR final cure, but no later than November 1.

492.17-PAVEMENT SMOOTHNESS: BLANK
Pavement smoothness of the cured CCPR mat shall meet the requirements of Section 720. The Contractor shall correct humps or depressions exceeding the tolerances in accordance with Section 720.

492.18-CCPR SURFACE COURSE:
The CCPR shall be swept of all loose material and standing water with a rotary power broom in accordance with Section 405 immediately prior to placing the tack coat. A tack coat shall be required and shall be applied to the CCPR in accordance with Section 408.

492.19-METHOD OF MEASUREMENT:
The CCPR will be measured by the square yard, complete in place. Asphalt emulsion will be measured by the gallon. Aggregate to adjust the CCPR gradation will be measured by the ton of material used. HMA Patching will be measured by the ton.

492.20-BASIS OF PAYMENT:
CCPR will be paid for at the contract unit price per square yard, complete in place. Asphalt emulsion will be paid for at the contract unit price per gallon, complete in place. Aggregate used to adjust the CCPR gradation will be paid for at the contract unit price per ton, complete in place.

The costs associated with the CCPR mix design and quality control testing; shall be included in the cost of the cold central plant recycling.
—— The costs associated with the removal of grass and vegetation, rubberized crack filler, durable pavement markings, loop wires and other non-pavement materials; shall be included in the cost of the cold central plant recycling.
—— The cost associated with pulverizing, stabilizing, compacting, curing, and maintenance of the CCPR not related to failing subgrade; shall be included in the cost of the cold central plant recycling.
—— The cost associated with mixing water for cold central plant material; shall be included in the cost of the cold central plant recycling.
—— The cost associated with aggregate when used to supplement material volume; and shall be included in the cost of the cold central plant recycling.
—— The cost associated with the use of Portland cement when used as an additive, shall be included in the cost of the cold central plant recycling.
The cost associated with aggregate when used to adjust the CCPR gradation shall be included in the cost of the corrective aggregate pay item.

The costs of the asphalt emulsion stabilizing material shall be included in the cost of stabilizing material pay item.

In the locations of failing subgrade, removal of the CCPR shall be included in the cost of subgrade treatment.

492.21- PAY ITEMS:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>492001-001</td>
<td>Cold Central Plant Recycling (CCPR) Pavement</td>
<td>Square Yard</td>
</tr>
<tr>
<td>492001-002</td>
<td>Corrective Aggregate, CCPR</td>
<td>Ton</td>
</tr>
<tr>
<td>492001-003</td>
<td>Asphalt Material, Emulsion</td>
<td>Gallon</td>
</tr>
<tr>
<td>492001-004</td>
<td>Asphalt Mixture, Patching</td>
<td>Ton</td>
</tr>
<tr>
<td>492001-005</td>
<td>Asphalt Mixture, Subgrade Treatment??</td>
<td>SY</td>
</tr>
</tbody>
</table>
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL PROVISION
FOR
STATE PROJECT NUMBER: __________________________
FEDERAL PROJECT NUMBER: __________________________

SECTION 490
NINE YEAR PAVEMENT PERFORMANCE CRITERIA

490.1-DESCRIPTION:
The pavement performance period shall consist of satisfying the performance criteria requirements of the work contained in the appendices. This special provision establishes the common terms and definitions. The pavement performance criteria assure and protect the Division from specific defects found in the pavement.

490.1.1-Definitions:
Acceptance Date of Initial Construction Work-The date when the work is completed and is continuously open to traffic. This shall be the date of initial acceptance and constitutes the start date for the performance criteria period. For divided highways, there may be more than one acceptance date of work for a project.

Performance Lane(s)-The portion of the pavement considered performance criteria work. Each of the following shall be considered a separate performance lane.
• 1. Each individual mainline lane and adjacent shoulder
• 2. The sum of all ramp lanes and the associated acceleration/deceleration lanes
• 3. The sum of all auxiliary lanes, such as passing lanes and turn lanes
Approaches and driveways are not considered.

Performance Criteria Work - Work that is guaranteed to meet the performance requirements as defined and calculated in Appendix A, throughout the performance rating period.

Maintenance Work - Corrective action taken by the Contractor to bring the performance criteria work into compliance with the performance requirements and calculations detailed in Appendix A.
490.2-INITIAL ACCEPTANCE:
The Division and the Contractor shall jointly review all completed work, or a portion thereof, as determined by the Division. If the Division determines that the work is in compliance with the contract specifications and is continuously open to traffic, then the date of initial acceptance occurs. If the work does not meet contract requirements, the Contractor shall make all necessary corrections, at its expense, prior to initial acceptance. The date on which initial acceptance occurs shall be termed the Initial Acceptance Date of Initial Construction Work and is to be documented in accordance with this special provision.

As stated in Section 490.1.1, once the Initial Acceptance date has been determined this shall act as the start date for the performance criteria period.

The Division may accept any portion of the work and begin the performance period to accommodate seasonal limitations or staged construction, excluding any area needing corrective work.

490.3-THIS SECTION INTENTIONALLY LEFT BLANK:

490.4-RIGHTS AND RESPONSIBILITIES OF THE DIVISION:
The Division:

1. Reserves the right to approve the time, traffic control and methods for performing any work.
2. Reserves the right to approve the schedule proposed by the Contractor to perform work.
3. Reserves the right to determine if work performed by the Contractor meets the contract specifications.
4. Reserves the right to perform, or have performed, routine core maintenance activities during the performance period, which this routine core maintenance will not diminish the Contractor’s responsibility under the performance criteria. Core Maintenance activities consist of: Mowing, Snow Removal, Striping, Guardrail Repair, Signing, and Maintaining Ditches and other Drainage Structures.
5. Reserves the right, if the Contractor is unable, to make immediate emergency repairs to the pavement to prevent an unsafe road condition as determined by the Division. The Division will attempt to notify the Contractor that action shall be required to address an unsafe condition. The Division will record the time and date of the attempts for Contractor notification. However, should the Contractor be unable to comply with this requirement, to the Division’s satisfaction and within the required time frame specified by the Division, the Division will perform, or have performed any emergency repairs deemed necessary. Any such emergency repairs undertaken will not relieve the Contractor from meeting the performance requirements of this Special Provision. Any costs associated with such emergency repairs due to defective work will be paid by the Contractor.
6. Shall be responsible for monitoring the pavement throughout the performance period and will provide the Contractor any written reports of the surface condition or maintenance activities, or both related to pavement performance.
7. Shall be responsible for notifying the Contractor, in writing, of any corrective action required to meet the pavement performance requirements.
**490.5- RIGHTS AND RESPONSIBILITIES OF THE CONTRACTOR:**
The Contractor:

1. Shall ensure that the work will be free of defects as measured by the performance parameters and specified threshold values as defined in Appendix A and as measured and defined in Appendix B.
2. Shall be responsible for performing all work including, but not limited to, maintaining traffic and restoring all associated pavement features, at the Contractor’s expense.
3. Shall be responsible for performing all work in accordance with any contract details, established WVDOH policies, or Industrywide Best Management Practices, or combination thereof. Use of repair materials different than the constructed pavement structure may be permitted on a temporary basis and no such temporary repairs shall remain in place at the end of the current rating period. Any deviations from such policies shall be approved by the Engineer and may require a signature and seal of a currently Licensed West Virginia Professional Engineer.
4. Shall be responsible for performing all temporary or emergency repairs, resulting from being in non-compliance with the pavement performance requirements, using Division approved materials.
5. Shall notify the Division and submit a written course of action for performing the needed work, ten calendar days prior to commencement of said work, except in the case of emergency repairs as detailed in this special provision. The submittal must propose a schedule for performing the work and the materials and methods to be used.
6. Shall follow a Division approved temporary traffic control plan when performing work.
7. Shall pay lane rental fees as stipulated in the Contract, during maintenance work.
8. Shall complete all work required by this special provision and prior to conclusion of the pavement performance period, or as otherwise agreed to by the Division.

**490.6-EVALUATION METHOD:**
The Division will conduct pavement evaluations in accordance with Appendix A and Appendix B of this section. Evaluation may include use of the Division’s Pavement Management System Condition Collection Contract or field pavement condition reviews, including roughness measurements, or both. This evaluation may be waived in emergency situations.

Results of the Division’s pavement evaluation will be handed over to the Contractor within thirty (30) days of August 31. These results will detail any bonus or penalties along with locations for various distress areas that require corrective action.

**490.7-PAVEMENT PERFORMANCE REQUIREMENTS:**
Maintenance work will be required as per the requirements and calculations of Appendix A.

**490.8- DISPUTE RESOLUTION BOARD: BLANK**
If included as part of the Contract, the sole responsibility of the Dispute Resolution Board (DRB) is to provide a decision on disputes between the Division and the Contractor regarding application or fulfillment of the pavement performance requirements. The DRB will be in accordance with Section 105.18.
The DRB will determine the scope of work and select the party to conduct the investigation. All costs related to the forensic investigation will be shared proportionally between the Contractor and the Division based on the determined cause of the condition.

490.9-EMERGENCY REPAIRS:
If the Division determines that emergency repairs are necessary for public safety, the Division or its agent may take repair action.
Prior to emergency repairs, the Division will document the basis for the emergency action, will preserve evidence of the defective condition, and document all materials and methods used for the repair.

490.10-NON-EXTENSION OF CONTRACT:
This Special Provision shall not be construed as extending or otherwise affecting the claim process and statute of limitation applicable to this Contract.
Preliminary Project Evaluation - In order to help facilitate design of a system that meets the criteria set forth in this contract, the Division may perform the following and make available the results to prospective bidders.

1. Perform Non-Destructive Testing (NDT) to help delineate pavement layer thickness and to help delineate transitions within the overall pavement structure in the pavement performance section.

2. Perform field coring of pavement at selected locations based on pavement condition, or at locations where abrupt changes in NDT results may indicate a transition in pavement section, or both.

Performance Requirements – Pavement Performance Requirements are set for three different categories: Ride Quality (Section A1), Threshold Limits (Section A2), and Pavement Surface Rating (PSRSDI) (Section A3).

The finished road surface shall be evaluated annually during the performance period no later than August 31 of each year; this date shall not be extended for any reason. The Contractor can ask the Division to perform the rating prior to August 31. Contractor’s personnel will be allowed to participate and review the evaluation process.

If desired, the contractor may monitor and survey the pavement in addition to the work being performed by this agency. However, any destructive work such as coring or milling shall not be performed without approval by the Engineer and at no additional cost to the Division.

Corrections for deficient shoulder conditions based on Threshold Limits (Section A2) are included in performance criteria Work, however no PSRSDI ratings or IRI ratings shall be performed on shoulders and no bonuses or penalties shall be received or collected due to shoulder conditions. The Contractor shall be notified of shoulder areas needing corrective action after each Roadway Evaluation, or in case of emergencies.

A1 RIDE QUALITY

Shoulder work shall be exempt from ride quality measures. Yearly IRI values shall be in accordance with Special Provision Standard Specifications Section 720, Ride Quality for Pavement Surface Smoothness Testing, for the entire length of the project limits. The yearly IRI values shall be determined by the Division no later than August 31 of each year; this date shall not be extended for any reason. The Contractor can ask the Division to perform the rating prior to August 31.

The overall IRI shall meet or exceed the following in Table A5 at the specified age:
**Table A1. IRI Criteria**

<table>
<thead>
<tr>
<th>Year</th>
<th>IRI Criteria for Bonus</th>
<th>Bonus</th>
<th>IRI Criteria for Penalty</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>&gt;65</td>
<td>0.11%</td>
<td>&gt;81</td>
<td>0.22%</td>
</tr>
<tr>
<td>Two</td>
<td>&gt;65</td>
<td>0.11%</td>
<td>&gt;81</td>
<td>0.22%</td>
</tr>
<tr>
<td>Three</td>
<td>&gt;65</td>
<td>0.28%</td>
<td>&gt;81</td>
<td>0.56%</td>
</tr>
<tr>
<td>Four</td>
<td>&gt;65</td>
<td>0.28%</td>
<td>&gt;81</td>
<td>0.56%</td>
</tr>
<tr>
<td>Five</td>
<td>&gt;65</td>
<td>0.44%</td>
<td>&gt;81</td>
<td>0.88%</td>
</tr>
<tr>
<td>Six</td>
<td>&gt;65</td>
<td>0.44%</td>
<td>&gt;81</td>
<td>0.88%</td>
</tr>
<tr>
<td>Seven</td>
<td>&gt;65</td>
<td>0.89%</td>
<td>&gt;81</td>
<td>1.78%</td>
</tr>
<tr>
<td>Eight</td>
<td>&gt;65</td>
<td>0.89%</td>
<td>&gt;81</td>
<td>1.78%</td>
</tr>
<tr>
<td>Nine</td>
<td>&gt;65</td>
<td>1.56%</td>
<td>&gt;81</td>
<td>3.12%</td>
</tr>
</tbody>
</table>

As noted above, the subject contract allows for payment bonuses and penalties for IRI. Bonus and Penalty Payments are not cumulative and do not carry over from year to year.

**A2 THRESHOLD LIMITS AND CORRECTIVE ACTION**

Each distress index in the following sections A2.1 and A2.2 has a threshold level applied to each segment of each performance lane before corrective action (maintenance work) shall be required. Following the annual review data collection, this work shall be completed prior to June 10 of the next calendar year.

Each lane mile will be divided into 10 equal 0.1 mile segments starting at the beginning milepost. Threshold limits apply to the entire performance section, and have been established to allow a certain extent of low severity distresses within 0.1 mile segments before corrective action is required. Any extent of medium or high severity distresses observed shall require corrective action.

Polished Aggregate will be described for informational purposes to support overall characterization of the road surface. Skid testing will be used to quantify acceptable levels of surface friction. Skid Testing will be conducted yearly and completed by the Division or an independent testing firm. Any skid number less than 35 shall require corrective action. Any corrective action required by DOH for skid numbers 35 or greater shall be paid for in accordance with section 109.4.

When corrective action is taken to address thresholds within a pavement segment, all distresses associated with that threshold must be addressed in that 0.1 mi segment and the adjacent lane. If a segment that is adjacent to a partial segment (roadway less than 0.1 mile) is subject to corrective action, that adjacent partial segment shall also receive the same corrective action in both lanes. Similarly, should a partial segment be subject to corrective action, the adjacent full segment shall receive the same corrective action in both lanes. Additionally, if a continuous distress exceeds threshold limits and lies within two or more adjacent segments (full or partial), that shall also require corrective action in both lanes. All corrected sections will be monitored for performance. If distresses are repaired and integrity of repair is maintained, it shall not be counted against threshold limits.

Any permanent repairs shall be of equal or better quality material than the original section. The Contractor is advised that any permanent repairs consisting of different material properties.
than was originally placed shall be done over the entire rating segment. Additionally, if a repair extends or lies within two or more adjacent segments (full or partial), the adjacent section shall receive the same repair solution. This restriction does not apply to temporary fixes, such as those placed for emergency purposes or placed to slow deterioration during winter.

Shoulders have no threshold limits for low severity distresses; however, medium and high severity distresses shall require corrective action.

**490.1.1-Definitions:**

**A2.1 ASPHALT PAVEMENT**

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Index</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alligator Cracking</td>
<td>Structural Cracking Index (SCI)</td>
<td>234</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>Environmental Cracking Index (ECI)</td>
<td>264</td>
</tr>
<tr>
<td>Longitudinal Cracking</td>
<td>Rut Depth Index (RDI)</td>
<td>764</td>
</tr>
<tr>
<td>Longitudinal Joint Deterioration</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Lane Edge Cracking/Deterioration</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Raveling/Weathering</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Patching</td>
<td>(Note 1)</td>
<td></td>
</tr>
<tr>
<td>Rutting</td>
<td>(Note 2)</td>
<td></td>
</tr>
<tr>
<td>Potholes/Surface Delamination</td>
<td>(Note 3)</td>
<td>0</td>
</tr>
</tbody>
</table>

**Note 1:** Patches shall require corrective action if any other distresses are found within them.

**Note 2:** Any individual measurement of ½ inch or greater shall require corrective action.

**Note 3:** Potholes/Surface Delamination refers to bowl-shaped holes or separation of surface and underlying pavement courses of various sizes within the pavement surface, but with generally a minimum plan dimension of 0.5 ft.

Areas with excessive segregation or raveling/weathering or areas exhibiting bleeding/flushing will be subject to measurements of Macrotecture as per MP 401.07.24 Standard Test Method for Measuring Pavement Macrotecture Depth using a Volumetric Technique. These open areas will be monitored throughout the performance period. Should the condition of these distresses continue to deteriorate, further investigation will be required to determine if maintenance work is required. If the average macrotecture test depth in flushed areas is less than or equal to 0.006 inches (0.152mm) then maintenance work is required.
A2.2 PCC PAVEMENT

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Index</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Joints Spalls (Note 1)</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Environmental Cracking Index (ECI) Blowups</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Rut Depth Index (RDI) Longitudinal Cracking</td>
<td></td>
<td>476</td>
</tr>
<tr>
<td>Longitudinal Joint Spalling</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Lane Edge Spalling</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>D Cracking (Note 2)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Scaling (Note 3)</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>Patching (Note 4)</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Popouts</td>
<td></td>
<td>26</td>
</tr>
</tbody>
</table>

Note 1: There is no threshold for low severity spalls with no loss of material

Note 2: Should D Cracking occur, a special evaluation may be conducted and corrective action will be paid for by section 109.4.

Note 3: Scaling or map cracking greater than one inch in depth shall require corrective action.

Note 4: Partial Depth Repairs with any other distresses in them shall require corrective action.

A3 PAVEMENT SURFACE RATING

The Pavement Surface Rating (PSR) will represent the West Virginia Division of Highways (WVDOH) crack and surface distress index for this contract. It uses a 0.0 to 100.0 rating scale: the higher the number, the less overall distress shall be present. Generally, a perfect or newly constructed road has a PSR of 100.0. As the type, amount and severity of the various defects increase, the PSR drops. The pavement distresses that make up the PSR are determined by the Division using the criteria contained in this provision and Appendix B.

Each lane mile will be divided into 10 equal 0.1 mile segments starting at the beginning milepost. Initially, the road surface evaluation for determining the (PSR) will be performed at two 0.1 mile (528’) segments within each lane mile by the Division.

- One PSR evaluation segment will initially lie between 0.4 and 0.5 miles within that lane mile.
- An additional PSR evaluation segment within each mile will be selected randomly by the Engineer.

Partial mile sections at the beginning and end of a contract shall also have segments for determination of PSR identified.

For sections less than 0.6 miles in length, one 0.1 mile segment shall be randomly selected.

For sections 0.6 miles or greater in length, two 0.1 mile segments shall be randomly selected.

Once the PSR evaluation segments are identified, the same segments will be used for the remainder of the performance period. If, however, it is suspected that the resulting PSR is not representative of the general overall road surface condition, one or more new segments may be randomly selected for determination of PSR. If corrective action is performed on a PSR evaluation segment, a new segment may be selected for determination of PSR.

The overall PSR shall meet or exceed the following in Table A3 at the specified age:
Table A3. PSRPSDI Criteria

<table>
<thead>
<tr>
<th>Year</th>
<th>PSRPSDI Criteria for Bonus</th>
<th>Bonus</th>
<th>PSRPSDI Criteria for Disincentive</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>≥98</td>
<td>0.11%</td>
<td>≤96</td>
<td>0.22%</td>
</tr>
<tr>
<td>Two</td>
<td>≥97</td>
<td>0.11%</td>
<td>≤95</td>
<td>0.22%</td>
</tr>
<tr>
<td>Three</td>
<td>≥96</td>
<td>0.28%</td>
<td>≤94</td>
<td>0.56%</td>
</tr>
<tr>
<td>Four</td>
<td>≥90</td>
<td>0.28%</td>
<td>≤88</td>
<td>0.56%</td>
</tr>
<tr>
<td>Five</td>
<td>≥90</td>
<td>0.44%</td>
<td>≤88</td>
<td>0.88%</td>
</tr>
<tr>
<td>Six</td>
<td>≥90</td>
<td>0.44%</td>
<td>≤88</td>
<td>0.88%</td>
</tr>
<tr>
<td>Seven</td>
<td>≥85</td>
<td>0.89%</td>
<td>≤80</td>
<td>1.78%</td>
</tr>
<tr>
<td>Eight</td>
<td>≥85</td>
<td>0.89%</td>
<td>≤80</td>
<td>1.78%</td>
</tr>
<tr>
<td>Nine</td>
<td>≥85</td>
<td>1.56%</td>
<td>≤80</td>
<td>3.12%</td>
</tr>
</tbody>
</table>

Please note that the subject contract allows for payment bonuses for PSRPSDI. Bonus and Penalty Payments are not cumulative and do not carry over from year to year.

A3.1—CALCULATING THE PAVEMENT SURFACE RATINGPAVEMENT SURFACE DISTRESS INDEX (PSRPSDI)

A3.1.1 Step One—Categorize and measure all distresses in the roadway

— Refer to Appendix B for definitions of distress types and severity levels.
— For bituminous surfaced pavements, the following distress types are measured and recorded for calculation of PSRPSDI.

<table>
<thead>
<tr>
<th>Asphalt Distress</th>
<th>Severity Levels</th>
<th>How to Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Cracking</td>
<td>Low, Medium, High</td>
<td>Count</td>
</tr>
<tr>
<td>Longitudinal Cracking</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Longitudinal Joint Deterioration</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Lane Edge Cracking</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Alligator Cracking</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Rutting</td>
<td>Low, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Raveling &amp; Weathering</td>
<td>None</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Patching</td>
<td>None</td>
<td>Linear Feet</td>
</tr>
</tbody>
</table>

— For jointed concrete pavements, the following distress types are measured and recorded for calculation of PSRPSDI.
### PCC Distress

<table>
<thead>
<tr>
<th>Distress</th>
<th>Severity Levels</th>
<th>How-to-Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Joint Spalling</td>
<td>Low, Medium, High</td>
<td>Count</td>
</tr>
<tr>
<td>Transverse Joint Faults</td>
<td>Low, Medium, High</td>
<td>Count</td>
</tr>
<tr>
<td>Blowups</td>
<td>None</td>
<td>Count</td>
</tr>
<tr>
<td>Patching</td>
<td>None</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>D-Cracking</td>
<td>None</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Longitudinal Joint Spalling</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Lane Edge Spalling</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Transverse Cracks</td>
<td>Low, Medium, High</td>
<td>Count</td>
</tr>
<tr>
<td>Longitudinal Cracks</td>
<td>Low, Medium, High</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Sealing</td>
<td>None</td>
<td>Linear Feet</td>
</tr>
<tr>
<td>Popouts</td>
<td>None</td>
<td>Linear Feet</td>
</tr>
</tbody>
</table>

---

**Important details to remember for PCC Pavements:**
- Count the total number of joints in each 0.1 mile (528’) rating segment. If the segment starts exactly on a joint, do not count the last joint if the segment also ends exactly on a joint.
- Any full depth concrete repairs will add to the number of joints. For example, a full depth repair on a joint will replace the existing joint with two spaced joints, where a full depth repair on a mid-panel crack will simply add two joints.
- Partial depth concrete repairs do not add to the number of joints, however, their length will be counted towards patching.

**A3.1.2 Step Two—Convert the amount of distress to a percent (round to the nearest 0.1%)**

- The amount of each distress type at each severity level must be converted to percent as described below.

**Bituminous Pavements:**
- For bituminous pavements, the number of transverse cracks, at all severities, shall be converted to percent using the following:
  \[
  \text{Percent Cracks (%) = Number of Cracks x } 2.85 \text{ (not to exceed 100%)}
  \]
- For other distresses, simply divide the length of each defect by the length of the surveyed section, 528’ in most cases, and then multiply the quotient by 100 to get percent. For distresses measured in linear feet, the sum of the length of all levels of severities for that distress type shall not exceed 528 feet. If multiple severities of the same distress type exist in the same linear foot, the higher severity shall be used.

**Jointed Concrete Pavements:**
- For jointed concrete pavement, as with bituminous pavements, the number of transverse cracks, at all severities, shall be converted to percent using the following:
  \[
  \text{Percent Cracks (%) = Number of Cracks x } 2.85 \text{ (not to exceed 100%)}
  \]
- Count the total number of joints in the segment. Distresses that occur at transverse joints, i.e., transverse joint spalls, transverse joint faults, and blowups, are to be measured by counting the number of affected joints. This count is then divided by the total number of transverse joints to get the percent affected.
— All other distresses, such as longitudinal cracking, longitudinal joint spalling, and scaling, shall be measured on a length basis. This number is then divided by the total segment length to get percent affected. For distresses measured in linear feet, the sum of the length of all levels of severities for that distress type shall not exceed the segment length. If multiple severities of the same distress type exist in the same linear foot, the higher severity shall be used.

A3.1.3 Step Three—Weight Factors

— Weight Factors are a numerical representation given to the types of roadway distresses at different severity levels. These weight factors are pre-determined by the division and are listed in the table below.

<table>
<thead>
<tr>
<th>Table A3.1.3—Weight Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt-Distress</td>
</tr>
<tr>
<td>Transverse Cracks</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Edge Cracking</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Alligator-Cracking</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Block Cracking</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Longitudinal Cracking</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Longitudinal Joint Deterioration</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Lane-Edge Cracking/Deterioration</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Raveling/Weathering</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Patching</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Rutting</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Note: For Jointed Concrete Pavements, since distress factors are based on 35 joints per segment (15’ slabs), and there can be a varying number of joints and slab lengths, a
normalized weight factor needs to be calculated for the distresses that are counted on a joint basis. To do this, multiply the original weight factor by the number of joints divided by 35. Please note this only applies to transverse joint spalls, transverse joint faults, and blowups.

**A3.1.4 Step Four—Calculate the Individual Weighted Distress**

— Multiply the percent of each distress by the appropriate weight factors.

**A3.1.5 Step Five—Calculate the Total Weighted Distress (TWD)**

— Sum up all the Individual Weighted Distress to get the Total Weighted Distress.

**A3.1.6 Step Six—Convert the TWD to PSRPSDI**

— Use the TWD in the following formula or Table A3.1.6 to find the PSRPSDI of the segment.

\[ \text{PSRPSDI} = 25 \left[ e^{1.386 \times (TWD)} \right] \]

— Values may need to be interpolated for either column. PSRPSDI should be reported to the nearest decimal. Traditional rounding procedures for numbers 5 and above are to be used when determining PSRPSDI. Do not use WVDOH rounding procedures.

<table>
<thead>
<tr>
<th>Total Weighted Distress</th>
<th>PSRPSDI</th>
<th>Total Weighted Distress</th>
<th>PSRPSDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>100.0</td>
<td>3.4</td>
<td>85.8</td>
</tr>
<tr>
<td>0.2</td>
<td>99.1</td>
<td>3.6</td>
<td>85.0</td>
</tr>
<tr>
<td>0.4</td>
<td>98.2</td>
<td>3.8</td>
<td>84.3</td>
</tr>
<tr>
<td>0.6</td>
<td>97.3</td>
<td>4.0</td>
<td>83.5</td>
</tr>
<tr>
<td>0.8</td>
<td>96.4</td>
<td>5.0</td>
<td>82.8</td>
</tr>
<tr>
<td>1.0</td>
<td>95.6</td>
<td>6.0</td>
<td>82.3</td>
</tr>
<tr>
<td>1.2</td>
<td>94.7</td>
<td>7.0</td>
<td>81.9</td>
</tr>
<tr>
<td>1.4</td>
<td>93.9</td>
<td>8.0</td>
<td>81.7</td>
</tr>
<tr>
<td>1.6</td>
<td>93.0</td>
<td>9.0</td>
<td>81.7</td>
</tr>
<tr>
<td>1.8</td>
<td>92.2</td>
<td>10.0</td>
<td>81.7</td>
</tr>
<tr>
<td>2.0</td>
<td>91.4</td>
<td>11.4</td>
<td>81.6</td>
</tr>
<tr>
<td>2.2</td>
<td>90.5</td>
<td>20.4</td>
<td>40.0</td>
</tr>
<tr>
<td>2.4</td>
<td>89.7</td>
<td>26.8</td>
<td>40.0</td>
</tr>
<tr>
<td>2.6</td>
<td>88.9</td>
<td>30.8</td>
<td>25.0</td>
</tr>
<tr>
<td>2.8</td>
<td>88.4</td>
<td>35.8</td>
<td>20.0</td>
</tr>
<tr>
<td>3.0</td>
<td>87.3</td>
<td>42.4</td>
<td>15.0</td>
</tr>
<tr>
<td>3.2</td>
<td>86.6</td>
<td>51.2</td>
<td>10.0</td>
</tr>
</tbody>
</table>

**A3.1.7 Step Seven—Average the PSRPSDI for all individual segments within the contract**

\[ PSR_{avg} = \frac{PSR_1 + PSR_2 + PSR_3 + \ldots + PSR_n}{n} \]

**A3.2 ASPHALT PAVEMENT EXAMPLE:**

— One 528’ segment within one lane mile of Hot-Mix Asphalt constructed road was surveyed and found to have the following defects:
A3.2.1 Step One—Categorize and measure all distresses in the roadway

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Severity</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Cracking</td>
<td>Low</td>
<td>20 Cracks</td>
</tr>
<tr>
<td>Transverse Cracking</td>
<td>Medium</td>
<td>5 Cracks</td>
</tr>
<tr>
<td>Longitudinal Joint Deterioration</td>
<td>Medium</td>
<td>528 Linear Feet</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>High</td>
<td>53 Linear Feet</td>
</tr>
</tbody>
</table>

A3.2.2 Step Two—Convert the amount of distress to a percent (round to the nearest 0.1%)

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Severity</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Cracking</td>
<td>Low</td>
<td>20 \times 0.0285 = 57.0%</td>
</tr>
<tr>
<td>Transverse Cracking</td>
<td>Medium</td>
<td>5 \times 0.0285 = 14.3%</td>
</tr>
<tr>
<td>Longitudinal Joint Deterioration</td>
<td>Medium</td>
<td>528/528 = 100%</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>High</td>
<td>53/528 = 10.0%</td>
</tr>
</tbody>
</table>

A3.2.3 Step Three—Weight Factors
— Obtained from Table A3.1.3

A3.2.4 Step Four and Five—Calculate the Individual Weighted Distress and Total Weighted Distress (TWD)

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Severity</th>
<th>Weight Factor</th>
<th>Percent</th>
<th>Individual Weighted Distress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Cracking</td>
<td>Low</td>
<td>0.02</td>
<td>X 57.0%</td>
<td>1.14</td>
</tr>
<tr>
<td>Transverse Cracking</td>
<td>Medium</td>
<td>0.11</td>
<td>X 14.3%</td>
<td>1.57</td>
</tr>
<tr>
<td>Longitudinal Joint Deterioration</td>
<td>Medium</td>
<td>0.045</td>
<td>X 10.0%</td>
<td>4.5</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>High</td>
<td>0.165</td>
<td>X 10.0%</td>
<td>1.66</td>
</tr>
<tr>
<td>Total Weighted Distress (TWD)</td>
<td></td>
<td></td>
<td></td>
<td>8.86</td>
</tr>
</tbody>
</table>

A3.2.5 Step Six—Convert the TWD to PSRPSDI
— The TWD of 8.86 shall be considered on the left side of Table A3.1.6 and by using the formula:

\[
\text{PSRPSDI} = 25 \left[ e^{1.386 - (0.045)(TWD)} \right]
\]
— Using both methods, a TWD of 8.86 yields a PSRPSDI of 67.1.

A3.2.6 Step Seven—Average the PSRPSDI for all individual segments within the contract
— The contract contains a total of four travel lanes covering four miles. Therefore, with two segments per lane mile, a total of 32 individual sections will be evaluated. The values for each section are summed and divided by 32, yielding the reported PSRPSDI for the entire contract section.

A3.3 PCC EXAMPLE
— One 528’ segment within one lane mile of Portland Cement Concrete constructed road was surveyed and found to have the following defects for a 6’ x 6’ panel overlay system:
A3.3.1 Step One—Categorize and measure all distresses in the roadway

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Severity</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Cracking</td>
<td>Low</td>
<td>8</td>
</tr>
<tr>
<td>Transverse Joint Spalling</td>
<td>Medium</td>
<td>13 Joints</td>
</tr>
<tr>
<td>Longitudinal Joint Spalling</td>
<td>Medium</td>
<td>156 Linear Feet</td>
</tr>
<tr>
<td>Transverse Joint Faults</td>
<td>Medium</td>
<td>8 Joints</td>
</tr>
</tbody>
</table>

A3.3.2 Step Two—Convert the amount of distress to a percent (round to the nearest 0.1%)

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Severity</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Cracking</td>
<td>Low</td>
<td>$8 \times 0.0285 = 23%$</td>
</tr>
<tr>
<td>Transverse Joint Spalling</td>
<td>Medium</td>
<td>$13 \text{ joints}/88 \text{ joints} = 14.8%$</td>
</tr>
<tr>
<td>Longitudinal Joint Spalling</td>
<td>Medium</td>
<td>$156/528 = 30%$</td>
</tr>
<tr>
<td>Transverse Joint Faults</td>
<td>Medium</td>
<td>$8 \text{ joints}/88 \text{ joints} = 9.1%$</td>
</tr>
</tbody>
</table>

A3.3.3 Step Three—Weight Factors

—Obtained from Table A3.1.3. Calculating the Normalized Weight Factor will be necessary for Transverse Joint Spalling. With a total of 88 transverse joints in the segment and a weight factor of 0.075,

Normalized Weight Factor = $0.075 \times \left(\frac{88}{35}\right) = 0.19$

A3.3.4 Steps Four and Five—Calculate the Individual Weighted Distress, and Total Weighted Distress

<table>
<thead>
<tr>
<th>Distress Type</th>
<th>Severity</th>
<th>Weight Factor</th>
<th>Normalized Weight Factor (if applicable)</th>
<th>Percent</th>
<th>Individual Weighted Distress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Cracking</td>
<td>Low</td>
<td>0.04</td>
<td>-</td>
<td>X 23</td>
<td>0.94</td>
</tr>
<tr>
<td>Transverse Joint Spalling</td>
<td>Medium</td>
<td>0.075</td>
<td>0.19</td>
<td>X 14.8</td>
<td>2.79</td>
</tr>
<tr>
<td>Longitudinal Joint Spalling</td>
<td>Medium</td>
<td>0.06</td>
<td>-</td>
<td>X 30</td>
<td>1.72</td>
</tr>
<tr>
<td>Transverse Joint Faults</td>
<td>Medium</td>
<td>0.11</td>
<td>-</td>
<td>X 9.1</td>
<td>2.51</td>
</tr>
<tr>
<td>Total Weighted Distress (TWD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.98</td>
</tr>
</tbody>
</table>

A3.3.5 Step Six—Convert the TWD to PSRPSDI

—The TWD of 7.98 shall be considered on the left side of Table A3.1.6 and by using the formula:

$$PSRPSDI = 25 \left[ e^{1.386 - (0.045)(TWD)} \right]$$

—Using both methods, a TWD of 5.23 yields a PSRPSDI of 69.8.

A3.3.6 Step Seven—Average the PSRPSDI

—The contract contains a total of four travel lanes covering four miles. Therefore, with two segments per lane mile, a total of 32 individual sections will be evaluated.
The values for each section are summed and divided by 32, yielding the reported PSRPSDI for the entire contract section.
SECTION 490: APPENDIX B

PAVEMENT PERFORMANCE

DISTRESS IDENTIFICATION MANUAL

This manual is used to define distresses and their severity levels found in pavements, to be used with roads manually surveyed for the calculation of PSRPSDI on 1/10th-mile long test sections as part of WVDOT Special Provision Section 490: Nine-Year Pavement Performance Criteria

B1. Asphalt Surfaces

These distress definitions, severity levels, and calculations are specific to asphalt surfaced roads. This may also include composite pavements (concrete pavements with asphalt overlays).

B1.1 Transverse Cracks — Transverse cracks are any cracks within the travel lane predominantly perpendicular to the pavement centerline. This may include reflection cracking in composite pavements. In the case of full width patching that produces transverse construction joints, evaluate distresses in these joints as transverse cracks using the severity levels described in Longitudinal Joint Deterioration. Rate the entire crack at highest level present for 10% or more of total crack length. Extent is calculated by multiplying amount of cracks at each distress level by 2.85. The sum of all three severities cannot exceed 100%. If this happens, disregard cracks of the lowest severity present until the sum of percentages equals 100%.

B1.1.1 Low
- unsealed cracks 0 – ¼ inch wide, no blowups, no adjacent random cracking, and no loss of material
- sealed cracks with sealant material in good condition, no faulting, no blowups, no adjacent random cracking, and no loss of material

B1.1.2 Medium
- any crack ¼ – ¾ inch wide, no blowups, no adjacent random cracking, and no loss of material
- any crack less than ¾ inch wide with adjacent low severity cracking, no blowups, and no loss of material

B1.1.3 High
- any crack greater than ¾ inch wide
- any crack with adjacent medium or high severity random cracking
- any crack with a noticeable blowup
- any crack with noticeable loss of material

B1.2 Edge Cracking — Edge cracking refers to any crescent-shaped or predominantly longitudinal cracks in the travel lane (including the paint stripe) that are within 2
feet of the pavements edge. This can occur only where there is an unpaved shoulder. Edge cracking may include longitudinal reflection cracking in composite pavements. Rate the entire crack at highest level present for 10% or more of total crack length. For each severity, the total length of edge cracking measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected. In the event of a one lane road with unpaved shoulders on both sides of the travel lane surveyed, the calculation will remain the same however now there will be the potential for a maximum of 200%.

---

B1.2.1 Low
- unsealed cracks 0 – ¼ inch wide and no loss of material
- sealed cracks with sealant material in good condition

---

B1.2.2 Medium
- any crack ¼ – ¾ inch wide and no loss of material

---

B1.2.3 High
- any crack greater than ¾ inch wide
- any crack with noticeable loss of material or loose pieces of pavement

---

B1.3 Alligator Cracking — Alligator cracking occurs only in areas subjected to repeated traffic loadings (wheelpaths). The exact location of the wheelpath is based on the inspector’s judgment but will usually occur approximately 1.5 feet from paint stripes and extend about 2.5 feet from that point. Alligator cracks appear as interconnected cracks in early stages and may develop into many sided, sharp angled pieces, usually less than 1 foot in any dimension, characteristically with a chicken wire/alligator pattern. Meandering longitudinal cracking with adjacent random cracking can be considered alligator cracking if it is within the wheelpath. In this case it cannot also be counted as longitudinal cracking. Severity of alligator cracking can change between each linear foot of pavement. Rate cracks at highest level present for 10% or more within each linear foot where appropriate. If severity changes frequently, inspector’s judgment should be applied. For each severity, the total length of alligator cracking measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected. If alligator cracking is present in both wheelpaths, consider only the higher severity within each linear foot. For example, if a ten foot section of pavement exhibits low severity alligator cracking in the left wheelpath and high severity alligator cracking in the right wheelpath, only ten feet of high severity alligator cracking shall be recorded.
If that same section exhibit low severity alligator cracking in both wheelpaths, only ten feet of low severity alligator cracking shall be recorded.

B1.3.1 Low
• an area with only a few connecting cracks and no noticeable loss of material

B1.3.2 Medium
• an area of interconnecting cracks that forms a complete pattern but no considerable loss of material

B1.3.3 High
• an area of interconnecting cracks with noticeable loss of material or loose pieces

B1.4 Block Cracking—Block cracking is a pattern of cracks that divides the pavement into approximately rectangular pieces greater than 1 foot and less than 10 feet in any dimension. This can occur anywhere within the lane. If a series of cracks is identified as block cracking, it should not also be counted as any other distress. Severity of block cracking can change between each linear foot of pavement. Rate cracks at highest level present for 10% or more of each section within the block cracking pattern. If severity changes frequently, inspector’s judgment should be applied. For each severity, the total length of block cracking measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected.

B1.4.1 Low
• unsealed cracks 0—½ inch wide, no adjacent random cracking, and no loss of material
• sealed cracks with sealant material in good condition

B1.4.2 Medium
• any crack ¼—¾ inch wide, no adjacent random cracking, and no loss of material
• any crack less than ¾ inch wide with adjacent low severity cracking, and no loss of material

B1.4.3 High
• any crack greater than ¾-inch wide
• any crack with adjacent medium or high severity random cracking
• any crack with noticeable loss of material

B1.5 Longitudinal Cracking—Longitudinal cracks are any cracks within the travel lane predominantly parallel with the pavement centerline. This may include reflection cracking in composite pavements. If a crack has been identified as longitudinal cracking, it should not be counted as any other distress. Severity of longitudinal cracking can change between each linear foot of pavement. Meandering longitudinal cracking with adjacent random cracking can be considered alligator cracking if it is within the wheelpath. In this case it cannot also be counted as longitudinal cracking. Rate cracks at highest level present for 10% or more within
each linear foot where appropriate. If severity changes frequently, inspector’s judgment should be applied. For each severity, the total length of longitudinal cracking measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected. If multiple longitudinal cracks are present in any linear foot of the lane, record only the highest severity within each linear foot.

B1.5.1 Low
• unsealed cracks 0 – ¼ inch wide, no adjacent random cracking, and no loss of material
• sealed cracks with sealant material in good condition, no adjacent random cracking, and no loss of material

B1.5.2 Medium
• any crack ¼ – ¾ inch wide, no adjacent random cracking, and no loss of material
• any crack less than ¾ inch wide with adjacent low severity cracking, and no loss of material

B1.5.3 High
• any crack greater than ¾ inch wide
• any crack with adjacent medium or high severity random cracking
• any crack with noticeable loss of material

B1.6 Longitudinal Joint Deterioration — Longitudinal joint deterioration refers to any distresses affecting the deterioration of longitudinal construction joints found entirely within travel lanes. Any distress occurring exclusively within six inches of a longitudinal joint should be counted only as joint deterioration. Any longitudinal joint located within (or 6 inches from) the paint line separating a lane from a shoulder shall be evaluated with the lane edge cracking distress. Otherwise count deterioration in whichever lane the joint is located. If a longitudinal joint is found within the divider line between travel lanes, consider that joint a part of the slower (right) lane. Severity of longitudinal joint deterioration can change between each linear foot of pavement. Rate cracks at highest level present for 10% or more within each linear foot where appropriate. If severity changes frequently, inspector’s judgment should be applied. For each severity, the total length of longitudinal joint deterioration measured in linear feet will be divided by 528 and then multiplied by 100 to determine the percent of test section affected. In the
unlikely event that multiple longitudinal joints are found within a single lane, percent affected could exceed 100%.

---

B1.6.1 Low
- unsealed crack 0–¼ inch wide propagating from the joint into the pavement, no adjacent random cracking
- minor loss of material on either side of a construction joint and no adjacent random cracking within 6 inches of the joint
- any other low severity distress located within 6 inches of a joint

---

B1.6.2 Medium
- a crack ¼–¾ inch wide propagating from the joint into the pavement, no adjacent random cracking
- a crack less than ¾ inch wide propagating from the joint into the pavement, adjacent random cracking less than ¼ inch wide
- minor loss of material on either side of a construction joint and adjacent random cracking less than ¼ inch wide
- any other medium severity distress located within 6 inches of a joint

---

B1.6.3 High
- a crack greater than ¾ inch wide propagating from the joint into the pavement
- a crack propagating from the joint into the pavement with adjacent random cracking greater than ¼ inch wide
- major loss of material on either side of a construction joint
- minor loss of material on either side of a construction joint and adjacent random cracking greater than ¼ inch wide

---

B1.7 Lane Edge Cracking/Deterioration—Lane edge cracking/deterioration refers to longitudinal joint deterioration specifically between a travel lane and a paved shoulder. A paved shoulder here is defined by at least two feet of pavement past the paint stripe. Lane edge cracking/deterioration also includes any distress which occurs or stretches into the paint stripe or first 6 inches of lane. All definitions of longitudinal joint deterioration apply to this location. Additionally, lane edge cracking will include cracking in the paint stripe which propagates into the pavement and is caused by the paint itself. Severity of lane edge cracking/deterioration can change between each linear foot of pavement. Rate cracks or deterioration at highest level present for 10% or more within each linear foot where appropriate. If severity changes frequently, inspector’s judgment should be applied. For each severity, the total length of lane edge cracking/deterioration...
measured in linear feet will be divided by 528 and then multiplied by 100 to
determine the extent of test section affected.

B1.7.1 Low
• unsealed crack 0–¼ inch wide propagating from the paint into the pavement, no
  adjacent random cracking
• unsealed crack 0–¼ inch wide propagating from the joint into the pavement, no
  adjacent random cracking
• minor loss of material on either side of a construction joint and no adjacent random
  cracking within 6 inches of the joint
• any other low severity distress located within 6 inches of a joint

B1.7.2 Medium
• a crack ¼–¾ inch wide propagating from the paint into the pavement, no adjacent
  random cracking
• a crack less than ¾ inch wide propagating from the paint into the pavement, adjacent
  random cracking less than ¼ inch wide
• a crack ¼–¾ inch wide propagating from the joint into the pavement, no adjacent
  random cracking
• a crack less than ¾ inch wide propagating from the joint into the pavement, adjacent
  random cracking less than ¼ inch wide
• minor loss of material on either side of a construction joint and adjacent random
  cracking less than ¼ inch wide
• any other medium severity distress located within 6 inches of a joint

B1.7.3 High
• a crack greater than ¾ inch wide propagating from the paint into the pavement
• a crack propagating from the paint into the pavement with adjacent random cracking
  greater than ¼ inch wide
• a crack greater than ¾ inch wide propagating from the joint into the pavement
• a crack propagating from the joint into the pavement with adjacent random cracking
  greater than ¼ inch wide
• major loss of material on either side of a construction joint
• minor loss of material on either side of a construction joint and adjacent random
  cracking greater than ¼ inch wide

B1.8 Raveling/Weathering—Raveling and weathering refer to the wearing of pavement
surface characterized by the dislodging of aggregate particles and loss of asphalt
binder. It may range from loss of fines and binder between coarse aggregate to very
rough and pitted surface with obvious loose aggregate. Raveling/weathering is
recorded in linear feet. If any of the pavement within the lane appears to be
raveled/weathered then it should be recorded. The total length of
raveling/weathering measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected.

B1.9 Patching—Patching refers to any portion of pavement surface that has been replaced or added to after the original construction. This includes full depth repairs. All other distresses found within the patch shall still be recorded. The perimeter of a patch does not get recorded as any type of cracking as long as it is maintained. Patching of any type, width, depth, etc., within the lane is recorded in linear feet. The total length of patching measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected.

B1.10 Rutting—Rutting refers to pavement surface depression due to repeated loading, within the wheelpath, and occurring in the longitudinal direction. Rutting severity is based on the average rut depth of 5 measurements in each wheelpath. These measurements should be taken approximately at the 64th, 164th, 264th, 364th, and 464th foot of the test section. These rut measurements will be taken using a 5-foot long straight edge, placed perpendicular to the pavement centerline. Rut depth is measured at the point of greatest distance from the bottom of the straightedge to the pavement surface. Measurements must be accurate to the closest 1/16th inch. If the average rut depth for the five measurements in either wheelpath qualify for a severity, then that entire test section is recorded at that severity. Also if both wheelpaths qualify, the higher severity shall be recorded. If the average rut depth qualifies for a severity, then 100% of that section is recorded at that severity.

B1.10.1 Low
- average rut depth ¼ — less than ½ inch

B1.10.2 High
- average rut depth greater than or equal to ½ inch

B2. Concrete Surfaces

These distress definitions, severity levels, and calculations are specific to all concrete surfaced roads. This may include jointed reinforced concrete pavements, jointed plain concrete pavements, and continuously reinforced concrete pavements. Surveys on pavements with concrete surfaces require an input for number of joints within the 1/10th mile segment as some extent calculations are dependent on this. If the segment starts exactly on a joint, do not count the last joint if the segment also ends exactly on a joint.

B2.1 Transverse Cracks—Transverse cracks are cracks predominantly perpendicular to the pavement centerline and propagate through the width of the slab. This may count a linear crack that separates a corner of a slab. This is sometimes referred to as a corner break but shall be recorded as a transverse crack if it is predominantly perpendicular to the pavement centerline. Rate entire crack at highest level present for 10% or more of total crack length. Extent is calculated by multiplying amount of cracks at each distress level by 2.85. The sum of all three severities cannot exceed
100%. If this happens, disregard cracks of the lowest severity present until the sum of percentages equals 100%.

B2.1.1 Low
- unsealed cracks less than 1/8 inch wide, no faulting, no spalling
- sealed cracks with sealant material in good condition, no faulting, no spalling

B2.1.2 Medium
- any crack 1/8 to less than 1/4 inch wide, no faulting, no spalling
- any crack less than 1/4 inch wide with faulting up to 3/8 inch
- any crack less than 1/4 inch wide with spalling up to 3 inches wide
- any crack that would otherwise be considered Low Severity but is accompanied by additional Low Severity cracks that fragment the slab

B2.1.3 High
- any crack greater than 1/4 inch wide
- any crack with greater than 3/8 inch faulting
- any crack with greater than 3 inch wide spalling
- any crack that would otherwise be considered Medium Severity but is accompanied by additional Low or Medium Severity cracks that fragment the slab

B2.2 Transverse Joint Spalls—Transverse joint spalling refers to cracking, breaking, chipping, or fraying of slab edges at transverse joints. Spalling includes any cracking within 1 foot of the face of the joint. Spalling is counted on a per joint basis so it does not matter if the spalling occurs on the leave or approach slab. Spall width is based on the distance from the face of the joint to the crack or end of displaced material on either side of the joint. If there is no loss of material but cracking is still present, the spall width is zero but it is still considered spalled at low severity. Rate a joint’s spalling as the highest severity present for at least 10% of the joint length. Spalling is recorded on a per joint basis so the entire joint is considered spalled at that severity. Record the number of transverse joints with spalling at each severity level. Divide the amount of affected joints at each severity
level by the total number of joints in the segment. Multiply by 100 to determine the extent of segment affected.

B2.2.1 Low
- spall widths up to 2 inches
- joints with low severity cracking in crescent shaped patterns or parallel to the joint within 1 foot of the joint

B2.2.2 Medium
- spall widths 2–4 inches

B2.2.3 High
- spall widths greater than 4 inches

B2.3 Transverse Joint Faults—Transverse joint faulting refers to the difference in elevation across a transverse joint. This can be an increase or decrease in elevation from the leave to the approach slab. It is recorded on a per joint basis. Rate a joints faulting as the highest severity present for at least 10% of the joint length. Faulting is recorded on a per joint basis so the entire joint is considered faulted at that severity. Record the number of transverse joints with faulting at each severity level. Divide the amount of affected joints at each severity level by the total number of joints in the segment. Multiply by 100 to determine the extent of segment affected.

B2.3.1 Low
- measurable faulting to a maximum of 1/8 inch

B2.3.2 Medium
- faulting greater than 1/8th inch but less than ½ inch

B2.3.3 High
- faulting ½ inch or greater

B2.4 Blowups—Blowups refer to localized upward movement of pavement surface at transverse joints, possible accompanied by shattering of concrete in the area on either side of the joint. Blowups can occur midslab at a transverse crack but these shall not be counted in this distress. If a joint is experiencing a blowup, there is no need to also record faulting or spalling at that joint. Record the number of transverse joints with a blowup. Divide the amount of affected joints at by the total number of joints in the segment. Multiply by 100 to determine the extent of segment affected.

B2.5 Longitudinal Cracking—Longitudinal cracks are cracks predominantly parallel to the pavement centerline and propagate through the length of the slab. This may count a linear crack that separates a corner of a slab. This is sometimes referred to as a corner break but shall be recorded as a longitudinal crack if it is predominantly
parallel to the pavement centerline. Rate the entire crack within a single slab at the highest level present for 10% or more of total crack length. Longitudinal cracks are recorded on a linear foot basis so if multiple longitudinal cracks are present on a single slab, record it as a single crack and increase the severity. For each severity, the total length of longitudinal cracking measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected.

B2.5.1 Low
- unsealed cracks 0 – 1/8 inch wide, no faulting, no spalling
- sealed cracks with sealant material in good condition, no faulting, no spalling

B2.5.2 Medium
- any crack 1/8 – ¼ inch wide, no faulting, no spalling
- any crack less than ¼ inch wide with faulting up to ¼ inch
- any crack less than ¼ inch wide with spalling up to 3 inches wide
- any crack that would otherwise be considered Low Severity but is accompanied by additional Low Severity cracks that fragment the slab

B2.5.3 High
- any crack greater than ¼ inch wide
- any crack with greater than ¼ inch faulting
- any crack with greater than 3 inch wide spalling
- any crack that would otherwise be considered Medium Severity but is accompanied by additional Low or Medium Severity cracks that fragment the slab

B2.6 Longitudinal Joint Spalling—Longitudinal joint spalling refers to any cracking, breaking, chipping, or fraying of slab edges at longitudinal construction joints found entirely within travel lanes. Spalling includes any cracking within 1 foot of the face of the joint. Any longitudinal joint located within (or 1 foot from) the paint line separating a lane from a shoulder shall be evaluated with the lane edge spalling distress. Otherwise count spalling in whichever lane the joint is located. If a longitudinal joint is found within the divider line between travel lanes, consider that joint a part of the slower (right) lane. Spalling is counted as a distress to the joint so it does not matter which side of the joint experiences spalling. Spall width is based on the distance from the face of the joint to the end of displaced material on either side of the joint. If there is no loss of material but cracking is still present, the spall width is zero but it is still considered spalled at low severity. Severity of longitudinal joint spalling can change between each linear foot of pavement. Rate spalls at highest level present for 10% or more within each linear foot where appropriate. If severity changes frequently, inspector’s judgment should be applied. For each severity, the total length of longitudinal joint spalling measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section.
affected. If multiple longitudinal joints are found within a single lane, extent could exceed 100%. This is relevant when slab widths are smaller than lane widths.

**B2.6.1 Low**
- spall widths up to 2 inches
- joints with low severity cracking in crescent shaped patterns or parallel to the joint within 1 foot of the joint

**B2.6.2 Medium**
- spall widths 2–4 inches

**B2.6.3 High**
- spall widths greater than 4 inches

**B2.7 Lane Edge Spalling**—Lane edge spalling refers to longitudinal joint spalling specifically between a travel lane and a shoulder. This includes both paved and unpaved shoulders. Spall width is based on the distance from the face of the joint to the end of displaced material on either side of the joint. If no material is displaced but cracking is still present, the spall width is zero but it is still considered spalled. In the case of unpaved shoulders, where there is technically no joint, spalling still can be experienced on the edge of the slab. Severity of lane edge spalling can change between each linear foot of pavement. Rate spalls at highest level present for 10% or more within each linear foot where appropriate. If severity changes frequently, inspector’s judgment should be applied. For each severity, the total length of lane edge spalling measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected. In the event of a one lane road with shoulders (paved or unpaved) on either side, lane edge spalling could be present on both sides, therefore, extent could exceed 100%.

**B2.7.1 Low**
- spall widths up to 3 inches
- joints with low severity cracking in crescent shaped patterns or parallel to the joint within 1 foot of the joint

**B2.7.2 Medium**
- spall widths 3–6 inches

**B2.7.3 High**
- spall widths greater than 6 inches

**B2.8 D Cracking**—D cracking, sometimes known as durability cracking, refers to closely spaced hairline cracking crescent shaped patterns that follow the edge of a slab near all joints. This is a very distinct distress that is usually caused by unideal properties of aggregate in concrete. It can increase in severity to entire slabs showing this patterned crack with significant loss of material across the surface. It is not to be confused with spalling which generally leads to loss of material specifically at the joint, or scaling which is usually a more random cracking pattern in the surface of
the concrete. The total length of D cracking measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected.

B2.9 Sealing — Sealing, also known as map cracking, refers to a series of interconnected cracks in the surface of concrete. This can range in severity from noticeable interconnected hairline cracks, to sections with significant loss of material across the surface. Generally, sealing will not result in displaced material deeper than ½ inch from the original pavement surface. The total length of sealing measured in linear feet will be divided by 528 and then multiplied by 100 to determine the percent of test section affected.

B2.10 Patching — Patching refers to any portion of pavement surface that has been replaced or added to after the original construction. Full depth, full width repairs will not be considered patches. However, it should be noted that full depth repairs could change the amount of joints and slabs within test sections for future surveys. For example, a full depth repair on a joint will replace the existing joint with two spaced joints, where a full depth repair on a mid-panel crack will simply add two joints. Partial depth concrete repairs do not add to the number of joints, however, their length will be counted towards patching. All other distresses found within the patch shall still be recorded. Patching of any type, width, depth, etc. within the lane is recorded in linear feet. The total length of patching measured in linear feet will be divided by 528 and then multiplied by 100 to determine the extent of test section affected.

B2.11 Popouts — Popouts are small pieces of pavement broken loose from the surface, normally ranging in diameter from 1 - 4 inches and depth from ½ - 2 inches. Take note if significant sections of pavement or entire slabs appear to exceed an average popout density of 3 popouts per square yard. Popouts are measured on a linear foot basis, so record the length of sections, or the length of slabs exhibiting excessive popouts. The total length in linear feet will be divided by 528 and then multiplied by 100 to determine the percent of test section affected.
490.1-DESCRIPTION:
The pavement performance period shall consist of satisfying the performance criteria requirements of the work contained in the appendices. This special provision establishes the common terms and definitions. The pavement performance criteria assure and protect the Division from specific defects found in the pavement.

490.1.1-Definitions:
Acceptance Date of Initial Construction Work-The date when the work is completed and is continuously open to traffic. This shall be the date of initial acceptance and constitutes the start date for the performance criteria period. For divided highways, there may be more than one acceptance date of work for a project.

Performance Lane(s)-The portion of the pavement considered performance criteria work. Each of the following shall be considered a separate performance lane.
1. Each individual mainline lane and adjacent shoulder
2. The sum of all ramp lanes and the associated acceleration/deceleration lanes
3. The sum of all auxiliary lanes, such as passing lanes and turn lanes
Approaches and driveways are not considered.

Performance Criteria Work - Work that is guaranteed to meet the performance requirements as defined and calculated in Appendix A, throughout the performance rating period.

Maintenance Work - Corrective action taken by the Contractor to bring the performance criteria work into compliance with the performance requirements and calculations detailed in Appendix A.
**490.2-INITIAL ACCEPTANCE:**

The Division and the Contractor shall jointly review all completed work, or a portion thereof, as determined by the Division. If the Division determines that the work is in compliance with the contract specifications and is continuously open to traffic, then the date of initial acceptance occurs. If the work does not meet contract requirements, the Contractor shall make all necessary corrections, at its expense, prior to initial acceptance. The date on which initial acceptance occurs shall be termed the Initial Acceptance Date of Initial Construction Work and is to be documented in accordance with this special provision.

As stated in Section 490.1.1, once the Initial Acceptance date has been determined this shall act as the start date for the performance criteria period.

The Division may accept any portion of the work and begin the performance period to accommodate seasonal limitations or staged construction, excluding any area needing corrective work.

**490.3- BLANK:**

**490.4-RIGHTS AND RESPONSIBILITIES OF THE DIVISION:**

The Division:

1. Reserves the right to approve the time, traffic control and methods for performing any work.
2. Reserves the right to approve the schedule proposed by the Contractor to perform work.
3. Reserves the right to determine if work performed by the Contractor meets the contract specifications.
4. Reserves the right to perform, or have performed, routine core maintenance activities during the performance period, which this routine core maintenance will not diminish the Contractor’s responsibility under the performance criteria. Core Maintenance activities consist of: Mowing, Snow Removal, Striping, Guardrail Repair, Signing, and Maintaining Ditches and other Drainage Structures.
5. Reserves the right, if the Contractor is unable, to make immediate emergency repairs to the pavement to prevent an unsafe road condition as determined by the Division. The Division will attempt to notify the Contractor that action shall be required to address an unsafe condition. The Division will record the time and date of the attempts for Contractor notification. However, should the Contractor be unable to comply with this requirement, to the Division’s satisfaction and within the required time frame specified by the Division, the Division will perform, or have performed any emergency repairs deemed necessary. Any such emergency repairs undertaken will not relieve the Contractor from meeting the performance requirements of this Special Provision. Any costs associated with such emergency repairs due to defective work will be paid by the Contractor.
6. Shall be responsible for monitoring the pavement throughout the performance period and will provide the Contractor any written reports of the surface condition or maintenance activities, or both related to pavement performance.
7. Shall be responsible for notifying the Contractor, in writing, of any corrective action required to meet the pavement performance requirements.
490.5-RIGHTS AND RESPONSIBILITIES OF THE CONTRACTOR:
The Contractor:
1. Shall ensure that the work will be free of defects as measured by the performance parameters and specified threshold values as defined in Appendix A.
2. Shall be responsible for performing all work including, but not limited to, maintaining traffic and restoring all associated pavement features, at the Contractor’s expense.
3. Shall be responsible for performing all work in accordance with any contract details, established WVDOH policies, or Industrywide Best Management Practices, or combination thereof. Use of repair materials different than the constructed pavement structure may be permitted on a temporary basis and no such temporary repairs shall remain in place at the end of the current rating period. Any deviations from such policies shall be approved by the Engineer and may require a signature and seal of a currently Licensed West Virginia Professional Engineer.
4. Shall be responsible for performing all temporary or emergency repairs, resulting from being in non-compliance with the pavement performance requirements, using Division approved materials.
5. Shall notify the Division and submit a written course of action for performing the needed work, ten calendar days prior to commencement of said work, except in the case of emergency repairs as detailed in this special provision. The submittal must propose a schedule for performing the work and the materials and methods to be used.
6. Shall follow a Division approved temporary traffic control plan when performing work.
7. Shall pay lane rental fees as stipulated in the Contract, during maintenance work.
8. Shall complete all work required by this special provision and prior to conclusion of the pavement performance period, or as otherwise agreed to by the Division.

490.6-EVALUATION METHOD:
The Division will conduct pavement evaluations in accordance with Appendix A using the Division’s Pavement Condition Collection Contract or field pavement condition reviews, including roughness measurements, or both. This evaluation may be waived in emergency situations.
Results of the Division’s pavement evaluation will be handed over to the Contractor within thirty (30) days of August 31. These results will detail any bonus or penalties along with locations for various distress areas that require corrective action.

490.7-PAVEMENT PERFORMANCE REQUIREMENTS:
Maintenance work will be required as per the requirements and calculations of Appendix A.

490.8- BLANK

490.9-EMERGENCY REPAIRS:
If the Division determines that emergency repairs are necessary for public safety, the Division or its agent may take repair action.
Prior to emergency repairs, the Division will document the basis for the emergency action, will preserve evidence of the defective condition, and document all materials and methods used for the repair.
490.10-NON-EXTENSION OF CONTRACT:

This Special Provision shall not be construed as extending or otherwise affecting the claim process and statute of limitation applicable to this Contract.
**SECTION 490: APPENDIX A**

**PAVEMENT PERFORMANCE**

**NINE YEAR PERFORMANCE CRITERIA AND EVALUATION**

**Preliminary Project Evaluation** - In order to help facilitate design of a system that meets the criteria set forth in this contract, the Division may perform the following and make available the results to prospective bidders.

1. Perform Non-Destructive Testing (NDT) to help delineate pavement layer thickness and to help delineate transitions within the overall pavement structure in the pavement performance section.

2. Perform field coring of pavement at selected locations based on pavement condition, or at locations where abrupt changes in NDT results may indicate a transition in pavement section, or both.

**Performance Requirements** – Pavement Performance Requirements are set for three different categories: Ride Quality (Section A1), Threshold Limits (Section A2), and Pavement Surface Distress Index (PSDI) (Section A3).

The finished road surface shall be evaluated annually during the performance period no later than August 31 of each year; this date shall not be extended for any reason. The Contractor can ask the Division to perform the rating prior to August 31. Contractor’s personnel will be allowed review the evaluation process.

If desired, the contractor may monitor and survey the pavement in addition to the work being performed by this agency. However, any destructive work such as coring or milling shall not be performed without approval by the Engineer and at no additional cost to the Division.

Corrections for deficient shoulder conditions based on Threshold Limits (Section A2) are included in performance criteria Work, however no PSDI ratings or IRI ratings shall be performed on shoulders and no bonuses or penalties shall be received or collected due to shoulder conditions. The Contractor shall be notified of shoulder areas needing corrective action after each Roadway Evaluation, or in case of emergencies.

**A1 RIDE QUALITY**

Shoulder work shall be exempt from ride quality measures. Yearly IRI values shall be in accordance with Standard Specifications Section 720, Smoothness Testing, for the entire length of the project limits. The yearly IRI values shall be determined by the Division no later than August 31 of each year; this date shall not be extended for any reason. The Contractor can ask the Division to perform the rating prior to August 31.

The overall IRI shall meet or exceed the following in Table A5 at the specified age:
As noted above, the subject contract allows for payment bonuses and penalties for IRI. Bonus and Penalty Payments are not cumulative and do not carry over from year to year.

A2  THRESHOLD LIMITS AND CORRECTIVE ACTION

Each index in the following sections A2.1 and A2.2 has a threshold level applied to each segment before corrective action (maintenance work) shall be required. Following the annual data collection, this work shall be completed prior to June 10 of the next calendar year.

Each lane mile will be divided into 10 equal 0.1 mile segments starting at the beginning milepost. Threshold limits apply to the entire performance section, and have been established to allow a certain extent of low severity distresses within 0.1 mile segments before corrective action is required.

Polished Aggregate will be described for informational purposes to support overall characterization of the road surface. Skid testing will be used to quantify acceptable levels of surface friction. Skid Testing will be conducted yearly and completed by the Division or an independent testing firm. Any skid number less than 35 shall require corrective action. Any corrective action required by DOH for skid numbers 35 or greater shall be paid for in accordance with section 109.4.

When corrective action is taken to address thresholds within a pavement segment, all distresses associated with that threshold must be addressed in that 0.1 mi segment and the adjacent lane. If a segment that is adjacent to a partial segment (roadway less than 0.1 mile) is subject to corrective action, that adjacent partial segment shall also receive the same corrective action in both lanes. Similarly, should a partial segment be subject to corrective action, the adjacent full segment shall receive the same corrective action in both lanes. All corrected sections will be monitored for performance. If distresses are repaired and integrity of repair is maintained, it shall not be counted against threshold limits.

Any permanent repairs shall be of equal or better quality material than the original section. The Contractor is advised that any permanent repairs consisting of different material properties than was originally placed shall be done over the entire rating segment. This restriction does not apply to temporary fixes, such as those placed for emergency purposes or placed to slow deterioration during winter.

<table>
<thead>
<tr>
<th>Year</th>
<th>IRI Criteria for Bonus</th>
<th>Bonus</th>
<th>IRI Criteria for Penalty</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>&lt;65</td>
<td>0.11%</td>
<td>&gt;81</td>
<td>0.22%</td>
</tr>
<tr>
<td>Two</td>
<td>&lt;65</td>
<td>0.11%</td>
<td>&gt;81</td>
<td>0.22%</td>
</tr>
<tr>
<td>Three</td>
<td>&lt;65</td>
<td>0.28%</td>
<td>&gt;81</td>
<td>0.56%</td>
</tr>
<tr>
<td>Four</td>
<td>&lt;65</td>
<td>0.28%</td>
<td>&gt;81</td>
<td>0.56%</td>
</tr>
<tr>
<td>Five</td>
<td>&lt;65</td>
<td>0.44%</td>
<td>&gt;81</td>
<td>0.88%</td>
</tr>
<tr>
<td>Six</td>
<td>&lt;65</td>
<td>0.44%</td>
<td>&gt;81</td>
<td>0.88%</td>
</tr>
<tr>
<td>Seven</td>
<td>&lt;65</td>
<td>0.89%</td>
<td>&gt;81</td>
<td>1.78%</td>
</tr>
<tr>
<td>Eight</td>
<td>&lt;65</td>
<td>0.89%</td>
<td>&gt;81</td>
<td>1.78%</td>
</tr>
<tr>
<td>Nine</td>
<td>&lt;65</td>
<td>1.56%</td>
<td>&gt;81</td>
<td>3.12%</td>
</tr>
</tbody>
</table>
Shoulders have no threshold limits for low severity distresses; however, medium and high severity distresses shall require corrective action.

490.1.1-Definitions:

A2.1 ASPHALT PAVEMENT

<table>
<thead>
<tr>
<th>Index</th>
<th>Limit</th>
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</thead>
<tbody>
<tr>
<td>Structural Cracking Index (SCI)</td>
<td>4</td>
</tr>
<tr>
<td>Environmental Cracking Index (ECI)</td>
<td>4</td>
</tr>
<tr>
<td>Rut Depth Index (RDI)</td>
<td>4</td>
</tr>
</tbody>
</table>

A2.2 PCC PAVEMENT

<table>
<thead>
<tr>
<th>Index</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Cracking Index (SCI)</td>
<td>4</td>
</tr>
<tr>
<td>Environmental Cracking Index (ECI)</td>
<td>4</td>
</tr>
<tr>
<td>Rut Depth Index (RDI)</td>
<td>4</td>
</tr>
</tbody>
</table>

A3  PAVEMENT SURFACE DISTRESS INDEX

The Pavement Surface Distress Index (PSDI) will represent the West Virginia Division of Highways (WVDOH) crack and surface distress index for this contract. It uses a 0.0 to 100.0 rating scale: the higher the number, the less overall distress shall be present. Generally, a perfect or newly constructed road has a PSDI of 100.0. As the type, amount and severity of the various defects increase, the PSDI drops.

The overall PSDI shall meet or exceed the following in Table A3 at the specified age:

<table>
<thead>
<tr>
<th>TABLE A3  PSDI CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>One</td>
</tr>
<tr>
<td>Two</td>
</tr>
<tr>
<td>Three</td>
</tr>
<tr>
<td>Four</td>
</tr>
<tr>
<td>Five</td>
</tr>
<tr>
<td>Six</td>
</tr>
<tr>
<td>Seven</td>
</tr>
<tr>
<td>Eight</td>
</tr>
<tr>
<td>Nine</td>
</tr>
</tbody>
</table>

Please note that the subject contract allows for payment bonuses for PSDI. Bonus and Penalty Payments are not cumulative and do not carry over from year to year.
219.4-CONSTRUCTION METHODS:

219.4.2-Testing:

DELETE THE FIRST PARAGRAPHS OF SUBSECTION 219.4.2 AND REPLACE WITH THE FOLLOWING:

Material shall be sampled in accordance with ASTM D5971. The pH tests shall be conducted in accordance with ASTM G51. Flow tests shall be conducted in accordance with ASTM D6103. Compressive strength tests shall be conducted in accordance with ASTM D4832.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL PROVISION
FOR

STATE PROJECT NUMBER: ______________________________
FEDERAL PROJECT NUMBER: ______________________________

SECTION 403
HOT-APPLIED ASPHALT MASTIC (HAM) TREATMENT

403.1–DESCRIPTION:
This work shall consist of cleaning and filling voids in asphalt pavement that are too large for standard crack sealing, yet smaller than those that require typical patching procedures. This process uses a hot applied, pourable, aggregate filled asphalt mastic material.

403.2–MATERIALS:
Hot-Applied Asphalt Mastic (HAM) shall be composed of quality selected asphalt, select aggregates with structural integrity, synthetic rubber polymers, antioxidants, naturally occurring and man-made reinforcing material, and other modifiers.

If not on the Division’s Approved Source List, the materials shall conform to the following requirements:

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>PROPERTY</th>
<th>TEST</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>Abrasion Resistance</td>
<td>ASTM C131</td>
<td>35% max</td>
</tr>
<tr>
<td></td>
<td>Gradation</td>
<td>AASHTO T27</td>
<td>100% pass 5/8”</td>
</tr>
<tr>
<td></td>
<td>Dust</td>
<td>AASHTO T11</td>
<td>8% dust max</td>
</tr>
<tr>
<td>Binder</td>
<td>Penetration @77°F</td>
<td>ASTM D5329</td>
<td>60 max</td>
</tr>
<tr>
<td></td>
<td>Penetration @122°F</td>
<td>ASTM D5329</td>
<td>120 max</td>
</tr>
<tr>
<td></td>
<td>Softening Point</td>
<td>ASTM D36</td>
<td>200°F min</td>
</tr>
<tr>
<td></td>
<td>Flexibility @32°F</td>
<td>ASTM D3111¹</td>
<td>Pass</td>
</tr>
<tr>
<td>Blend</td>
<td>Flexibility @32°F</td>
<td>ASTM D5329²</td>
<td>No cracking or loss of aggregate adhesion</td>
</tr>
</tbody>
</table>

Note 1: 1 inch mandrel, 180 degree bend, 10 seconds.
Note 2: Specimen size 10” long, 1” wide, and ¾” deep.
403.3–CONSTRUCTION:

403.3.1–General: Construction methods and QC plan, which shall include the manufacturer’s installation guidance, shall be submitted to the Engineer for review at least 7 calendar days prior to the start of work. This review may require modification of the proposed methods to provide the desired end result. The manufacturer’s recommended installation procedures shall be followed unless otherwise specified in this Special Provision. The manufacturer must supply on-site technical assistance for at least the first day and must remain until the engineer determines the assistance is no longer required.

403.3.2–Weather Restrictions: Perform surface preparation and repair when the ambient and pavement surface temperatures are least 45°F and rising. Should the HAM be placed and rain falls before the HAM has properly cured, remove and replace the contaminated HAM at no additional cost to the state.

403.3.3–Surface Preparation: All repair areas shall be dry and free of all dirt, dust, grease, and loose material prior to application of the HAM. When recommended by the manufacturer, a surface conditioner or primer approved by the manufacturer shall be applied to the repair area prior to placement of the HAM.

403.3.3–Equipment: All equipment, tools, and machinery shall be provided by the contractor and maintained in a satisfactory working condition. The contractor shall use a machine that can simultaneously agitate and indirectly heat the material to the manufacturer’s recommendations, while continuously agitating and indirectly heating during application. Immediately discard any material if it is heated beyond the manufacturer’s recommended safe heating temperature, is allowed to cool, or is unused for more than 10 hours.

403.3.4–Installation: The HAM shall be agitated and heated in a manufacturer’s recommended melter, to the manufacturer’s recommended application temperature. The hot HAM shall be poured directly onto the repair area, made flush with the existing pavement, and leveled for a smooth surface. If two lifts are required, the first lift shall be sufficiently cooled before the second lift is applied. Any HAM that pulls loose within 96 hours after opening to traffic shall be replaced at no additional cost. The contractor shall cooperate with the Engineer to keep accurate running totals of the pounds of HAM used. This shall be reported daily.

403.4–MEASUREMENT AND PAYMENT:
HAM will be measured and paid for at the Contract unit price per pound. Payment will be full compensation for furnishing, hauling, and placing of all materials, the removal and disposal of old filler and debris, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Payment will not be made for wasted material.

403.5–PAY ITEMS:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>403002-001</td>
<td>Hot-Applied Asphalt Mastic</td>
<td>Pound</td>
</tr>
</tbody>
</table>
501.1-DESCRIPTION:

DELETE THE SECOND PARAGRAPH IN THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Pozzolanic Supplementary cementitious materials (fly ash, ground granulated blast furnace slag slag cement, and microsilica silica fume) conforming to the provisions of these specifications may be used as an additive to portland Cement Concrete Pavement at the Contractor's option. These additives are not permitted when a blended hydraulic cement is used. For the purposes of cement material substitution with SCMs, Type IL cement shall not be treated as a blended cement, and a supplementary cementitious material (SCM) may be used with Type IL cement.

501.2–MATERIALS:

DELETE POZZOLANIC ADDITIVES (THE 11th LINE) FROM THE TABLE AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>SUBSECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pozzolanic Additives Supplementary Cementitious Materials (SCMs)</td>
<td>707.4</td>
</tr>
</tbody>
</table>

DELETE THE SECOND PARAGRAPH IN THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Shipping and Storage of Pozzolanic Additives SCMs: Pozzolanic additives SCMs shall be shipped from only those sources approved by the Division. Bulk Pozzolanic additives SCMs shall be stored at the job site in weatherproof bins. Pozzolanic additives SCMs from different sources or from different lots at the same source shall be stored separately.
501.3-PROPORTIONING:

DELETE FOOTNOTE ** TABLE 501.3.1 AND REPLACE WITH THE FOLLOWING:

** TABLE 501.3.1

** An equal volume of a Pozzolanic additive SCM may be substituted for portland cement up to the following maximum amount. Only one Pozzolanic additive SCM is permitted in a mix design.

DELETE THE MATERIAL/QUANTITY TABLE, BELOW TABLE 501.3.1 AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly Ash</td>
<td>1 bag</td>
</tr>
<tr>
<td>Ground-Granulated Blast Furnace Slag</td>
<td>3 bags</td>
</tr>
<tr>
<td>Slag Cement</td>
<td>3 bags</td>
</tr>
<tr>
<td>Microsilica-Silica Fume</td>
<td>1/2 bag</td>
</tr>
</tbody>
</table>

501.7-HANDLING, MEASURING, AND BATCHING MATERIALS:

DELETE THE FIFTH PARAGRAPH IN THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

When cement or pozzolanic additives SCMs are being added in bag form, under no circumstances shall the packaging material be allowed to enter into the mix.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 514
ROLLER COMPACTED CONCRETE

514.1-DESCRIPTION:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Roller Compacted Concrete (RCC) consists of aggregate, Portland cement and possibly other supplementary cementitious materials (fly ash, slag cement), and water. RCC is proportioned, mixed, placed, compacted, and cured in accordance with these specifications. Ensure that the RCC conforms to the lines, grades, thickness, and typical cross section shown in the plans or otherwise established by the WVDOH. When used as base course, it shall be constructed as shown in the plans.

514.2–MATERIALS:

DELETE THE POZZOLANIC ADDITIVES (5TH LINE) IN THE TABLE AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>SUBSECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pozzolanic Additives</td>
<td>707.4</td>
</tr>
<tr>
<td>Supplementary Cementitious Materials (SCMs)</td>
<td></td>
</tr>
</tbody>
</table>

DELETE THE SECOND PARAGRAPH IN THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Shipping and storage of Cement and Pozzolanic Additives SCMs: Cement and pozollanic additives SCMs shall be shipped and stored as outlined in Section 501.2.
514.3—PROPORTIONING:

514.3.1-RCC Mix Design Requirements:

DELETE THE FIRST PARAGRAPH OF SUBSECTION 514.3.1 AND REPLACE WITH THE FOLLOWING:

At least 45 days prior to the start of construction, the Contractor shall submit to the Engineer for approval the proportion of materials to be used which will result in a workable RCC mix. No more than 25%, by mass, of the cementitious material content of the RCC mix shall be pozzolanic materials—SCMs. The Engineer will review these proportions within 14 (fourteen) Calendar Days.

514.5—EQUIPMENT AND TOOLS:

514.5.2-Mixing Plant:

514.5.2.2-Pugmill Plant:

DELETE THE CONTENTS OF SUBSECTION 514.5.2.2 AND REPLACE WITH THE FOLLOWING:

Use only pugmill plants of the central plant type with a twin-shaft pugmill mixer, capable of batch or continuous mixing, equipped with synchronized metering devices and feeders to maintain the correct proportions of aggregate, cement, pozzolan—SCM, and water. These plants shall meet the requirements of AASHTO M156. Other pugmill plant requirements are as follows:

DELETE SUBSECTION 514.5.2.2.4 AND REPLACE WITH THE FOLLOWING:

514.5.2.2.4-Cement and Pozzolan Material—SCM Storage: Supply separate and independent storage silos for Portland cement and pozzolan—SCMs. At plants with two or more silos in which different types of cement or cementitious materials are stored, ensure that each silo has a sign at each fill inlet to reduce the potential for loading errors. Make the sign from a durable material, with minimum two-inch high by ¼-inch wide letters that are raised, indented, or cut. Ensure that the sign clearly identifies the material that is in the silo and may be easily read even when completely coated with dust.

DELETE SUBSECTION 514.5.2.2.5 AND REPLACE WITH THE FOLLOWING:

514.5.2.2.5-Portland Cement and Pozzolan—SCM: If using Portland cement and pozzolan—SCM (such as fly ash or slag—slag cement), employ blending equipment acceptable to the WVDOH and demonstrate, with a testing plan, the ability to successfully produce a uniform blended material meeting the mix design requirements. Perform testing on at least a daily basis to ensure both uniformity and proper quantities.

DELETE SUBSECTION 514.5.2.2.6 AND REPLACE WITH THE FOLLOWING:
514.5.2.2.6-Cement and Pozzolan-SCM Feed Unit: Provide a satisfactory means of dispensing Portland cement and Pozzolan-SCM, volumetrically or by weight, to ensure a uniform and accurate quantity of cementitious material enters the mixer.

514.5.2.3-Rotary Drum Mixer:
514.5.2.3.1-Weighing Equipment:

DELETE THE CONTENTS OF SUBSECTION 514.5.2.3.1 AND REPLACE WITH THE FOLLOWING:

Measure the amounts of cement, Pozzolan-SCM, and aggregate entering into each batch of RCC by direct weighing equipment. Use only weighing equipment that is readily adjustable in order to compensate for the moisture content of the aggregate or to change the proportionate batch weights. Include a visible dial or equally suitable device that will accurately register the scale load from zero to full capacity. The cement and Pozzolan-SCM may be weighed separately or cumulatively in the same hopper on the same scale, provided the cement is weighed first.

DELETE SUBSECTION 514.5.2.3.2 AND REPLACE WITH THE FOLLOWING:

514.5.2.3.2-Weigh Hoppers: Use only bulk cement and Pozzolan-SCM weigh hoppers that are equipped with vibrators to operate automatically and continuously while weighing hoppers are being dumped. Ensure that the weigh hopper has sufficient capacity to hold not less than 10 percent in excess of the cementitious material required for one batch.

514.8–MIXING RCC:
514.8.1-Mixing Process:

DELETE THE FIRST PARAGRAPH OF SUBSECTION 514.8.1 AND REPLACE WITH THE FOLLOWING:

Use the same mixture for the entire project unless otherwise stated in the project documents. If, during production, the source of Portland cement, Pozzolan–SCM, or aggregates is changed, then suspend production and submit a new mix design to the Engineer for approval. Do not exceed the manufacturer's rated capacity for dry concrete mixtures in the mixing chamber. Keep the sides of the mixer and mixer blades free of hardened RCC or other buildups. Routinely check mixer blades for wear and replace if wear is sufficient to cause inadequate mixing.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 601
STRUCTURAL CONCRETE

601.2–MATERIALS:

DELETE THE SECOND PARAGRAPH IN THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Class H Concrete Requirements: The total concrete constituents shall contribute less than 0.10% water soluble chloride ion by weight of cement. The Contractor shall use only one brand and/or source for any concrete constituent. The Contractor shall obtain a written statement from the manufacturer of the microsilica silica fume admixture that confirms the compatibility of the material combination and the sequence in which they are combined. The written statement, along with the results of all required tests, shall be furnished to the Engineer prior to the pre-pour meeting.

DELETE POZZOLANIC ADDITIVES (THE 13th LINE) AND FOOTNOTE *** FROM THE TABLE AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>MATERIAL</th>
</tr>
</thead>
</table>
| Pozzolanic Additive***
Supplementary Cementitious Materials (SCM)*** |
| SECTION OR SUBSECTION |
| 707.4 |

*** The use of a Pozzolanic additive Supplementary Cementitious Material (SCM) will not be permitted when a blended hydraulic cement is used. For the purposes of cement material substitution with SCMs, Type IL cement shall not be treated as a blended cement, and a SCM may be used with Type IL cement. Unless otherwise permitted by the Engineer, only one source of a Pozzolanic additive SCM shall be used in any one structure.

DELETE THE FOURTH PARAGRAPH IN THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Shipping and Storage of Pozzolanic Additives SCM: Pozzolanic additives SCM shall be shipped from only those sources approved by the Division. Bulk SCMs shall be stored at the job site in weatherproof bins. Pozzolanic additives SCM from different sources or from different lots at the same source shall be stored separately.
601.3-PROPORTIONING:

DELETE THE SECOND and THIRD PARAGRAPHS IN THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Class H concrete shall consist of a homogeneous mixture of cement, fine aggregate, coarse aggregate, microsilica-silica fume admixture, fly ash or ground granulated blast furnace slag-cement, chemical admixtures, and water.

Establishment of mixture proportions shall be coordinated with the manufacturer of the microsilica-silica fume admixture.

601.3.1-Mix Design Requirements:

DELETE FOOTNOTES * AND ** AT THE BOTTOM OF TABLE 601.3.1A AND REPLACE WITH THE FOLLOWING:

TABLE 601.3.1A

<table>
<thead>
<tr>
<th>Material</th>
<th>Class of Concrete</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly Ash</td>
<td>B, C, D</td>
<td>0.48 ft³ (0.014 m³)</td>
</tr>
<tr>
<td></td>
<td>A, K</td>
<td>0.60 ft³ (0.017 m³)</td>
</tr>
<tr>
<td></td>
<td>DC</td>
<td>0.72 ft³ (0.020 m³)</td>
</tr>
<tr>
<td>Ground Granulated Furnace Slag Cement</td>
<td>A, B, K</td>
<td>1.43 ft³ (0.040 m³)</td>
</tr>
<tr>
<td></td>
<td>C, D</td>
<td>0.96 ft³ (0.027 m³)</td>
</tr>
<tr>
<td></td>
<td>DC</td>
<td>1.79 ft³ (0.051 m³)</td>
</tr>
<tr>
<td>Microsilica-Silica Fume</td>
<td>All Classes</td>
<td>0.24 ft³ (0.007 m³)</td>
</tr>
</tbody>
</table>

DELETE TABLE 601.3.1B AND TABLE 601.3.1C AND REPLACE WITH THE FOLLOWING:

TABLE 601.3.1B

<table>
<thead>
<tr>
<th>Option</th>
<th>Cement</th>
<th>Fly Ash</th>
<th>Ground Granulated Furnace Slag Cement</th>
<th>Microsilica Silica Fume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.39 ft³ (0.068 m³)</td>
<td>0.84 ft³ (0.024 m³)</td>
<td></td>
<td>30 lbs. (13.6 kg)</td>
</tr>
</tbody>
</table>
When microsilica silica fume densified powder is used, the densified powder shall be weighed using an approved cement scale or standard 25 lb. (11.3 kg) or 50 lb. (22.6 kg) full bags may be substituted. Batching tolerance for the cement plus densified powder shall be 1.0%.

Batching and mixing recommendations for bulk and bagged densified microsilica (silica fume) are provided in the Silica Fume User’s Manual which is available through the Silica Fume Association (Report Number FHWA-IF-05-016).

These recommendations include procedures to be used when the Ready-Mix Supplier desires to add microsilica silica fume, which is supplied in repulpable bags, into the mix. If these recommendations are followed, and the Ready-Mix Supplier can satisfactorily demonstrate to the Engineer, by means of testing and wet-sieving a trial batch (see section 7.3.6 of the Silica Fume User’s Manual), that there are no fragments of the packaging material remaining in the mix, then the restriction in section 501.7, concerning the addition of the pozzolan SCM packaging material, may be waived.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 603
PRESTRESSED CONCRETE MEMBERS

603.2–MATERIALS:

DELETE THE 5th LINE OF THE TABLE AND FOOTNOTE ** IN THE
SUBSECTION AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>Precast/Prestressed Concrete Materials</th>
<th>Sections/Subsections</th>
</tr>
</thead>
<tbody>
<tr>
<td>+Admixtures:</td>
<td></td>
</tr>
<tr>
<td><strong>Pozzolonic Additives Supplementary Cementitious Materials (SCMs)</strong></td>
<td>707.4</td>
</tr>
</tbody>
</table>

** The use of a pozollonic additive–SCM is not permitted when a blended hydraulic cement is used. For the purposes of cement material substitution with SCMs, Type II cement shall not be treated as a blended cement, and a SCM may be used with Type II cement. For Class S-P concrete, a combination of up to two pozollonic additives–SCMs are permitted, as shown in Table 603.6.3.1. The maximum percent of total cementitious materials permitted in Class S-P concrete mix designs is shown in Table 603.6.3.1.

603.6–CONCRETE:

603.6.1-General:

603.6.1.1-Class S-P Concrete:

DELETE THE SECOND PARAGRAPH OF SUBSECTION 603.6.1.1 AND REPLACE WITH THE FOLLOWING:

Class S-P concrete shall consist of a homogeneous, flowable mixture of cement, fine aggregate, coarse aggregate, chemical admixtures and water. Class S-P concrete may also contain fly ash, ground granulated blast furnace slag, and silica fume. The mixture proportions shall be such that the Class S-P concrete will resist segregation, bleeding, and the generation of foam during placement, and will need no external compaction or vibration, unless the mix is qualified as outlined in Section 603.6.1.1. While the properties of fresh SCC differ significantly from that of conventional fresh concrete, the quality in terms of strength, durability, and performance of the hardened SCC shall be equal to or better than that of a similar specified conventional concrete mix.
Establishment of the mixture proportions shall be coordinated with the manufacturer of the admixtures which will be used in the Class S-P concrete.

DELETE THE FOURTH PARAGRAPH IN THE SUBSECTION 603.6.1.1 AND REPLACE WITH THE FOLLOWING:

For Class S-P concrete, a combination of admixtures which may be used includes water-reducing admixtures, air-entraining agents, water-reducing and retarding admixtures, VMAs, shrinkage-reducing admixtures (SRAs), and other specific performance admixtures, provided they are on the WVDOH approved list of admixtures. These admixtures used shall all come from the same manufacturer, and measures should be taken to ensure that no adverse reactions occur. Also, for Class S-P concrete, it is permitted to use a combination of up to two AASHTO gradations of coarse aggregate to obtain an optimal combination of strength, self-consolidating ability, and passing ability. Likewise, a combination of up to two pozzolanic additives-SCMs may be used in combination with Portland cement for Class S-P concrete in order to achieve ideal characteristics for the mix.

603.6.3-Proportioning of Normal (Non-SCC) Concrete:

603.6.3.1-Proportioning of Class S-P Concrete:

DELETE TABLE 603.6.3.1 AND REPLACE WITH THE FOLLOWING:

**TABLE 603.6.3.1**

<table>
<thead>
<tr>
<th>Cementitious Materials</th>
<th>Maximum Percent of Total Cementitious Materials in Class S-P Concrete by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class F Fly Ash</td>
<td>25</td>
</tr>
<tr>
<td><strong>Ground Granulated Blast Furnace Slag Slag Cement</strong></td>
<td>50</td>
</tr>
<tr>
<td>MicrosilicaSilica Fume</td>
<td>10</td>
</tr>
<tr>
<td>Total of Class F Fly Ash and Silica Fume</td>
<td>35</td>
</tr>
<tr>
<td>Total of <strong>Ground Granulated Blast Furnace Slag Slag Cement</strong> and Silica Fume</td>
<td>50</td>
</tr>
</tbody>
</table>

**NOTE:**
Class F Fly Ash shall constitute no more than 25 percent of the total weight of cementitious materials. MicrosilicaSilica Fume shall constitute no more than 10 percent of the total weight of cementitious materials.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 620
THREE-SIDED REINFORCED CONCRETE BRIDGE/CULVERT

620.5-MATERIALS:
   620.5.1-Concrete:

DELETE SUBSECTION 620.5.1.9 AND REPLACE WITH THE FOLLOWING:

   620.5.1.9-Pozzolanic Additives Supplementary Cementitious Materials (SCMs):
   Shall conform to Section 707.4.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 679
OVERLAYING OF PORTLAND CEMENT CONCRETE BRIDGE DECKS

679.1-DESCRIPTIONS:
679.1.2-Definitions:

DELETE SUBSECTION 679.1.2.1 AND REPLACE WITH THE FOLLOWING:

679.1.2.1-Specialized Concrete Overlay: Two types of specialized concrete overlay are permitted as follows:
1) Latex Modified Concrete: A Portland cement concrete to which an approved styrene butadiene latex admixture has been added.
2) Microsilica-Silica Fume Concrete: A Portland cement concrete to which an approved microsilica silica fume admixture has been added.

679.2-MATERIALS:
679.2.1-General:

DELETE SUBSECTION 679.2.1.4 AND REPLACE WITH THE FOLLOWING:

679.2.1.4-Microsilica Silica Fume Admixture: Microsilica silica fume admixture shall meet the requirements of Section 707.4.3 of the Standard Specifications.

679.2.2-Specialized Concrete Mix Design and Testing:

DELETE THE CONTENTS OF SUBSECTION 679.2.2 AND REPLACE WITH THE FOLLOWING:

Specialized concrete shall consist of a homogeneous mixture of cement, fine aggregate, coarse aggregate, latex or microsilica silica fume admixture, chemical admixtures and water.

The Contractor shall determine mixture proportions in general accordance with ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete." Establishment of mixture proportions shall be coordinated with the manufacturer of the latex or microsilica silica fume admixture.
Prior to the start of construction, the Contractor shall design and submit to the Engineer for approval the proportion of materials, including admixtures, to be used which will result in a workable concrete having the applicable properties enumerated below, including those of section 679.2.2.1 or 679.2.2.2. This mix design shall be prepared in accordance with MP 711.03.23.

Design mixture testing shall include air content, slump, and compressive strength results at 28 days and results of rapid chloride permeability tests. Compressive strength cylinders for microsilica silica fume concrete shall be cured in accordance with ASTM C 192 for 28 days, but compressive strength cylinders for latex modified concrete shall be moist cured in accordance with ASTM C 192 for 2 days then air cured in the lab at a temperature between 73.5 ± 3.5 °F (23 ± 2 °C) for 26 days. For establishment of mixture proportions, rapid chloride permeability tests for microsilica silica fume concrete shall be made on representative samples cured for 56 days in accordance with ASTM C 192, then allowed to air dry in the lab at a temperature of 73.5 ± 3.5 °F (23 ± 2 °C) until the time of test. These specimens shall be prepared and tested in accordance with AASHTO T277 at an age of 56 to 90 days. For establishment of mixture proportions, rapid chloride permeability tests for latex modified concrete shall be made on representative samples moist cured in accordance with ASTM C 192 for 2 days, air cured at in the lab at a temperature between 73.5 ± 3.5 °F (23 ± 2 °C) for 54 days, then prepared and tested in accordance with AASHTO T277 at an age of 56 to 90 days. The final rapid chloride permeability test result shall consist of the average of the two individual test results. This average shall not exceed 750 coulombs.

For establishment of mixture proportions, as an alternative to the curing methods for rapid chloride permeability testing outlined in the previous paragraph, microsilica silica fume concrete specimens may be moist cured for 7 days in accordance with ASTM C 192, then cured for 21 days in lime-saturated water at 100.0 ± 3.5 °F (38.0 ± 2.0 °C), then tested at an age of 28 days. For establishment of mixture proportions, as an alternative to the curing methods for rapid chloride permeability testing outlined in the previous paragraph, latex modified concrete specimens may be moist cured for 2 days in accordance with ASTM C 192, then cured for 26 days in air at 100.0 ± 3.5 °F (38.0 ± 2.0 °C) and a minimum of 50% relative humidity, then tested at an age of 28 days. These methods of curing shall be noted as the accelerated RCPT curing methods.

The 28-day compressive strength of the test mix that satisfies the 750 coulomb threshold shall be used as the basis for acceptance of the Specialized Concrete Overlay permeability requirements. Concrete for any slump test shall be deposited in a manner and location that excludes the effects of vibrations caused by traffic and concrete placement operations.

The total concrete constituents shall contribute less than 0.10% water soluble chloride ion by weight of cement. Use one brand and/or one source for any concrete constituent.

The Contractor shall obtain a written statement from the manufacturer of the latex or microsilica silica fume admixture that confirms the compatibility of the material combination and the sequence in which they are combined. The written statement, along with the results of all required tests, shall be furnished to the Engineer prior to the pre-construction meeting (refer to 679.2.2.3). Substantiating data showing compliance with the requirements of this specification shall also be submitted. This data shall also include the sources of coarse and fine aggregates as well as the brands of all admixtures to be used.
Contractor’s Quality Control: Quality control of the specialized concrete is the responsibility of the Contractor as designated in MP 601.03.50. The Contractor shall maintain equipment and qualified personnel, including at least one certified Portland Cement Concrete Technician who shall direct all field inspection, sampling, and testing necessary to determine the magnitude of the various properties of concrete governed by the Specifications and shall maintain these properties within the limits of this Specification. The Contractor’s personnel who conduct the field sampling and testing shall be a certified Portland Cement Concrete Inspector. The quality control plan designated in MP 601.03.50 shall be submitted to the Engineer at the preconstruction conference. Work shall not begin until the plan is reviewed for conformance with the contract documents.

Compressive strength specimens shall be made and cured in accordance with AASHTO T23 and MP 601.04.20 at the frequency required in MP 601.03.50 except that specimens for latex modified concrete shall be moist cured for 2 days and air cured at a temperature of 73.5 ± 3.5 °F (23 ± 2 °C) for 26 days.

During construction, a minimum of four specimens shall be fabricated for rapid chloride permeability testing in accordance with AASHTO T277 every time that a set of compressive strength specimens is fabricated.

If the 28-day compressive strength of the in-place concrete, obtained from specimens made as outlined in the previous paragraph, is less than or equal to eighty percent of the compressive strength of the approved test mix, these rapid chloride permeability test specimens shall be tested, as outlined in the following two paragraphs. Otherwise, testing of these specimens is not required.

When microsilica silica fume concrete is used, these specimens shall be moist cured for 56 days and then allowed to air dry at a temperature of 73.5 ± 3.5 °F (23 ± 2 °C) until the time of test. Two of these specimens shall be tested at an age of 90 days in accordance with AASHTO T277, and if necessary, the remaining two specimens shall be tested at an age of 180 days in accordance with AASHTO T277, and the average result of the two values from these specimens shall be reported as the result required in Note (a) in section 679.2.2.2.

When latex modified concrete is used these specimens shall be moist cured for 2 days and then air dried at a temperature of 73.5 ± 3.5 °F (23 ± 2 °C) until the time of test. Two of these specimens shall be tested at an age of 90 days in accordance with AASHTO T277, and the average result of the two values from these specimens shall be reported as the result required in Note (a) in section 679.2.2.1. If necessary, the remaining two specimens shall be tested at an age of 180 days in accordance with AASHTO T277, and the average result of the two values from these specimens shall be reported as the result required in Note (a) in section 679.2.2.1.

Gradation testing shall be performed in accordance with Section 601.3.2.4.

679.2.2.2-Microsilica Silica Fume Concrete:

DELETE THE FIRST PARAGRAPH IN SUBSECTION 679.2.2.2 AND REPLACE WITH THE FOLLOWING:

The following test criteria must be met for all microsilica silica fume concrete pours placed at the structure. This testing shall be performed by the Contractor or his
designated representative and certified results provided to the Engineer prior to final acceptance of the project.

DELETE THE 5th LINE OF TABLE 679.2.2.2 AND FOOTNOTE NOTES (d) AND (e) AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>Microsilica</th>
<th>Silica Fume Content (e) (Dry Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 lb./cu. yd., minimum</td>
</tr>
<tr>
<td></td>
<td>(30 kg/m³, minimum)</td>
</tr>
</tbody>
</table>

Note (d) An equal volume of fly ash may be substituted for cement to a maximum of 1 ¼ bags per cubic yard. An equal volume of ground granulated blast furnace slag (GGBFS) slag cement may be substituted for cement to a maximum of 3 bags per cubic yard (meter). When fly ash or GGBFS slag cement are used, equivalent volumes of fly ash or GGBFS slag cement shall be considered as cement for purposes of determining the proportioning ratios.

Note (e) Microsilica Silica fume sampling shall be in accordance with 707.4.3.

679.2.3-Equipment:

679.2.3.3-Proportioning and Mixing Equipment:

DELETE SUBSECTION 679.2.3.3.2 AND REPLACE WITH THE FOLLOWING:

679.2.3.3.2-Microsilica Silica Fume Concrete: An approved concrete batch plant, mobile mixer or truck mixer shall supply all concrete. The requirements of Section 601 of the Specifications shall apply, except as modified herein.

When microsilica silica fume densified powder is used, the densified powder shall be weighed using an approved cement scale or supplied in bags, the weight of each bag shall be clearly marked on the bag. The densified powder shall be last in the weighing sequence and the tolerance for each material draw weight shall be based upon the total weight of cement plus densified powder. Batching tolerance for the cement plus densified powder shall be 1%.

679.2.3.4-Mobile Mixer Units:

DELETE THE TABLE IN SUBSECTION 679.2.3.4 AND REPLACE WITH THE FOLLOWING:

| Coarse Aggregate | ±2% |
| Fine Aggregate   | ±2% |
| Cement + fly ash | 0% to +4% |
| Water            | ±1% |
| Cement + microsilica-silica fume powder | 1% |
| Latex Admixture  | 1% |
| Other Admixtures | 3% |
679.3-CONSTRUCTION METHODS:

679.3.6-Placing, Finishing and Curing Slab Reconstruction Concrete:

DELETE THE TABLE IN SUBSECTION 679.3.6 AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>Overlay Type</th>
<th>Slab Reconstruction Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latex Modified</td>
<td>Latex Modified or Class K</td>
</tr>
<tr>
<td>Microsilica-Silica Fume</td>
<td>Microsilica-Silica Fume or Class K</td>
</tr>
</tbody>
</table>

679.3.6.1-Slab Reconstruction Concrete Curing Requirements:

DELETE THE CONTENTS OF SUBSECTION 679.3.6.1 AND REPLACE WITH THE FOLLOWING:

Curing shall be accomplished in the following manner:

- Latex Modified Concrete. Curing shall be performed in accordance with 679.3.7.5.1.
- Microsilica-Silica Fume and Class K Concrete. Curing shall be by means of quilted covers, or plastic-coated fiber blankets. Quilted covers, if used, shall be kept wet for the entire curing period in accordance with 679.3.7.5.2. The wet curing period shall be 72 curing hours.

The use of membrane curing compounds shall not be allowed.

679.3.7-Placing and Finishing Specialized Concrete Overlay:

679.3.7.5.2-Curing Microsilica Concrete:

DELETE SUBSECTION 679.3.7.5.2 AND REPLACE WITH THE FOLLOWING:

679.3.7.5.2-Curing Microsilica-Silica Fume Concrete: Care shall be exercised to ensure that the burlap is well drained. Burlap shall be continuously wet for a period of 168 curing hours by means of automatic intermittent sprinkling or a continuous wetting system.

679.4-CONSTRUCTION LIMITATIONS AND REQUIREMENTS:

679.4.8-External Heat Provisions:

DELETE BULLET d. of SUBSECTION 679.4.8 AND REPLACE WITH THE FOLLOWING:

d. Continuous wetting will not be required, but the burlap shall be kept wet by wetting at regular intervals in a manner satisfactory to the Engineer for microsilica-silica fume concrete.
707.4-POZZOLANIC ADDITIVES FOR USE IN PORTLAND CEMENT CONCRETE:

DELETE SUBSECTION 707.4 AND REPLACE WITH THE FOLLOWING:

707.4-POZZOLANIC ADDITIVES-SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCMs) FOR USE IN PORTLAND CEMENT CONCRETE:

707.4.1-Fly Ash: Fly ash shall conform to the following requirements of ASTM C618, Class F or C when sampled and tested in accordance with the applicable Section of ASTM C311.

<table>
<thead>
<tr>
<th>Fineness</th>
<th>Class F (ASTM C618)</th>
<th>Class C (ASTM C618)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Retained on No. 325 (45 μm) Sieve</td>
<td>34% Max.</td>
<td>34% Max.</td>
</tr>
<tr>
<td>Loss on Ignition</td>
<td>6% Max.</td>
<td>6% Max.</td>
</tr>
<tr>
<td>( \text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 )</td>
<td>70% Min.</td>
<td>50% Min</td>
</tr>
</tbody>
</table>

707.4.1.1-Fly ash with an amount retained on the No. 325 (45 μm) sieve >34% but ≤40% shall be considered as meeting specification requirements provided either of the following criteria are met:

i. 50% minimum reduction in mortar bar expansion when tested in accordance with ASTM C441. The alkali content of test mix shall be equal to or greater than the control mix. The weight of fly ash shall be 20-30% of weight of cementitious materials.

ii. 0.1% maximum mortar bar expansion, at 16 days after casting, when tested in accordance with ASTM C1567. Very highly reactive aggregate (R3 Class from AASHTO R 80) shall be used as fine aggregate. The weight of fly ash shall be ≤35% of the weight of total cementitious materials.
707.4.2-Slag Cement: Ground granulated blast furnace slag Slag cement shall conform to the requirements of AASHTO M302.

707.4.3-Microsilica Silica Fume Admixture: Microsilica Silica Fume shall be supplied in the densified powder form and shall meet the requirements of AASHTO M 307.

707.4.4-Natural Pozzolans: Natural pozzolans shall conform to the requirements of ASTM C618, Class N.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

SPECIAL PROVISION

FOR

STATE PROJECT NUMBER: ________________________________
FEDERAL PROJECT NUMBER: ________________________________

SECTION 601
STRUCTURAL CONCRETE

601.1-DESCRIPTION:

ADD THE FOLLOWING SUBSECTION:

601.1.1-Electrochemical Chloride Extraction: This work consists of the extraction of chloride ions from contaminated reinforced concrete bridge elements, as noted in the plans, using an Electrochemical Chloride Extraction (ECE) treatment. The ECE treatment is performed by applying an electrical field between the reinforcement and an anode mesh placed in a reservoir on the surface of the concrete.

601.2-MATERIALS:

ADD THE FOLLOWING TO THE END OF THE SECTION:

Materials for Concrete Repair shall be only Portland cement concrete, or mortars having an appropriate electrical resistivity for repairs.

Anode System:
1. Use steel anode mesh during the treatment. Remove any rust staining produced by the steel anode during the ECE treatment.
2. Provide anode system with an anode mesh embedded in a reservoir on the concrete surface.
3. Provide electrolyte reservoir consisting of cellulose fiber saturated with an electrolyte.
4. Use cellulose fiber specifically designed and tested for use with Electrochemical Chloride Extraction. Provide cellulose fiber having the following physical properties:
   a. Consist of 100% natural cellulose fibers
   b. Be treated with fire retardant
c. Contain a minimum of 8% calcium hydroxide as a pH buffer and chlorine scavenger.
d. Be self-adherent
e. Have water absorption of up to approximately 1500% of dry fiber weight.
f. Prior to spraying of the cellulose fiber onto the concrete surface to be treated, affix wooden battens of appropriate size or suitable spacers to the concrete.
g. Electrolyte - provide electrolyte consisting of potable water. Calcium Hydroxide may be added if deemed necessary by ECE Contractor. The electrolyte will be delivered via ½ gallon/hour maximum drippers spaced every 1.5 feet.
h. Electrical Insulating Material - Waterproof electrical insulating materials to be used to cover all electrical connections.

**Power Supply:**

1. Provide an appropriate AC power supply.
2. DC Power Supply
   a. Provide DC power rectifiers supplied by the ECE Contractor with sufficient number of independent AC/DC converter circuits for the number of individual concrete zones to be treated.
   b. Provide AC/DC converters rated to provide total output current and voltage to meet the current demand of the individual abutment, wing wall, or pier column zone. Provide a current distribution box for each zone, so that each zone can be divided into subzones that can operate electrically in parallel. The voltage on the secondary side is to be limited to approximately 40 VDC. Converters are to operate continuously at maximum output under site conditions of temperature and relative humidity.
   c. Enclosures - House converters in vandal-proof enclosures suitable for site conditions.
   d. Controls and connections – Provide each AC/DC converter output unit with:
      i. All output controls.
      ii. One output voltmeter and one output ammeter.
      iii. Provision for direct measurement of output voltage of the secondary side with an external meter.
      iv. Easy access to the positive and negative terminals of each output, clearly marked "+VE Anode" and "-VE Rebars". Fully insulate output terminals from the chassis or its enclosure.
      v. An adequately rated circuit breaker, enclosed in a moulded case designed for operation at ambient temperature, on the main input to ensure protection against short circuit and thermal overload.
      vi. Main cable connections conforming to all applicable standards and regulations.
   e. Electrical components:
      i. Encapsulate all electronic component subassemblies in epoxy resin or varnishes, as recommended by the component manufacturers.
      ii. Provide rectifiers suitable for continuous operation at the specified output ratings, with a peak inverse voltage of at least 800 volts. These rectifiers are to have double windings, which must be separated by a grounded metallic screen or mounted on separate limbs of a grounded core.
iii. Provide rectifiers of the silicon type with suitable AC surge protection. Use fuses to protect the rectifiers on the DC output side.

iv. AC ripple on DC output of all rectifiers not to exceed 2V at all output settings from 10 to 100% of rated voltage and current outputs.

3. Cables- Provide stranded copper conductors, insulated with cross-linked polyethylene listed by UL for all cables and wiring.
   a. DC cables:
      i. Identify cables for connection to the anode mesh (positive) by red insulation and of a minimum gauge 10 AWG.
      ii. Identify cables for connection to the reinforcing steel (negative) by black insulation and of a minimum gauge of 6 AWG.
      iii. Label each DC cable according to the zone or portion of a concrete structure that it is connected to.
      iv. Digital Voltmeter – Provide a battery-operated digital voltmeter (DVM) to enable test and monitoring during the treatment period. Ensure that spare batteries are available for continuous testing. At a minimum, provide the DVM with 3.5 digit display and resolution of 10 mV and an error of no more than 1 digit. Input impedance of the DVM to be at least 10 MegaOhms.
      v. Current Probes – Provide a battery-operated current tong probe, with spare batteries for continuous testing, for current readings during the treatment period. The error of the probe to be no more than +5%.

601.3-PROPORTIONING:

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:

601.3-ECE CONTRACTOR QUALIFICATIONS:

   601.3.1-ECE Contractor Qualifications: A qualified speciality ECE contractor shall perform and monitor the ECE treatment.

   The ECE contractor shall have successfully completed at least five previous ECE installation projects on concrete structures in the US within the last 10 years. Documentation verifying the description, location, agency, agency contact representative, and contact details shall be submitted at the preconstruction conference. A project is defined as a structure or series of structures which were completed as part of a single contract.

   601.3.2-ECE Installation Personnel Qualifications: All personnel engaged in the ECE work shall have satisfactorily completed an education and training program in the installation methods, monitoring, and removal procedures for ECE. Training certification shall be submitted at the preconstruction conference.

   601.3.3-ECE Project Management and Quality Control Personnel Qualifications: The ECE Contractor shall provide a Cathodic Protection (CP) Specialist accredited by the National Association of Corrosion Engineers (NACE) with a minimum of 10 years of ECE work experience. The CP Specialist, or a CP Technician under his direction, shall supervise the overall installation of the ECE system including the design of construction sequence and oversee every phase of the work.
The CP Specialist or the CP Technician under his direction shall be responsible for preparing and implementing a quality control plan for the project, which shall be submitted to the engineer for approval.

The CP Specialist and the CP Technician each shall have a minimum of 5 years ECE system installation work experience in a supervisory/quality control position.

Qualifications of the Project Management/Quality Control personnel shall be submitted at the preconstruction conference.

601.4-TESTING:

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:

601.4.1-Sampling and Testing Methods:

601.4.1.1-Chloride Analysis: Sampling of concrete for chloride analysis is performed by drilling either cores or obtaining powder samples. Cores shall be cut into slices and crushed to fine powder.

Analyses to determine the residual water-soluble chloride content in the concrete shall be in accordance to AASHTO T260-97. Field measurements may be made using the rapid chloride test method.

601.4.1.2 Sampling Procedure: Sampling of the concrete before and after treatment should be carried out by experienced personnel. Care shall be taken to prevent cross contamination between samples. As chlorides in unreinforced concrete do not cause any deterioration of the concrete, the main purpose of the process is to treat the concrete in the vicinity of the rebar. It is therefore important that this is the area which is tested (particularly post treatment samples).

The procedure for collecting samples shall be as follows:

a. The exact location of the rebars, in the area to be tested, shall be located with a cover meter, pachometer, or other suitable rebar-locating device. Core samples shall be taken directly over a single rebar while dust samples may be drilled adjacent to the intersection of two rebars. The samples shall be extracted by taking cores no greater than 3” in diameter down to the depth of the rebar and if permitted by the engineer, through the rebar. Alternatively, dust samples may be extracted with the use of a hammer drill. The drill bit should be the smaller of 1.5d_b of the rebar in the location being tested, or 1”. To eliminate surface variability, the concrete shall be drilled to a depth of ¼” (6mm) and the dust discarded. Dust samples shall be taken in standard increments from the surface to the depth of the rebar. To avoid cross contamination the drill bit shall be cleaned or maybe changed to one of a smaller diameter for the different increments. The hole shall be thoroughly cleaned with compressed air at each increment. Samples shall immediately be placed into sealed airtight bags, or other suitable containers. They should then be clearly marked with the contract name, the date, the location of the sample, the depth from which the sample was removed, and the depth of the rebar at that location.
601.5-EQUIPMENT AND TOOLS:

DELETE THE CONTENTS AND REPLACE THE FOLLOWING:

601.5.1-Core and Rotary Impact Drills: Drills for obtaining concrete cores and powder before and after treatment to be made available by the ECE Contractor. Typical diameter of the cores to be drilled is 2 to 3 inches.

601.6-HANDLING, MEASURING, AND BATCHING OF MATERIALS:

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:

601.6-CONSTRUCTION:

Apply the ECE treatment to all concrete surfaces as detailed in the plans. Prior to performing ECE, all concrete repair work shall be complete and sufficiently cured (minimum 7 days) before proceeding with the treatment.

601.6.1 Working Drawings: The Contractor shall submit plans and notes that include the location of all equipment on the project site, proposed sampling and testing procedures, core and dust sample locations, anticipated treatment duration, power feeds to the structure being treated, material catalog cuts, application and removal procedures with anticipated lane closure durations, equipment required, and contact information.

601.6.2 Sampling, Testing, and Coordination: A minimum of 10 working days before beginning substructure repairs, conduct a coordination meeting with the Engineer, ECE subconsultant contractor, and the manufacturers of the epoxy injection materials and surface crack sealant materials to ensure that the substructure repairs will not adversely affect the performance of the ECE.

Only portland cement concrete, or mortars having an appropriate electrical resistivity shall be used in repairs. Use only hydraulic cement concrete for spall repairs.

Obtain a minimum of five (5) samples from the each substructure for chloride analysis.

Sample concrete for chloride analysis by drilling either cores or powder samples. Cut cores into slices and crush to fine powder.

Determine the residual water soluble chloride content in the concrete as specified in AASHTO T260-97. Measurements may be made using the rapid chloride test method.

Sample the concrete before and after treatment. Prevent cross contamination between samples. Take core samples directly over a single reinforcing bar while dust samples may be drilled adjacent to the intersection of two reinforcing bars.

Submit a report to the Engineer which includes documenting the findings from the preliminary investigation and recommendations for the ECE installation.

601.7-MIXING:

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:
601.7-INSTALLATION PROCEDURE:

601.7.1 Preparation of the Concrete for Treatment:

601.7.1.1 Pre-Installation Survey: Visual and sounding surveys shall be carried out over the full surface area of the structure to determine where delamination and where previous repairs have been carried out. In addition, areas where concrete cover over the rebars is insufficient (i.e., less than 0.4 inch) shall be located, by means of a cover meter/pachometer survey or selective chip-outs.

601.7.1.2 Removal and Replacement of Delaminated Concrete: Delaminated and spalled concrete areas shall be repaired in accordance with contract documents, before the ECE treatment.

601.7.1.3 Remediation for Insufficient Concrete Cover: A layer of cement-based grout shall be applied over all areas determined to have insufficient concrete cover until the total cover at each area is at least 0.4 inch.

601.7.1.4 Insulation of Visible or Shallow Metal Components: Any tie wires, nails, or other metal components, that are close to the surface or visible on the surface of the concrete, shall be removed or insulated with silicon rubber or non-conductive epoxy. If necessary, these may be cut back to not less than 0.4 inch below the surface, then patched with a cement-based grout.

601.7.1.5 Reinforcement Continuity: Ensure that the top-layer rebars in the structure are electrically continuous prior to treatment. This can be done either at existing spall locations, or at cathode (rebar) connection points. If necessary additional holes can be drilled or chipped. If the voltage difference between any two rebars (from different locations in the structure) is no more than 1.0 mV (when measured with a high input impedance voltmeter with a resolution of no less than 0.1 mV), or resistance is less than 5 Ohms (when measured with an Ohm / multimeter), these rebars are considered to be continuous.

Drawings of the structure showing reinforcement details shall be inspected to locate areas where continuity might not exist, and direct measurements of voltage differences or resistance between rebars in these areas and other areas in the structure shall be made. In addition, measurement points shall include locations along the perimeter and the middle of each structural component. Records of the locations of measurement points and the measured voltage/resistance differences shall be submitted to the Engineer with the final report, or sooner if requested.

Where any electrical discontinuity is identified, proposals for providing continuity shall be submitted to the Engineer for approval before proceeding.

601.7.1.6 Reinforcement (Negative) Connections: There shall be at least 1 rebar connection per 500 sq. ft. of concrete surface area, and never less than 2 connections per zone. Rebar connections shall be made by drilling a ¾ inch diameter hole down to the rebar, ensuring that the rebar surface is cleaned by the action of the drill, and then inserting a lead plug connected to the cathode wire into the hole, and compressing the lead plug against the rebar with the use of a setting tool. Immediately after a connection has been
made, the connection shall be coated with a non-conductive material, such as silicon rubber, or the hole may be sealed with an approved patch repair mortar.

601.7.1.7-Connection of Metal Fixtures: Any metal fixtures attached to the concrete structure must be protected against corrosion by electrical connection to the reinforcement. Exposed steel shall also be masked and protected from contact to the anode mesh. Any cable used in providing electrical connections shall comply with the requirements of Section 601.2 and the sheathing shall be color coded black.

601.7.2-Installation of the Anode System:
   601.7.2.1-Preparation of the Concrete Surface: The surface of the concrete shall be cleaned of any grease, coating, etc., that may interfere with the passage of electrical current, to ensure optimum treatment efficiency. Sandblasting or water jetting may be required to achieve this.

To prevent short circuits, any exposed steel, in or on the surface of the concrete, shall be adequately masked and, if necessary, connected to the reinforcement or removed, before applying the anode system.

601.7.2.2-Electrolytic Reservoir: The reservoir shall consist of an anode mesh embedded within electrolyte-saturated cellulose fibre.

The fibre and the electrolyte shall be delivered through separate hoses, then mixed at a nozzle and sprayed directly onto the surface of the concrete. The anode mesh shall be securely fixed using wooden battens or suitable plastic spacers. (Plastic screws and plugs must be used with wooden battens). The distance between the wooden battens shall be no more than 3 ft.

The cellulose fibre shall contain a minimum of 8% calcium hydroxide or a minimum of 8% calcium hydroxide shall be added to the cellulose fibre during mixing and spraying.

The fibre-electrolyte mixture shall be applied only after the anode mesh is securely installed. The total fibre-electrolyte layer shall be approximately 1.5 to 2 inch thick and must submerge the anode mesh.

After the anode and reservoir have been installed, the entire area shall be wrapped with plastic and secured to reduce dehydration. Throughout the ECE treatment, the reservoir shall be wetted with electrolyte and kept saturated. Provide the necessary water supply and containers.

601.7.3-Connection of Cables: All DC cables shall be placed and connected so that they do not cause any unnecessary inconvenience. Cable insulation shall be checked; any damaged insulation shall be repaired using a generous amount of an appropriate insulation material, or by making new joints, which shall be contained in junction boxes.

All AC power cables shall be installed in accordance to relevant NEC codes and standards.

601.7.4-Placement of the AC/DC Converters: The Engineer shall approve the location for placement of the converters. The chassis of the converters shall be grounded in accordance with relevant NEC codes and standards.
601.7.5-Inspection of the Installation: The installed anode system, its electrical connections, and power cables shall be fully inspected by the ECE Contractor’s technician to the satisfaction of the Engineer prior to the initiation of the ECE treatment. AC power will be connected by a certified electrician as per relevant codes.

601.8-FORMS:

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:

601.8-SYSTEM OPERATION AND MAINTENANCE:

601.8.1-System Start-Up:

601.8.1.1-Circuit Verification: Prior to start-up or energization of power, tests shall be undertaken to ensure that all measurements and power distribution circuits are correctly wired, connected and labelled. Where appropriate, the circuits shall have the expected resistances.

Using a suitable voltmeter, the negative polarity of the reinforcement shall be confirmed when the power sources are switched on.

601.8.1.2-Adjustment of Current Output: Initial energizing of the system shall be undertaken only upon completion of the procedures described in clause 601.8.1.1.

The current used for the chloride removal treatment shall generally be between 0.1 A/sq. ft. to 0.2 A/sq. ft. and shall not exceed 0.5 A/sq. ft.

During the treatment, the current output shall be measured individually in each anode cable (as detailed in section 601.8.2). The total current can be adjusted by decreasing or increasing the applied voltage. If the results indicate an unexpected current distribution, an inspection shall be carried out to determine the reason, and remedial action shall be taken and documented.

601.8.2-Monitoring of System Operation:

601.8.2.1-Inspections: During the treatment, the operation of the system shall be checked regularly by the ECE Contractor and the following records shall be made:

1. Date and time
2. Current (to each zone and subzone)
3. Voltage (to each zone)
4. Amp-hour (calculate for each zone)

If a problem develops the ECE Contractor shall determine the cause, rectify the problem, and report it to the Engineer.

In addition, visual inspection of cable connections, cable insulation, anode meshes, and wetting of the cellulose fibre shall be conducted regularly.

Any interruption in the operation shall be recorded and reported to the Engineer.

601.8.2.2-Determination of Chloride Content: In addition to the regular inspection, determination of the residual water-soluble chloride (Cl-) in the concrete adjacent to the steel (per ASTM C-1218) shall be carried out as deemed necessary during the treatment. The determination shall be conducted on concrete samples to be taken at pre-determined
points at the level of the rebar. These locations shall be submitted to the Engineer for approval prior to commencement of the ECE treatment. Tests are generally completed near the location and at the same depth (reinforcing steel depth) as previous pre-treatment test locations.

If the results of any of these analyses indicate that the system is not operating properly, the ECE Contractor shall determine the cause and rectify the situation.

**601.8.3-Remedial Work:** During the treatment, remedial work shall be conducted whenever any inspection indicates that the system is not performing properly. Any remedial work shall be performed at no additional cost to the Division. This remedial work shall include, but not necessarily be limited to, the following:

1. Repair or replacement of defective components of the system.
2. Modification to correct any electrical short circuits or to prevent stray currents.

**601.9-ADVERSE WEATHER CONDITIONS:**

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:

**601.9-TERMINATION OF THE ELECTROCHEMICAL CHLORIDE EXTRACTION (ECE) TREATMENT:**

**601.9.1-Termination of Treatment:** The ECE treatment shall be performed until one of the following criteria is achieved:
1. 60 calendar days treatment duration
2. Until a total of 60A-hrs/sq. ft. of current has been passed
3. Until the chloride in the concrete in the vicinity of the reinforcing steel has decreased to 0.03% by weight of concrete after correction for background or chlorides, whichever is the earliest.

**601.9.2-Removal and Disposal of the System:** The ECE Contractor shall remove all electrical cables, conduits, hangers, and power supplies from the site. The cellulose fibre, anode mesh, and wooden battens shall also be removed from the site or be disposed in accordance with applicable disposal and safety regulations.

**601.9.3-Post Treatment Cleaning and Repairs:** The surface of all treated concrete shall be washed with pressure cleaning, using clean water. If a steel anode has been used, then a light abrasive blast shall be undertaken to remove stains left by the corroded mesh.

The entire treated structure shall then be inspected; the occurrence, location, and extent of any physical damage or changes to the concrete shall be noted. Any defects such as holes made on the concrete (to install wooden battens, conduit hangers, system negative connections, etc.) shall then be repaired.

**601.9.4-Surface Treatment of the Concrete:** After the ECE treatment, all the treated concrete surfaces shall be cleaned, prepared, and sealed/coated as per Contract documents.
**601.9.5-Documentation:** Within 60 calendar days upon completion of the surface treatment, the ECE Contractor shall submit a written final report to the Engineer detailing the installation and all operating data for the system. This shall include records of all tests and measurements, made before, during, and after treatment, including those listed in Section 601.8.2.

The final report shall include, and describe in detail, at least the following information:
1. Rebar continuity on the structure and locations of any continuity bondings made surface preparation performed before treatment
2. Description of the ECE installation and procedure used
3. Materials used with manufacturers' data sheets
4. Description of test locations and test procedures
5. Current and voltage readings during treatment
6. All test results including pre and post Cl- levels.
7. Locations and repair of any damage to the concrete arising from the treatment
8. Discussion of results, including consideration of any local anomalies or variations in results
9. Statement on effectiveness of the treatment

**601.10-PLACING CONCRETE:**

DELETE THE SECTION AND REPLACE WITH THE FOLLOWING:

**601.10-GALVANIC ANODE INSTALLATION:**

Contractor shall install embedded galvanic anodes in accordance with manufacturer’s recommendations, at all exposed areas of exposed rebar in the reinforced concrete bridge elements, as noted in the plans, and as listed in this Special Provision.

1. Install galvanic anodes to existing reinforcement along the perimeter of the repair at spacing as specified by the manufacturer. In no case shall the distance between anodes exceed 30 inches nor shall the distance between the anode and the edge of the repair exceed 6 inches.
2. Provide a 1-inch clearance between anodes and substrate to allow repair material to encase anode. If necessary, increase the size of the repair cavity to accommodate the anodes.
3. Secure the galvanic anodes as close as possible to the patch edge using the anode tie wires (bare wire). Wrap tie wires around the cleaned and uncoated reinforcing steel at least one full turn in opposite directions and then tighten the tie wires to allow little or no free movement. If the anode is to be tied onto a single bar, or if less than 1½-inch of concrete cover is expected, place anode beneath the uncoated bar and secure to reinforcing steel. If 1½-inch concrete cover will exist over the anode, the anode may be placed at the intersection between two bars and secured to each bar.
NOTE: Do not use this special provision for patch areas less than 5 ft². Anode spacing shall be specified by the designer. Anode spacing is dependent upon the reinforcing steel density, chloride content; and amount of zinc per anode. The density of the reinforcing steel is the total surface area of the bar (ft²) within a square foot of concrete (regardless of depth). Corrosion levels in the concrete can be broken into three measurable categories based on ASTM C 1152 Acid-Soluble Chloride of Mortar and Concrete: Light corrosion levels: < 4 lb/yd³, Moderate corrosion levels 4 to 8 lb/yd³ and High corrosion levels: > 8 lb/yd³. In lieu of coring to determine chloride thresholds, the following general guidelines may be considered: Light corrosion for concrete aged 0-15 years and exposed to deicing salt or concrete of any age not directly exposed to deicing salt; Moderate corrosion for concrete aged 16-30 years and exposed to deicing salt; High corrosion for concrete 31 years and older and exposed to deicing salt. The following anode spacing guidelines are based a minimum zinc content of 100 grams per anode and to mitigate the initiation of new corrosion activity:

<table>
<thead>
<tr>
<th>Steel Density Ratio</th>
<th>Light Corrosion Levels</th>
<th>Moderate Corrosion Levels</th>
<th>High Corrosion Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.3</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>0.31 – 0.6</td>
<td>28</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>0.61 – 0.9</td>
<td>26</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td>0.91 – 1.2</td>
<td>22</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>1.21 – 1.5</td>
<td>20</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>1.51 – 1.8</td>
<td>18</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>1.81 – 2.1</td>
<td>17</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

Confirm electrical connection between every anode tie wire and uncoated reinforcing steel with a multi-meter. The maximum DC resistance shall be 1 Ohm. Confirm electrical continuity of every exposed uncoated reinforcing steel bar within the repair area. Steel reinforcement shall be considered continuous when the DC resistance is 1 Ohm or less. If necessary, establish the electrical continuity with uncoated steel tie wire.

Provide the Engineer a report documenting the resistance measurement for every reinforcing bar in each repair area. The report shall be signed by the contractor’s employee responsible for supervision of the repair work.

601.14-METHOD OF MEASUREMENT:

ADD THE FOLLOWING TO THE END OF THE SECTION:

The quantity of Electrochemical Chloride Extraction will be based on the surface area in square feet as determined from the lines and dimensions shown on the plans, subject to field verification.

601.15–BASIS OF PAYMENT:

ADD THE FOLLOWING TO THE END OF THE SECTION:

The quantities, determined as provided above, will be paid for at the contract bid price, which includes all labor, tools, equipment, supplies, tests, and incidentals necessary to complete the work.
601.16-PAY ITEMS

ADD THE FOLLOWING ITEM TO THE TABLE:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>601030-XXX</td>
<td>Electrochemical Chloride Extraction</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 604
PIPE CULVERTS

604.2-MATERIALS:

DELETE THE TABLE AND REPLACE WITH THE FOLLOWING:

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>SUBSECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Structural Plate Box Culvert</td>
<td>713.18</td>
</tr>
<tr>
<td>Aluminum Coated Corrugated Steel Pipe and Pipe Arch</td>
<td>713.24</td>
</tr>
<tr>
<td>Bitumen Sealant</td>
<td>708.9</td>
</tr>
<tr>
<td>Controlled Low Strength Material (CLSM)</td>
<td>219</td>
</tr>
<tr>
<td>Concrete End Section for Arch, Elliptical, or Round Concrete Pipe</td>
<td>714.8</td>
</tr>
<tr>
<td>Crushed Aggregate</td>
<td>704.6, Class 1 or Class 3</td>
</tr>
<tr>
<td>End Section for Corrugated Steel Pipe, Safety Slope, or Pipe Arch</td>
<td>713.20</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>702.1.2-702.1.5 and 702.6, or 702.2</td>
</tr>
<tr>
<td>Granular Material</td>
<td>716.1.1.2</td>
</tr>
<tr>
<td>High Density Polyethylene Pipe (HDPE), Profile Wall</td>
<td>714.19</td>
</tr>
<tr>
<td>High Density Polyethylene Pipe (HDPE), Steel-Reinforced</td>
<td>714.26-714.18</td>
</tr>
<tr>
<td>Polypropylene Pipe</td>
<td>714.24-714.17</td>
</tr>
<tr>
<td>Polyvinyl Chloride (PVC) Pipe</td>
<td>714.22</td>
</tr>
<tr>
<td>Precast Reinforced Concrete Box Culverts</td>
<td>714.7</td>
</tr>
<tr>
<td>Reinforced Concrete Elliptical Pipe</td>
<td>714.4</td>
</tr>
<tr>
<td>Reinforced Concrete Pipe</td>
<td>714.2</td>
</tr>
<tr>
<td>Reinforced Concrete Pipe Arch</td>
<td>714.3</td>
</tr>
</tbody>
</table>
SECTION 623
PNEUMATICALLY APPLIED MORTAR OR CONCRETE (SHOTCRETE)

623.1-DESCRIPTION:

This work shall consist of repair of concrete structures, protection of structural steel, or any other type of work as may be designated on the Plans by applying one or more layers of concrete conveyed through a hose pneumatically projected at a high velocity against a prepared surface in conformity with the dimensions and design shown on the Plans. It shall include removal of all loose, soft, honeycombed, and disintegrated concrete, the preparation of the surface, the furnishing and placing of reinforcing steel including wire fabric, dowels, and any other steel items noted on the Plans, and the mixing and applying of shotcrete as outlined in this sub-section.

623.1.1-Definitions:

- **Dry-mix shotcrete**: shotcrete in which the mixing water is added to concrete materials at the nozzle.
- **Nozzle Operator**: craftsman on shotcrete crew who manipulates the nozzle, controls consistency with the dry process, and controls final deposition of the material.
- **Shotcrete**: This is mortar or concrete conveyed through a hose and pneumatically projected at high velocity onto a surface.
- **Wet-mix shotcrete**: shotcrete in which all the ingredients, including water, are mixed before introduction into the delivery hose; compressed air accelerates to the material flow at the nozzle.

623.2-MATERIALS:

Materials shall meet the requirements specified in the following Sections, Subsections, or Standards and other requirements as noted below:
### MATERIAL

<table>
<thead>
<tr>
<th>Material</th>
<th>Subsection or Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerating Admixtures</td>
<td>707.13</td>
</tr>
<tr>
<td>Air-Entraining Admixtures</td>
<td>707.1</td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td>703.1, 703.2</td>
</tr>
<tr>
<td>Curing Materials</td>
<td>7076.7-07.10</td>
</tr>
<tr>
<td>Fibers*</td>
<td>ASTM C1116</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>702.1</td>
</tr>
<tr>
<td>Portland Cement</td>
<td>701.1, 701.3</td>
</tr>
<tr>
<td>Pozzolanic Additives**</td>
<td>707.4</td>
</tr>
<tr>
<td>Reinforcing Steel</td>
<td>709.1, 709.3, 709.4</td>
</tr>
<tr>
<td>Water</td>
<td>715.7</td>
</tr>
<tr>
<td>Water Reducing Admixtures</td>
<td>707.3</td>
</tr>
<tr>
<td>Water Reducing, Accelerating Admixtures</td>
<td>707.14</td>
</tr>
<tr>
<td>Water Reducing, Retarding Admixtures</td>
<td>707.2</td>
</tr>
</tbody>
</table>

* Steel fibers must be hooked fibers, and the minimum length of any fiber must be 3/4-inches (19 mm).

** The use of a pozzolanic additive will not be permitted when a blended hydraulic cement is used.

#### Gradation:

The aggregate gradation shall comply with the following requirements.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent By Mass Passing Each Individual Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>½ inch (12.5 mm)</td>
<td>100</td>
</tr>
<tr>
<td>3/8 inch (9.5 mm)</td>
<td>90-100</td>
</tr>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>70-85</td>
</tr>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>50-70</td>
</tr>
<tr>
<td>No. 16 (1.18 mm)</td>
<td>35-55</td>
</tr>
<tr>
<td>No. 30 (600 µm)</td>
<td>20-35</td>
</tr>
<tr>
<td>No. 50 (300 µm)</td>
<td>8-20</td>
</tr>
<tr>
<td>No. 100 (150 µm)</td>
<td>2-10</td>
</tr>
</tbody>
</table>

#### CONSTRUCTION METHODS

**623.3-QUALIFICATIONS:**

The Contractor shall maintain necessary equipment and qualified personnel to perform all work, sampling, and testing. The minimum qualifications are listed below:

**Contractor:** The contractor will have completed at least five shotcrete projects of similar size, scope, and shotcrete process used (dry or wet-mix). The contractor must provide proper documentation, including full contact information for owner/engineer/construction manager/general contractor who contracted the contractor to perform the shotcrete work, a project description, scope, and outcome of previous 5 structural shotcrete projects.

**Superintendent, Project Engineer, or Project Manager:** The Project Engineer, Project Manager, or Superintendent will have a minimum of 3 years of relevant experience on
structural shotcrete projects. The contractor must provide proof of the previous shotcrete experience.

**Foreman:** The foreman will have a proficiency in all positions. The foreman will be required to have at least two years of experience on structural shotcrete projects. The foreman must provide references of the previous shotcrete projects that can be contacted to verify the experience and outcome of these projects. The contractor must provide proof of the foreman’s previous shotcrete experience.

**Nozzleman:** The nozzleman will be required to be ACI certified as required by the current ACI Shotcrete Nozzleman certification policy (CCP 660.1) in the shotcrete delivery method that is chosen for the project, either dry-mix process or wet-mix process. The Nozzle Operator must have at least 300 hours of experience as a nozzle operator on projects with a similar application and scope. The contractor must provide proof of the Nozzleman’s previous shotcrete experience. The nozzleman will also be able to demonstrate, by test, an ability to satisfactorily perform the required duties and to apply the shotcrete as required by specifications.

### 623.4 - PROPORTIONING:

Unless otherwise specified, the proportioning and mix design of shotcrete shall conform to Section 601.3. At least 30 days prior to the start of construction, the Contractor shall design and submit, to the Engineer, for approval, the proportions of materials, including cement, aggregate, admixtures, fibers, and supplementary cementitious materials, to be used which will result in a mixture conducive to effective shotcreting, and a mixture having the desired properties. A mix design shall be required for each different type of shotcrete to be used in the work. The mix design shall be accompanied by a statement giving the source of materials and components used in the mix. All shotcrete mix designs will be accepted based on the results of preconstruction testing.

When using the wet-mix process the air content of the concrete must be 10 ± 2% before shooting.

Dry-mix shotcrete may be used provided that the in-place air entrainment shall be checked at least once at the beginning of the operation, once in the middle, and once after restarting the shotcrete process after any breaks each day and found that the in-place mixture has a minimum of 4% air entrainment.

The maximum allowable w/c ratio for any shotcrete mix design will be 0.45. Shotcrete shall achieve a minimum compressive strength of 2000 psi in 3-days and 4000 psi in 28-days when tested using cores in accordance with ASTM C1140.

Compressive strength and plastic air content test results from at least one test panel for each mix design shall be submitted to the Engineer prior to construction.

### 623.5 - PRE-CONSTRUCTION TESTING:

Prior to the start of construction, the contractor will shoot two test panels. Two panels will be shot for every different mix design that is going to be used on the project. The same ACI certified nozzleman, crew, and equipment that will be performing shotcreting operations on the project must be used to shoot the test panels. The same shooting positions that will be used in the project must be used in shooting the test panels. All form materials and procedures will comply with ASTM C 1140.

One of these two test panels will have reinforcement which is the same as the most congested section on the shotcrete project and shall use the same mix design designated for that
section of the project. The finish that is selected for the section of the project, which the panel with reinforcement represents, will be applied to the panel with reinforcement, to indicate whether that finish has any effect on the shotcrete encasement around the reinforcement. This will be used to qualify the nozzleman and shotcreting feasibility. The minimum diameter for the cores taken from the panel with reinforcement will be 3.75-inches (95 mm) and will be the entire thickness of the panel. The panel with reinforcement will be large enough so that actual project conditions can be simulated. The other panel will have no reinforcement and will be used to qualify the properties of the mix design. The size of the panel without reinforcement, for qualifying the mix design, will be such so that cores can be drilled allowing for 3-inches (75 mm) diameter and length of 5.5-inches (140 mm) or the thickness of the panel, whichever is greater. This process shall follow the guidelines of ASTM C 1604. A WVDOH representative must be present when the test panels are constructed and tested, and the WVDOH representative must inspect the performance of the test panels with reinforcement for quality of shotcrete placement, quality of nozzleman, and encasement.

Three cores shall be taken from the test panel with reinforcement and will be visually inspected to ensure proper shotcrete placement and consolidation around the reinforcement. Three cores shall be taken from the test panel without reinforcement and will be tested in accordance with ASTM C 1604. Cores that are damaged from drilling must be immediately discarded.

If any preconstruction testing panel fails the contractor will be allowed to shoot another test panel with the same nozzleman, equipment, and mix design. If the second panel also fails, the contractor must make changes until the shotcrete panel passes the testing. These changes must be implemented during the entire shotcreting process during construction.

If permitted by the Engineer on small projects, where preconstruction testing is cost prohibitive, the requirement for constructing test panels may be waived if the contractor provides results of previous tests with the same materials, mix designs, qualified personnel, and similar project application. The requests must be made to the Engineer and approved before pre-construction testing may be omitted.

623.6-TESTING DURING CONSTRUCTION:

The Contractor must notify the Engineer at least 48 hours prior to beginning any shotcreting operations.

The Contractor shall perform Quality Control Testing as outlined in this sub-section.

623.6.1-Sampling and Testing Methods:

| Sampling Materials for Shotcrete | ASTM C1385 |
| Temperature of Freshly Mixed Hydraulic Cement Concrete | ASTM C1064 |
| Testing of Air Content | ASTM C231 or AASHTO T152 |
| Preparing and Testing Specimens from Shotcrete Test Panels | ASTM C1140 |
| Obtaining and Testing Drilled Cores of Shotcrete | ASTM C1604 |

623.6.2-Temperature: Testing of the temperature will be performed hourly and shall be within the allowable temperature ranges specified in Section 601.9.
623.6.3-Air Content: For wet-mix shotcrete, the air content must be 10 ± 2\% when tested prior to placement. The testing frequencies of air content for wet-mix shotcrete, prior to placement, will be as required in MP 601.03.50 Table 1 Section C.

Dry-mix shotcrete may be used if air entraining admixture is used.

A, “as shot shotcrete”, air test shall be performed one per ½ day of operation for both wet-mix and dry-mix shotcrete as follows. The shotcrete nozzle operator will shoot a sample of shotcrete into a wheelbarrow or at the wall or floor, then place the shotcrete sample into the air meter using a scoop. The subsequent sample will follow guidelines of ASTM C231 or AASHTO T152. The minimum air entrainment of the “as shot shotcrete” will be 4.0%.

623.6.4-Compressive Strength: During construction, test panels shall be shot for each different mix in the project. The panels will have a minimum dimension of 16 inches x 16 inches (400 mm x 400 mm) and have enough depth to allow cores to be 5.5-inches (140 mm) long. One test panel will be shot for each mix every day or every 50 yd³ (38 m³), whichever produces the greatest number of panels. The panels will then be cured using the procedures in ASTM C1140. Three cores with a diameter of 3 inches (75 mm) and a length of 5.5- inches (140 mm) will obtained from each panel and tested for compressive strength following the guidelines of ASTM C1604.

The minimum 28-day average compressive strength for each set of cores from each panel shall be 3,500 psi (24 Mpa) with no single core strength less than 3,000 psi (21 MPa).

When testing in-place concrete that has been placed using shotcrete, cores will be obtained at the location specified by the Engineer and tested as outlined in ASTM C1604.

623.7-EQUIPMENT AND TOOLS:

The Contractor shall maintain a clean, dry, oil-free supply of compressed air sufficient for maintaining adequate nozzle velocity at all times. The equipment shall be capable of delivering the premixed material accurately, uniformly and continuously through the delivery hose. To prevent sagging or sloughing of freshly-applied shotcrete, control must be taken with the application thickness, nozzle technique, air pressure and rate of shotcrete placement. A minimum 600 CFM compressor capable of producing 120 psi air pressure exiting the compressor is required.

The internal diameter of the hose shall be at least three times larger than the largest particle in the mixture. For shotcrete containing steel fiber-reinforcement, the internal hose diameter shall be a minimum of 1.5 times the length of the fiber, and for shotcrete containing synthetic fibers, the internal hose diameter shall be a minimum of the same length as the fiber.

623.8-HANDLING, MEASURING AND BATCHING OF MATERIALS:

The batch aggregate and cement by weight or by volume must be in accordance with the requirements of Section 601 and AASHTO M157 or AASHTO M241. The mixing equipment must thoroughly blend the materials in sufficient quantity to maintain placing continuity. The batch, delivery and placement of shotcrete must be completed within 90 minutes of mixing. The use of retarding admixtures may extend application time beyond 90 minutes if approved by the Engineer.

Dry-mix shotcrete shall be sufficiently damp prior to shotcreting. Site-batched dry-mix shotcrete typically does not need to be pre-dampened, since the aggregate usually contains sufficient moisture. However, pre-bagged dry-mix shotcrete must be pre-dampened.
623.9-CLEANING:
All surfaces must be free from damaged material. The surfaces must be clean from dirt, oil, or other contaminants that could inhibit the bond of shotcrete. Concrete or masonry surfaces will be chipped prior to the placement of shotcrete to make surfaces even, sawcut surfaces must be roughened.

In concrete repair work, disintegrated concrete shall first be removed with pneumatic or hand tools. The surfaces shall then be thoroughly blasted to remove all dirt and loose materials, special care being taken in concrete repair work to thoroughly clean exposed reinforcing steel. Any unsound concrete, on which shotcrete will be placed, shall be removed. Prior to applying each layer of shotcrete, the concrete surfaces shall be cleaned and washed with water and dried to a saturated surface dry condition with compressed air.

Earth surfaces shall be dug to line and grade. The surface will be dampened prior to the placement of shotcrete. There will be no pools of standing water prior to the shooting of shotcrete.

623.10-PLACING REINFORCING STEEL:
Lap adjacent sheets of reinforcing wire or reinforcing bars and install anchors as directed on the Plans.

623.11-PLACING SHOTCRETE:
Shotcrete shall not be installed on frozen surfaces or ground. Shotcrete shall be deposited with a material temperature of not less than 50° F (10° C) or more than 90° F (32° C), and unless otherwise stated, shotcrete temperature requirements will comply with Section 601.9.

During high wind or rain, unless suitable protective covers, enclosures or wind breaks are installed, shotcrete application shall be suspended. Any newly placed shotcrete that has been exposed to rain making the shotcrete unacceptable shall be removed and replaced. A polyethylene film or equivalent shall be used to protect the work from exposure to adverse weather.

Shotcrete may not be placed during precipitation that will disturb the finish or cause the shotcrete to run. Shotcrete will not be placed when wind conditions will disturb the stream of shotcrete before hitting the receiving surface. The Contractor shall maintain the face of the surface on which the shotcrete is to be applied and other surfaces, such as reinforcing steel, clean of loose materials, mud, rebound, overspray or other foreign matter that could prevent or reduce shotcrete bond. Any surface materials that are loosened or damaged, to a sufficient depth should be removed. Any material that loosens during application shall be removed. The adjacent surfaces shall be protected from overspray during shooting. Water flow shall be diverted, and standing water shall be removed so that shotcrete placement will not be affected.

Unless otherwise required, shotcrete will be placed in one layer to eliminate the possibility of cold joints and laminations. If shotcrete is placed in multiple layers, precautions will be taken in order to lessen the chance of cold joints and laminations. The shotcrete shall be applied from the lower part of the area upward to prevent accumulation of rebound. The placement of the nozzle shall be at a distance and approximately perpendicular to the working face so that rebound will be minimal and compaction will be maximized.

Rebound shall not be worked back into the construction. Shotcrete crews must always keep area around nozzleman clean and clear using compressed air to removed impurities and shoveling overspray before that area is shot.

A clearly defined pattern of continuous horizontal or vertical ridges or depressions at the reinforcing elements after they are covered with shotcrete will be considered as indication of
insufficient reinforcement cover or poor nozzle techniques. In this case, immediately suspend the application of shotcrete and implement corrective measures. Correct the shotcreting procedure by adjusting the nozzle distance and orientation, insuring adequate cover over the reinforcement and adjusting the water content of the shotcrete mix or other means.

Any shotcrete surface defects shall be repaired after placement as soon as possible. Any shotcrete that exhibits segregation, honeycombing, lamination, void or sand pockets, or excessive shrinkage cracking shall be removed and replaced. In-place shotcrete not meeting the specified strength requirement will be subject to remediation. Possible remediation options include placement of additional shotcrete thickness or removal and replacement, at no additional cost to the WVDOH.

623.12-FINISHING SHOTCRETE SURFACES:
The finish shall be completed as per the contract documents. When specified, a pre-construction mockup panel representing the desired finish shall be provided and evaluated by the WVDOT for conformance with the contract documents. When using a troweled or rod finish, the shotcrete must sufficiently set to avoid sagging or sloughing.

623.13-CURING AND PROTECTING SHOTCRETE:
Shotcrete shall be cured as outlined in Section 601.12.

623.14-METHOD OF MEASUREMENT:
The quantity of shotcrete to be paid for will be the number of square yards (meters) complete in place and accepted.

623.15-BASIS OF PAYMENT:
The quantities, determined, as provided above, will be paid for at the contract unit price, and shall constitute full compensation for furnishing and preparing of all materials, including reinforcing steel, all items incorporated into the shotcrete work as shown in the Plans such as anchors and bolts, placing, finishing, testing, and curing shotcrete, and all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

623.16-PAY ITEMS:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>623001-*</td>
<td>Shotcrete</td>
<td>Square Yard (Meter)</td>
</tr>
</tbody>
</table>

* Sequence Number
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SPECIAL PROVISION
FOR

STATE PROJECT NUMBER: ____________________________
FEDERAL PROJECT NUMBER: ____________________________

SECTION 699
JUST IN TIME TRAINING

699.1-DESCRIPTION:
This work shall consist of a training course for the Contractor and Engineer for the named construction item. The training shall be from an instructor experienced with the construction item.

699.2-JUST-IN-TIME TRAINING:
The Engineer and Contractor are required to attend a Just-In-Time Training (JITT), course regarding ____________________________. The training will cover the materials, construction methods, test methods, and best management practices. The course instructor, course content, training site, and schedule of training shall be approved by the Engineer.

The training class shall be conducted at a location convenient for all project construction personnel responsible for construction operations and inspection to attend. The JITT course shall be held during normal working hours and be completed not more than 14 calendar days prior to the start of construction operations. A copy of the course syllabus, handouts and presentation materials shall be submitted to the Engineer at least five working days before the course is to be taught.

699.3-BASIS OF PAYMENT:
The Just-In-Time Training shall be paid for as a lump sum basis, which includes all instructors, instruction materials, equipment, supplies, training location, and incidentals necessary to provide the training.

699.4- PAY ITEMS:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>699001-001</td>
<td>Just In Time Training</td>
<td>Each</td>
</tr>
</tbody>
</table>
705.5-PERFORMANCE GRADED ASPHALT BINDERS:

DELETE THE CONTENTS OF THE SUBSECTION AND REPLACE WITH THE FOLLOWING:

Performance Graded (PG) Asphalt Binders shall conform to the requirements in Table 1 of AASHTO M-332-Performance Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test, with the following deviations:

1. **Manufacturers are not required to meet the requirements of AASHTO T-314-Determining the Fracture Properties of Asphalt in Direct Tension** shall be waived for all binders.

2. For Binder grades with a $J_{nr\,3.2}$ max requirement of 2.0 kPa$^{-1}$ (PG64 H - 22),
   a. A minimum 3.2 kPa Elastic Response of 25% shall be required and tested in accordance with AASHTO R92 - Evaluating the Elastic Behavior of Asphalt Binders Using the Multiple Stress Creep Recovery (MSCR) Test.

3. For Binder grades with a $J_{nr\,3.2}$ max requirement of 0.5 kPa$^{-1}$ (PG64 E - 22),
   a. The manufacturer is not required to meet the 75% Max requirements for $J_{nr\,Diff}$ shall be waived.

   b. Elastic Response values shall meet the requirements of the curve found in AASHTO R 92 – Evaluating the Elastic Behavior of Asphalt Binders Using the Multiple Stress Creep Recovery (MSCR) Test.

3. For Standard Testing Temperatures grade designations and their corresponding testing temperatures see Table 705A below.

---

**Table 705A – Performance Graded Asphalt Binders**
A certified producer or distribution terminal will be the last source to handle/manipulate a PG binder before being shipped to an asphalt concrete plant or project. The producer or terminal will provide the PG binder certification report with the shipment.

<table>
<thead>
<tr>
<th>Binder Grade Designations</th>
<th>Testing Temperature</th>
<th>Non-recoverable creep compliance at 3.2 kPa, Jnr (3.2), kPa⁻¹, Max</th>
<th>% Difference in Non-Recoverable Creep Compliance, Jnr(diff), %, Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 58S – 28</td>
<td>58°C</td>
<td>4.5</td>
<td>75%</td>
</tr>
<tr>
<td>PG 64S – 22</td>
<td>64°C</td>
<td>4.5</td>
<td>75%</td>
</tr>
<tr>
<td>PG 64H – 22</td>
<td>64°C</td>
<td>2.0</td>
<td>75%</td>
</tr>
<tr>
<td>PG 64E – 22</td>
<td>64°C</td>
<td>0.5</td>
<td>-</td>
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1. The requirements of AASHTO T-314-Determining the Fracture Properties of Asphalt in Direct Tension shall be waived for all binders.
2. For Binder grades with a $J_{nr \text{ max}}$ requirement of 2.0 kPa$^{-1}$ (PG64 H - 22),
   a. A minimum 3.2kPa Elastic Response of 25% shall be required and tested in accordance with AASHTO R92 - Evaluating the Elastic Behavior of Asphalt Binders Using the Multiple Stress Creep Recovery (MSCR) Test.
3. For Binder grades with a $J_{nr \text{ max}}$ requirement of 0.5 kPa$^{-1}$ (PG64 E - 22)
   a. The 75% Max requirement for $J_{nr \text{ Diff}}$ shall be waived.
   b. A 3.2kPa Elastic Response values shall meet the requirements of the curve found in AASHTO R 92 – Evaluating the Elastic Behavior of Asphalt Binders Using the Multiple Stress Creep Recovery (MSCR) Test.

For grade designations and their corresponding testing temperatures see Table 705A below.

<table>
<thead>
<tr>
<th>Binder Grade Designations</th>
<th>Testing Temperature</th>
<th>Non-recoverable creep compliance at 3.2kPa, $J_{nr \text{ (3.2), Max}}$</th>
<th>% Difference in Non-Recoverable Creep Compliance, $J_{nr\text{(diff)}, %}$, Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 58S – 28</td>
<td>58°C</td>
<td>4.5</td>
<td>75%</td>
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<td>64°C</td>
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</tr>
<tr>
<td>PG 64E – 22</td>
<td>64°C</td>
<td>0.5</td>
<td>-</td>
</tr>
</tbody>
</table>
A certified producer or distribution terminal will be the last source to handle/manipulate a PG binder before being shipped to an asphalt concrete plant or project. The producer or terminal will provide the PG binder certification report with the shipment.
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 707
CONCRETE ADMIXTURES, CURING AND COATING MATERIALS

707.1-AIR-ENTRAINING ADMIXTURES FOR CONCRETE:
707.1.1-Acceptance Requirements for Air-Entraining Admixtures:

DELETE THE CONTENTS OF SUBSECTION 707.1.1.1 AND REPLACE WITH THE FOLLOWING:

707.1.1.1-In the event that the Contractor elects to use an air-entraining admixture, evidence based on testing by NTPEP (National Transportation Product Evaluation Program) shall be submitted to the Division to show that the material conforms to the requirements of AASHTO M 154. Tests for bleeding, bond strength and volume change will not be required unless specifically called for in the Plans. Tests made in a recognized laboratory shall be submitted to show that the material conforms to the requirements of AASHTO M 154 for 7-day and 28-day compressive and flexural strengths and resistance to freezing and thawing, except as provided in 707.1.1.2. Tests for bleeding, bond strength and volume change will not be required unless specifically called for in the Plans. A "recognized" laboratory is any Division, Federal Highway Administration or cement and concrete laboratory regularly inspected by the Cement and Concrete Reference Laboratory of the National Bureau of Standards. Tests may be made upon samples taken from a quantity submitted by the Contractor for use on the project or upon samples submitted and certified by the manufacturer as representative of the admixture to be supplied.

707.2-WATER-REDUCING AND RETARDING ADMIXTURES FOR CONCRETE:

DELETE THE CONTENTS OF SUBSECTION 707.2.1 AND REPLACE WITH THE FOLLOWING:

707.2.1-Acceptance Requirements for Approval of Retarders: Water reducing and retarding admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type D or Type G. conform to the requirements of AASHTO M 194, Type D or Type G.
707.3-WATER-REDUCING ADMIXTURES FOR CONCRETE:

DELETE THE CONTENTS OF SUBSECTION 707.3.1 AND REPLACE WITH THE FOLLOWING:

707.3.1-Acceptance Requirements for Approval of Water-Reducers: Water-reducing admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type A or Type F, conform to the requirements of AASHTO M 194, Type A or Type F.

707.13-ACCELERATING ADMIXTURES FOR CONCRETE:

DELETE THE CONTENTS OF SUBSECTION 707.13.1 AND REPLACE WITH THE FOLLOWING:

707.13.1-Acceptance Requirements for Approval of Accelerators: Accelerating admixtures for concrete shall be non-chloride and shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type C, conform to the requirements of AASHTO M 194, Type C.

707.14-WATER-REDUCING AND ACCELERATING ADMIXTURES FOR CONCRETE:

DELETE THE CONTENTS OF SUBSECTION 707.14.1 AND REPLACE WITH THE FOLLOWING:

707.14.1-Acceptance Requirements for Approval of Water-Reducing and Accelerating Admixtures: Water-reducing and accelerating admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type E, non-chloride and shall conform to the requirements of AASHTO M 194, Type E.

707.15-HYDRATION CONTROL STABILIZING ADMIXTURES FOR CONCRETE:

DELETE THE CONTENTS OF SUBSECTION 707.15.1 AND REPLACE WITH THE FOLLOWING:

707.15.1-Acceptance Requirements for Approval of Hydration Control Stabilizing Admixtures: Hydration control stabilizing admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet conform to the requirements of AASHTO M 194, Type B or D.
707.17-SPECIFIC PERFORMANCE ADMIXTURES FOR CONCRETE:

DELETE THE CONTENTS OF SUBSECTION 707.17.1 AND REPLACE WITH THE FOLLOWING

707.17.1-Acceptance Requirements for Approval of Specific Performance Admixtures: Specific performance admixtures for concrete shall be tested by NTPEP (National Transportation Product Evaluation Program). The NTPEP testing results shall meet the requirements of AASHTO M 194, Type S.
WES.T VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
SUPPLEMENTAL SPECIFICATION
FOR
SECTION 715
MISCELLANEOUS MATERIALS

715.39-ELASTOMERIC GASKET AND SEALING MATERIAL:

DELETE THE CONTENTS AND REPLACE WITH THE FOLLOWING:

These Specifications cover those elastomeric materials intended for use as, but not restricted to, such noncritical applications as gaskets, sealing materials, miscellaneous drainage items, etc. The elastomeric material shall meet the following requirements:

Tensile Strength, minimum psi (MPa), ASTM D 412 ................. 1,200 (8.3)
Elongation at Break, minimum percent, ASTM D 412 ..................... 350
Shore Durometer Hardness, ASTM D 2240ASTM D 2440
  Minimum .......................................................... 35
  Maximum .......................................................... 65
Compression Set, max percent, ASTM D 395,
  Method B .......................................................... 25
Accelerated Aging, ASTM D 573 (96 hr. at 70EC):
  Decreased Tensile Strength, maximum percent .................... 15
  Decreased Elongation, maximum percent .......................... 20
Water Absorption by Weight, maximum percent, ASTM D 471 .......... 10